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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

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Engineering News-Record is a consolidation of *Engineering News* and *Engineering Record*, effected in 1917.

Engineering News was founded in 1874 by George H. Frost, as the *Engineer and Surveyor*, which title subsequently became the *Engineer, Architect and Surveyor*, then *Engineering News and American Railway Journal* and finally, *Engineering News*, under the successive editorships of D. McN. Stauffer, Arthur M. Wellington and Charles Whiting Baker.

Engineering Record was established in 1877 by Henry C. Meyer as the *Plumber and Sanitary Engineer*. The name was subsequently changed to the *Sanitary Engineer, Engineering and Building Record* and, finally, to *Engineering Record*. During his ownership of the paper, Mr. Meyer was directly responsible for the editorial policy. John M. Goodell became editor in 1902, and was succeeded by E. J. Mehren.

The Contractor was consolidated with *Engineering News-Record* in 1918.

The staff of *Engineering News-Record* consists of

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San Francisco: N. A. Bowers.

Facing the Future

THE beginning year is the time to light the lamp of experience for better guidance on the way ahead. Each man must do this for himself, according to his needs, his vocation and his experience, but to all in a given vocation there are common sources of light which serve to intensify the light from the individual lamps. This issue of *Engineering News-Record* is intended as such a light for those in the construction industry—for engineers, for contractors and for manufacturers. There are articles on some of the important general phases of the industry, there are the statistical statements of the volume and costs in the year just past, there is a review of the improvements in the machinery and material with which the industry works, and lastly there is a survey, in the columns next succeeding this one, of the state of the industry as seen by the editors of *Engineering News-Record.*

The State of Business

ANY survey of the construction industry must begin with a survey of business in general, for the construction industry is peculiarly the servant of all other industries and under normal conditions responds most quickly and most markedly to fluctuations in the general prosperity. The prevailing sentiment today is one of hope and tempered optimism. Most of the traditional omens are favorable and, excepting for the European situation the clouds that hover in the business skies are not taken to presage any extended or grave disturbance. Car-loadings reached in October a level that barely missed breaking the record; for the current period of the year they never have been exceeded. The banking situation is sound, while the money market is easy in all departments. Retail business is emerging from a holiday trade that has exceeded expectations and that speaks well for the purchasing power of the American people. In the entire situation there is no element of inflation and it is certain that American business will enter the new year with a fair measure of confidence and with indications generally favorable to a continuance of the trade revival.

National prosperity depends largely on the prosperity of the farmer, who today is emerging from the slough of despond. Although there still is an unhappy discrepancy between the prices of what he has to sell and of what he must buy, the margin is closing. But approximately 15 per cent of the agricultural products of the country must be consumed abroad or remain as surplus on the domestic market. Good prices for farm products, then, depend largely on Europe taking its accustomed volume, and although it has been laboring under the disadvantage of low purchasing power, Europe now is beginning to take our surplus in increasing measure. This, it is hoped, may augur an increasing demand not only for our agricultural products but for our manufactured goods as well; for it is only through the demand of a reconstituted Europe that America can attain a generous measure of prosperity.

Conditions Abroad

LOOKING first at fundamental conditions we find western Europe tending toward stability. Fear has given way to confidence; and during the last twelve months production has increased remarkably, both in the industries and in agriculture, in which increased production is reflected not only in increased acreage but also in an increased yield per acre. Coal production in the United Kingdom exceeds pre-war and even in Germany is approaching pre-war volume. In Great Britain unemployment has decreased appreciably during the third quarter of 1922. European industry is coming back, although slowly, and the productive capacity of the European worker is asserting itself in increasing measure.

Turning from these fundamental conditions, however, to the machinery of exchange and national finance, we find the prospect far from encouraging. Three evils are notorious: Currencies are inflated, exchanges fluctuate violently, and national budgets are still woefully unbalanced. Great Britain is making unquestioned progress toward stability, Italy's feet are on the road, but Germany still flounders impotently. France suffers from her reliance upon reparations, which are the evil genius of the situation, for the stability of a European nation may be said to vary inversely with its reliance on reparations as a basis for its national finances. It is obvious that however much the European may need our goods and however industriously he may labor to attain them, he is under handicap when he must trade in the international market with a depreciated and unstable currency.

The hope of the movement appears to lie in the movement for an economic conference of the nations now taking form in Washington. This idea is being approached from several angles and it is probable that there will emerge an opportunity for this country to participate helpfully.

The Clouds on the Horizon

REFERENCE has been made to certain clouds on the business horizon. One of these is the high cost of government. As has been pointed out in these columns, government is not a productive industry; it is supported out of the earnings of the community for the service and well-being of all, including productive industry. It constitutes an expense which is reflected in the tax burden. In many parts of the country and in many industries this burden is becoming onerous. Much of it, of course, is part of the price we must pay for the war, but in view of this great mandatory expense, there is the more reason why we should eliminate waste, scale down unessential expenditures, and reflect long before assuming new burdens that not only will tax the producing community but also will divert the public wealth into nonproductive channels.

Another cloud is the danger of a nation-wide coal strike in April. Handicapped as we still are from the effects of last year's coal war, American industry is awaiting anxiously the preliminary report of the President's coal commission, due on January 15. The coal operators and miners are now met to consider wage agreements for the coming year. Although the President's commission holds no mandate to mediate between them, there can be little doubt that such findings of fact as the commission may make available between January 15 and April 1 will materially influence public opinion as to the controversy. If happily this public opinion should help to bring about a fortunate outcome of the wage negotiations, the commission will have achieved no small measure of progress in its more far-reaching task.

A third cloud is the danger of ill-considered legislation, of which there is now much talk in Washington. In estimating this danger it is well to remember, however, that unless it be called in special session by the President the new Congress will not convene until next December, and also that the exuberance of a political campaign frequently is sobered by responsibility.

It is rumored that the so-called progressive attack will be leveled against two targets; one, the banking system, and the other, the railroads. Thoroughly legitimate demands for an extension of banking service have arisen out of the distress under which the farmers of the country have suffered during the last few years. The financial problems of the farmer are special and call for special consideration. During the last few years hard times have descended most heavily upon him, with the result that his shrinking purchasing power and his burden of debt have raised a harvest of political discontent. Progress in solving the problem of agricultural credits will be achieved only if it is approached with the idea of actually helping the farmer rather than of punishing some imaginary enemy. Constructive handling of the problem can bring relief to the farmer without prejudice to the soundness of banking practice in general.

The Railroads

THE railroads have had an unhappy year, and some of the proposed legislation now under discussion offers them small encouragement. Their troubles began with the business depression of 1921, as a result of which the roads as a whole earned a net return for that year slightly more than 3 per cent—barely enough to pay their fixed charges. Early last year much thought was devoted to their predicament. It was pointed out that the roads were deteriorating materially because of too-long deferred maintenance, that they were so far behind in the expansion of their facilities that a business revival would find them wanting, that earnings under existing conditions made it impossible to command the requisite capital, and that a failure to remedy these conditions would constitute a grave industrial handicap.

Many hearings were held and remedies were proposed but the net result was a general reduction of freight rates followed closely by wage cuts in the various railroad crafts other than train-service. The shopmen struck, with what results we all know. During their strike the coal strikes were settled, and the American people began to clamor for transportation to move their coal in time to avoid a mid-winter famine. Simultaneously the farmer demanded the movement of his harvest. Despite every handicap, October car-loadings approached closely the record for that month, and with the recent business up-turn there is a possibility of the roads closing the year with a net near 4 per cent.

Progress during the coming year will be subject to the handicap of apprehension as to what the new Congress may do to the Transportation Act. Many business men and farmers are still insistent upon lower transportation charges and legislators are casting about for means whereby to satisfy them. One scheme contemplates a revision of the policy laid down in the act that rates shall be fixed so as to permit a reasonable return on the value of the railroad property; another seeks to scale down the valuations determined by the Interstate Commerce Commission; a third would restore to the several state commissions the authority to fix intra-state rates. Organized labor is dissatisfied with the workings of the Railroad Labor Board and is seeking escape from any regulation that involves compulsory arbitration or any abridgment of the "right of strike."

Danger lurks in these proposals. The Transportation Act has not yet been in operation long enough to prove its merit under normal business conditions. It represents the best judgment of many well-informed minds and is probably the sanest and most progressive regulatory measure that has yet governed our railroad operation. It deserves a better chance than it has had; but if management must function under the shadow of legislative interference, and if the thrifty be frightened away from our railroads into seeking more stable investment for their savings there will be small chance of prosperity for the roads under this, or any other, law.

Despite this general handicap, however, the more prosperous roads, whose earnings are above the average, now have in hand and in prospect a number of projects that will bulk large in the construction activities of the coming year. But assured stability of railroad affairs, coupled with a fair measure of general prosperity, doubtless would increase the number of roads that would dare also to undertake improvements, which, in the aggregate, would mean much to the construction industry.

The Supply of Labor

ANOTHER factor of concern to American industry in general and to the construction industry in particular is the adequacy of our supply of labor, both skilled and unskilled. The exceptional construction activity of the year just passed and the promise of similar conditions for some time to come emphasizes the importance of this factor, and the analysis by Milan V. Ayres elsewhere in this issue deserves thoughtful reading.

Mr. Ayres takes occasion to indicate the possibility of less wasteful use of our present labor supply by a more uniform distribution of construction work throughout the year. The gains to be derived from a smoothing down of the peaks in the construction year were discussed at length in the series of articles on "Lost Time in Construction" recently published in this journal. The need of today is not only for greater production in the aggregate, but also for greater output from present productive capacity; and it is desirable that we consider the possibilities in the latter direction before we take for granted the need for any great additional supply of producers.

This question has a bearing also on the discussion of the immigration problem by Mr. Alexander, who reviews the operation of the 3-per cent immigration law and considers the social, political, and industrial aspects of a national immigration policy. We concur in his emphasis upon the social aspect. Under pressure of current industrial requirements, we are in danger of permitting the industrialist's need for strong backs to transcend the nation's need for worthy citizenship. We need the immigrant's productive capacity, to be sure, but we cannot receive that without at the same time accepting him as an individual, a neighbor, and, perhaps, as a fellow citizen. Any accession of material industrial strength at the expense of our standards of life and citizenship would be a net loss to American welfare, and Mr. Alexander is on sound ground when he urges a counsel based upon national welfare as opposed to industrial expediency.

The Construction Industry

PROBABLY no other single element has contributed so materially to the continued recovery of business in general during the last year as has the construction industry. The effect of greater construction activity cuts two ways; not only does it give direct employment to a broad range of labor, skilled and unskilled, but it stimulates also those basic industries upon which it calls for its raw materials. Much prosperity in many fields has been keyed to the record construction activity of the year just closed.

This is noteworthy because, as has been explained, construction normally is the servant of other industries, dependent upon their general prosperity for its own impetus. When commerce and industry prosper, the construction industry is called upon to expand existing facilities and to provide new; but when depression looms, industry seeks to keep its resources liquid and to cut to a minimum the volume of capital tied up in plants or otherwise fixed. As construction is essentially a process of fixing capital, it languishes. During the last year or two, despite the general business depression, the industry has thrived because of special influences that have been brought to bear upon it.

One of these is the shortage of commercial and home building during the war. This deficiency is not yet made up and there will be need for more than normal activity for some years to come. Declining costs during the early months of last year were responsible for the contribution of 1922 toward making up the deficiency. Another factor has been the federal and state-aid highway construction program. The federal-aid program, authorized in 1916 and put under way in 1919, attained its stride only during the year just past, with consequent increase in construction activity. A third influence making for increased construction has been the tax-exempt securities issued by governmental units. This has brought about during 1921 and 1922 the largest volume of state and municipal bonds of which there is record, amounting to more than two billion dollars.

Contracts let during 1922 are estimated at about four billion and a half of dollars, or about one-third more than during 1921. Although much of this work has been completed, some of it has not yet been started. The indications are that 1923 will equal or surpass the record of 1922. *Engineering News-Record* Volume Index, which takes into account variation in purchasing power of the dollar and therefore reflects more accurately the actual volume of construction work, increased from 88 in 1921 to 130 for 1922, the last month being estimated. These are based upon a value of 100 for 1913. Important awards covering public works and fireproof buildings reported by *Engineering News-Record* during 1922, excluding industrial contracts, were worth $1,411,000,000, as against $1,117,000,000 for 1921. Large industrial contracts also showed an increase from $114,000,000 in 1921 to $164,000,000 in 1922. The building permits issued in 166 cities, according to the Federal Reserve Bank statistics, were for the first nine months of 1921 $1,196,000,000, while for the first nine months of 1922 they amounted to $1,879,000,000.

Since March, costs have been rising and are now about 15 per cent higher than they were a year ago. On the other hand, the average cost of construction of all kinds in 1922 was, according to *Engineering News-Record* Index 14 per cent under the average cost in 1921. During 1922 the cost index varied from 168.72 in January to 192.60 in December. Of the prime materials, steel, as compared with pre-war prices, is cheaper than lumber, cement, and brick.

Taken altogether the year-end developments point to a continuation of building activity, subject always to the danger of restriction that might be brought about by runaway prices for labor and material.

Municipal Engineering

A MORE favorable bond market and some reduction in costs stimulated construction in the municipal field in the early and middle parts of 1922. A reverse in both respects later on acted as a brake and if continued may retard progress in making up for deferred construction. Besides the stimuli already mentioned, water-works construction was facilitated in some cities by readjustments of water rates, including some municipally-owned plants. Strong arguments for improvement in the financing of municipally-owned works, going as far as the advocacy of putting such works under the control of state utility commissions, were advanced during the fall and early winter at meetings of the New England Water Works Association.

Throughout all branches of the municipal service, mounting debts, interest charges and tax rates present a serious problem, but one too little recognized and when recognized too seldom squarely faced by municipal authorities.

In water filtration a tendency to go above the standard rate of 125 m.g.d. for mechanical filters is apparent. The very high rate of 175 m.g.d. adopted for the Detroit filters—the largest in the world—may be considered as exceptional, and due in part to local conditions that favor a higher rate. Buffalo, St. Paul, Omaha and other cities are providing for filtration. Some of the new plants will treat waters that only a few years ago would have been considered quite satisfactory without treatment and which, even now, have little against them so far as danger of producing disease is concerned; but in all these cases there is a degree of added safety that warrants considerable expense and a gain in physical qualities that is well worth while.

The activated-sludge process is still the center of interest in the sewage-works field. Construction of the Milwaukee and Indianapolis plants is now well advanced, and several plants are in use or projected by the Chicago Sanitary District. In Canada and in England the process seems to be gaining in favor. Dewatering the sludge from the activated-sludge process continues to be the subject of study but it is significant to note that after the most varied and extended tests of sludge treatment ever made at one place, Milwaukee has adopted heat-acid conditioning and the Oliver vacuum filter, with drying by heat as the final stage. Whether a marketable sludge can be produced by the activated-sludge process has not been proven. Much of the uncertainty lies in the variability of the demand and price for fertilizer base—which also works against garbage reduction.

Garbage disposal is still shifty as to methods in favor—largely because it is the football of party changes in political administration of cities and not yet generally recognized as an engineering service. Although instances of incinerator shutdowns after a few months or years of operation are numerous, there seems to be a decided tendency of late to install incinerators; particularly several in a city, so distributed as to reduce haulage costs. The British type of high-temperature destructor, with attempts at heat utilization, is losing ground. Even in England it is being displaced by disintegration and screening (of mixed refuse), with more or less use of clinker for concrete and of fine ash and shredded garbage for land improvement. Garbage reduction and hog feeding have both had a setback owing to the poor market for grease, fertilizer base and hogs. All these conditions tend to garbage disposal in conjunction with ashes to fill low land, at least as a temporary measure in medium-sized and small cities.

City planning is slowly but surely becoming established as an essential to municipal progress and economy. Most of the planning and re-planning work that has got to the construction stage is street widening and extensions, to provide more adequate arteries for the rapidly growing use of automobiles and motor trucks. Traffic regulation and the control of parking are being pressed to the front—not always with due recognition of the fact that the fundamental need is more adequate travel routes. City zoning is making more substantial progress than other branches of city planning—partly because it costs less in time and money than does street planning and construction and largely because it is now being recognized as the basis of many other lines of city planning.

The great needs of the future in the municipal field are co-ordinated planning, both physical and financial, with a far look ahead, and emancipation from partisan politics and the resulting inefficiency.

Road Construction Stabilized

HIGHWAY construction was slightly less active last year than in 1921. As a matter of comparative record this fact is of interest. The conclusion of importance, however, is that, with the advance of the last twelve months, the country is committed to a long program of national and state highway extension which only unusual circumstances can interrupt. It does not signify much, therefore, how the volume of work performed swings up or down a little in any year. The essential facts are that there was a large expenditure for road improvement in 1922 and unless all indications are unreliable there will be substantially as great an expenditure in 1923.

Being committed to a long program of highway improvement does not indicate that the public is passive in its attitude toward the volume and the management of its highway appropriations. An outstanding feature of the year's activities has been a disposition to review and criticize expenditures for road construction. This is, fundamentally, the result of present general economic conditions reflected as an inclination to curtail heavy spending. There is no indication that public sentiment does not generally favor improved roads. There is indication that it resents paying uncurbed prices for improved roads. With improved business conditions and better prices for farm products, conditions are possible which may entirely change the inclination toward frugality which now prevails. A helpful influence will be education of the public by road officials in highway technic and economics.

Technically road building has made decisive advances. Research work completed during the year gives highway engineers means to approach the rational design of pavements. Methods of construction have been better formulated, and, more significant than this, four years of intensive road building has developed a corps of skilled road contractors. Maintenance has been widely extended. There are many facts indicative of all these conclusions and they will be reviewed in the coming issue of Jan. 11 devoted especially to highway engineering in honor of the convention and exhibition of the American Road Builders Association.

Research, design, construction and maintenance all showed progress in 1922. Administration made little progress. It is true that there were increased forces and better organization in detail, but in the broad essentials of freedom from political interference, salaries adequate to responsibility and centralized authority there was little forward movement. Such advance as is indicated is due largely to the requirements which Congress laid down under the advice of the Bureau of Public Roads in its latest federal-aid legislation. A public and official awakening to higher principles and greater proficiency in highway administration is one of the requirements which the last twelve months record has impressed on forward-looking highway officials.

Water Power Normal

IN THE current review of hydro-electric progress on another page practically all attention is given to Western developments because there, it seems, the most progress is being made in hydraulic power generation. The East has not been idle during the past year but its development has been more on the even curve upward of past achievement. It is not forgotten that Niagara is the premier water power in the world and that records for size of units, for totals generated, for canal capacities and for tunnel sections are still held there but outside of Niagara there is no new hydro-electric project east of the Rockies which its designers would claim to be more than the normally improved practice. The novel semi-enclosed power house at the Mitchell Dam of the Alabama Power Co. and the low-head, high-speed propeller wheels at Winnipeg and at the Ford plant at Troy are steps forward noted last year.

But if the East does not show any great novelty in practice, it is apparently on the eve of a greatly increased development of water power. During the year past several extensive investigations of large watersheds have come to light and several others are still matters of private concern but all are apparently merely waiting for favorable financial conditions to be transformed into actual construction. Such companies as the Southern Power and New England Power continue steadily to extend their operations farther and farther back toward the headwaters of the streams descending the Appalachian range and others such as the Clarion River in Pennsylvania and the Tippecanoe in Indiana to open up new sources. The distinguishing features of such projects is the extent of the vision of their projectors. No longer in the East is the development of one falls or even a short stretch of river attacked as a single problem. Rather is the area to be served considered as a whole with farseeing plans for the tying in, by reservoirs as well as by electric lines, the outlying units so that eventually all of the rain falling on a given slope will be made to do its maximum work. This is a desirable end toward which, as our fuel supply diminishes, all power development must tend.

In details of hydro-electric design there have been no outstanding features. The major manufacturers are working all the time toward an increase in efficiency and decrease of complication and at no one time is it possible to point to a definite marked step ahead. The possibilities of the propeller and the combined impulse-reaction wheel have been remarked before; the remodeling of draft tubes for greater ease of egress seems not to have progressed beyond the novelties of a few years ago. The automatic station for the smaller capacities is growing more and more practical. Outside of these, design details are not remarkable for novelty.

The Federal Power Commission continues to operate under difficulties because of lack of personnel. With this limitation it has managed to do a prodigious amount of preliminary work both in examination of projects and in establishing proper accounting rules. Actual progress under the federal law continues to be disappointingly small. Applications have been made in great numbers but only a few (outside of the big Niagara development) have been transmuted into horsepower. By terms of the law these pending applications must soon either lapse or become active so that the real test of the law will come when the lives of the applications begin to reach their end.

Irrigation's Future

IRRIGATION possibilities in the West are still great. In the public domain alone, according to F. H. Newell, consulting engineer, United States Reclamation Service, some 20,000,000 acres might be reclaimed, or more than ten times the area for which water has been provided by the Federal Government. It has taken twenty years, including the time spent in preliminary studies, and has cost about $135,000,000 to irrigate some 2,000,000 acres. Allowing a 50 per cent increase in construction cost, to water the remainder of the irrigable public domain would cost $2,000,000,000. If it be assumed that the reclamation fund—derived from sales of public land, royalties on the production of oil, etc., and repayments to the fund by settlers on account of construction costs—would amount to $10,000,000 a year, it would be 200 years before all the irrigable public domain was supplied with water for irrigation. Recent financial and industrial conditions have slackened the contributions to the Reclamation Service fund, so that without radical changes in financing there is no prospect of $10,000,000 a year becoming available for many years to come. Already $20,000,000 of bonds have been provided to expedite the completion of projects under way. As these bonds are payable at the rate of $1,000,000 a year from the normal reclamation fund they reduce by that sum the current construction fund. Further depletion arises from a congressional relief act approved March 31, 1922, authorizing the extension of the time for paying construction charges against settlers. Besides credit for the first cost of irrigation projects some of our best authorities—Elwood Mead, for instance—urge that loans should be made to help the settler prepare the land for cultivation, put up buildings, buy tools and live stock. This would greatly increase the total of public funds advanced to finance irrigation projects.

It is taken for granted that the federal government will continue to build or at least to finance or help finance the larger of the irrigation projects of the country. The Reclamation Service was created because of the conviction that the irrigation works awaiting construction were too large and the economic and human problems involved too many and complex for private enterprise, as they were also beyond the financial capacity of irrigation districts and even of entire states. The irrigation works of the future will require still more capital and skill. Add, for instance, the cost of the huge Columbia River Basin Project to the minor projects that would press for simultaneous execution, and then increase all this by the settler's loans for lands, buildings, tools and livestock, already mentioned, and the total becomes so large as to make it patent that the future of irrigation in the United States is a subject demanding searching study by engineers, agriculturists, economists and statesmen.

Federal Engineering Queries

THIS question of federal expenditure for local benefits is just now of tremendous importance to engineers. Leaving aside the long established river and harbor policy and the more recent federal aid to highways, there are five outstanding engineering projects now before the American people the cost of which will run into the billions and the benefits from which are primarily local, though each has an ultimate relation to national welfare. These are the St. Lawrence improvement in the northeast, Muscle Shoals in the southeast, the Columbia Basin irrigation in the northwest, the Colorado River in the southwest, and the Mississippi River in the central section. If each is examined it will be seen that the arguments in their behalf are identical. The advocates of each claim that through its construction there will flow out over the country a general reduction in the cost of living and a corresponding increase in the amenities of life; the St. Lawrence project will create cheap power and lower grain prices, the Colorado control, the new Columbia basin, and the Mississippi flood retention will decrease farm produce costs. Muscle Shoals will give cheap fertilizer.

Yet in each case the immediate benefit is obviously to those in the range of the improved districts, and the main reason they themselves do not undertake the work is the enormous cost which, partly from selfish reasons and partly from absolute inability to shoulder, they would pass onto the general government. On the theory which governs road aid and river and harbor work, each section should agree to all of the projects if its own is authorized, but in these five huge schemes the grand total of cost is staggering and quite beyond the power of the government to assume. We come, therefore, to an impasse which promises to delay each of the admittedly desirable developments until some way other than national control is found. In the case of the St. Lawrence and Muscle Shoals, private ownership is offered, but so far, at least, that easy way out has not appealed to the people. On the Colorado seven states seem in a fair way toward assuming the disproportionate proportion of cost their disproportionate benefits suggest. The Mississippi, it would appear, must remain mainly a national expense to be paid out in small amounts year by year until complete.

Mississippi Problem

AFTER every big flood on the Mississippi there arises a clamorous demand for a new method of protecting the valley against the rising waters. Most of the clamor is from people ignorant of the history of the river or of the science of river control who are either personally affected by the floods or are impressed, from a distance, by the stories of the almost irresistible power of the mighty river. Such criticism is negligible; it has neither authority or permanence, and it generally puts its faith in such discredited relief means as reservoirs, forest planting and contour plowing. There is, however, after each flood a large body of expert critics which, with more or less justification, offers methods of control in opposition or in addition to those now accepted in the continuing plan of the Mississippi River Commission, the supreme power over the river from Cairo to the Passes.

The record flood of 1922 proved no exception to the rule. In spite of the fact that there was less actual damage by this highest of floods than from any of those approaching it the past four decades, the daily and long continued menace of the weakened levees and the almost superhuman efforts required to prevent a dozen prospective breaks along the river—to say nothing of the three crevasses that did occur—combined to warn experts and laymen alike of the possibilities that may follow a quite conceivable discharge greater even than this greatest yet recorded. Out of all the post-flood study and agitation, however, there arises only one suggested protective measure which has any degree of plausibility or of unanimity among those qualified to discuss it. This is the spillway at some or several locations below the mouth of the Red River. There are some faint whisperings of criticism of machine built levees, some suggestions for improvement for revetment designs and a competent demand for study of river hydraulics through a model river in a laboratory, but these are generalities which do not promise an immediate program.

The review in this issue states adequately, we think, the pros and cons of the spillway argument. It may be pointed out that each side avoids extensive reference to the main criticism of the other. The spillway advocates are little concerned with the structural stability of a spillway or weir; Colonel Townsend dismisses rather lightly the long held contention that the main arguments against a spillway is the possible silting up the river below the spillway. Of the two omissions, Colonel Townsend has the better of it in that he is arguing about something that is tangible and assured, the tremendous force of 250,000 sec.-ft. of water and the difficulty of building on the Louisiana alluvium any dam or weir that could withstand it. That is an engineering problem of gigantic proportions and while it is by no means inherently insoluble its solution involves courage and huge expenditure. The danger from silting, on the other hand, lies in the realm of river hydraulics, which is still far from an exact science and where experience is a more powerful teacher than theory. Only observations after the fact will be conclusive as to the effect of a spillway on river depths.

Meanwhile the Mississippi remains a serious problem, for even the spillway advocates admit that the levees must be continued, spillways or no spillways. All they claim for the spillway is that it will take off the crest of the flood and thus preclude the necessity of raising levees which are already at or near their maximum safe height. No scheme has yet been proposed, or at least seriously considered, which will relieve the country of the obligation of lining both banks of the Mississippi from far above Cairo to well below New Orleans with high stable mounds capable of withstanding, without anxiety, any ordinary high water and safe as human things can be against the highest water possible. There always remains the chance that distributed rainfalls will combine to cause higher water than ever before and that the established levee heights will be overtopped.

Structural Activity

THERE has been a brisk and growing activity during the year in the businesses depending on structural engineering, but technical growth has not been marked, and research has produced few results. By far the encouraging feature of the year's progress is a rebirth of interest in research, evident in all parts of the field of civil engineering, which promises much for the future. Quite independent of this an outstanding development impresses itself on the careful observer, namely a movement toward economy of material by the reduction of excessive safety factors.

Efforts toward commercial and industrial uniformity, represented chiefly in the work of the federal Department of Commerce and the American Engineering Standards Committee, have continued, unobtrusively. Their most important result is a model building code for small houses and a draft of simplified house plumbing rules. Fire-protection matters received attention in a new direction after the Burlington railway office building in Chicago was swept by fire, early in the year, bringing to the front the exposure fire problem and the dangers centered in downtown districts. Even aside from this, there has been fully the usual amount of advance in the long struggle against the fire waste, and building law development has been effective.

A situation of decided interest has come about in the field of bridge construction, due to a demand for highway crossings over wide bodies of water where ferries now serving transportation are finding it difficult to meet the needs of increased traffic. All the large highway bridges projected are being brought forward as private undertakings; the Philadelphia-Camden bridge, already under construction, is the only large public bridge enterprise. Opinions differ as to public policy on the question of toll bridges or free public bridges for such cases, where the work is necessarily of large cost. It is unmistakably evident, however, that in spite of its large expenditures for free improved roads the public is not very willing to supply funds for costly long-span bridges; many men, indeed, hold the view that their cost should be assessed on the user by adopting the toll-bridge plan of construction.

Structural materials, finally, brought forth no important innovations during the year—or for that matter during several years. An advance was confidently looked for a few years ago, the extension of the use of alloy steels, has lagged decidedly. Prices do not encourage rapid progress in this direction. That the weight factor maintains its influence on bridge practice, however, is expressed in the fact that an exceptional number of suspension structures figured in the year's developments, including the short-span highway bridge at Kingston put into service last summer, and that all the long-span projects involve wire cables, with the single exception of a recently ordered structure with suspension chains of treated, high-strength eyebars.

Progress in Concrete

PORTLAND cement production in 1922 will probably prove to be around 115,000,000 bbl., by far the record year in the history of the material. This means that more concrete was placed in 1922 than in any other year, but just where it is going statistics do not show. Concrete road construction was little, if any, greater than in the preceding year nor do such figures as are available indicate that industrial buildings of concrete were noticeably more than in recent years. There remains, then, general construction, which was heavy, and the multitude of small uses of concrete by builder and farmer which in all probability accounts for most of the increase.

At any rate, more concrete was used than ever before, which is interesting particularly in view of the fact that less obvious forward progress was made in the study of concrete design and construction than for some years. The report of the Joint Committee was before the engineering public the whole year and was discussed at a series of meetings and by the committee but its final revision will not be made until some time this year and it would be unsafe to predict what form it will take except to say that the strength design clause will probably be killed or emasculated. The main result of the long discussion has been to show that the contractors are too prone to stand on the principle that whatever is is right and forward-looking engineers too willing to take prospects for actualities.

Research in concrete continues to spread and, as the vast amount of work already done appears on the record, more and better co-ordination of effort is to be expected. During the past year, however, there were no outstanding investigations to report. The value of research and education is beginning to show in concrete construction, the standards of which have risen measurably in the past few years. It is no longer true that only a few contractors are competent to build in concrete, or that a great majority are careless of the fundamentals of safe construction.

In cement itself, there is evident a newborn interest on the part of the manufacturers in the make-up of their product. They are beginning to look beyond the detail chemistry of manufacture into the chemistry of behavior and to step beyond a too rigidly held attitude that portland cement is a perfected product. A continuance of this policy promises much toward insuring a more permanent concrete.

Equipment and Materials

DEVELOPMENTS during 1922 in the construction equipment and material fields were characterized by widespread improvement in details of well established types of machinery rather than by the introduction of new types. Efforts have been directed to strengthening parts, increasing sizes and capacities, simplifying operating control, and, particularly, to increasing the mobility of portable equipment. This trend is clearly seen in the increasing use of rubber tires, both solid and pneumatic, for machines which were formerly moved upon steel rims. In a number of cases, too, motor-truck chassis for concrete mixers and elevating loaders have been adopted. In the mounting of equipment, too, the year has developed an extensive use of crawler traction, which has been applied not only to locomotive cranes, concrete mixers, elevating loaders, and the light revolving types of steam shovels, but also to the heavy-duty railroad shovel.

One of the notable steps taken during the year was the equipment of power shovels with Diesel engines. The use of gasoline engines for operating construction equipment showed a decided gain during the year and the multiple-cylinder types are being employed more widely than ever before. Great strides have been made in the application of pneumatic hand tools to construction work. In the field of industrial locomotives and elevating loaders transmission has been introduced to give a greater variety of speeds than formerly and the large types of paving mixers have now reached the stage of self-contained units, fully equipped not merely for mixing and delivering concrete but for handling aggregate delivered in batch-boxes. Concrete chuting has, until recently, been considered economical only for large-scale work, but manufacturers have evolved simple and cheap equipment of this type for small jobs. In the rock crusher field the introduction of cast-steel frames instead of grey iron, is a move to increase durability.

Among developments also should be noted devices for measuring and handling concrete aggregate and the perfection of mechanical loaders of the elevating bucket type. The year also witnessed the manufacture, in the United States, of both concrete and cast-iron pipe by the centrifugal process.

The Labor Shortage—Its Volume and Means of Relief

Labor Shortage in the Building Trades—Immigration as Affecting
the Labor Situation—Apprenticeship and Seasonable Employment

As a contribution to the study of the serious shortage of labor in the building trades there is started in this issue a series of articles which should help to a better understanding of the situation. They include, first, a statistical study of the actual labor shortage, statistics which have hitherto not been available, an analysis of the immigration situation by the head of the National Industrial Conference Board which has been engaged in a survey of this subject, a discussion of the apprenticeship system, its defects and some attempted remedies, and finally, the story of seasonal employment in Philadelphia, where a special investigation of that situation has been made. The first two of these articles appear in this issue. The others will follow in succeeding issues.

How Great Is the Shortage of Building Trades Workers?

By Milan V. Ayres
Statistician, Associated General Contractors of America

HOW serious is the shortage of building trades workers? A brief and correct answer to that question would be, "Nobody knows." We do know, however, certain facts which are clearly related to the problem, and which would have to be taken into account in formulating a complete answer if such an answer were possible.

Table I shows the number of people employed in certain trades in this country as recorded in the census of 1910 and that of 1920. Some of the groups enumerated in the table are clearly people engaged in the construction of buildings, while others, such as electricians, plumbers and carpenters, include a considerable number of people working in shops or in other occupations not identified with new buildings. Table II shows, by the length of the bars, what percentage the people in each group in 1920 are of those in 1910. The first four classes, electricians, structural iron workers, plumbers and carpenters, have increased in numbers during the decade, while all of the others have decreased. During the same period the population of the country increased 15 per cent, so that only the first three groups increased as fast as the population.

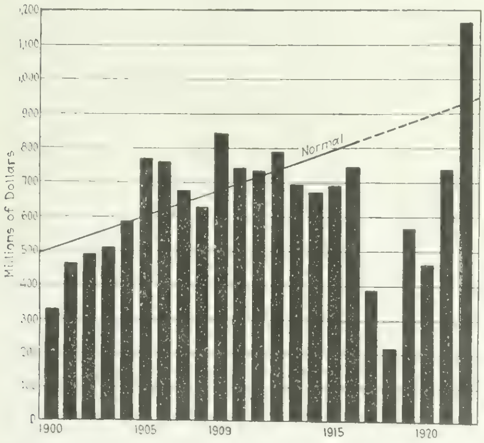


FIG. 1—VALUE OF BUILDING PERMITS FROM 1900 TO 1922

Value of building permits for 50 cities each year from 1900 through 1922 after data have been converted to 1913 cost basis. Straight line shows general trend from 1900 through 1916.

These figures seem to indicate that there must be a most alarming shortage in most of the building trades, but there are a number of reasons for believing that conditions are not nearly so bad as the census data seem to imply. Because of their authoritative character, it is almost necessary to begin any discussion of this subject with a consideration of these census figures, but I shall show further on that they really mean comparatively little.

The heights of the columns in Fig. 1 show, according to the best available information, the relative amount of building in our American cities each year, beginning with 1900 and ending with 1922, the figures for the latter year being, of course, partially estimated. The heights of these columns are proportional, not to the amount of money spent on building each year, but to the actual physical volume of work done. The figures from which the diagram is plotted were obtained by finding first, for each year, the total cost of all the buildings for which permits were issued in a list of 50 cities, and then dividing the figures for each year by the index number of the cost of building.

This process gives figures which show how much the buildings for which permits were issued in each year would have cost if the cost of building in that year had been what it was in 1913. The heights of the columns are proportional to these latter figures, and are therefore also proportional to the actual volume of the work done.

It is, of course, true that building sometimes costs more and sometimes less than the figures set forth in the permit, but the errors introduced by this fact are largely compensatory and whatever error finally remains is almost certainly about the same percentage of the total for each year, so that the results probably show with ample accuracy for our purposes the relative volume of building year by year.

The year 1909 was clearly the biggest building year in our history prior to 1922, and the 1910 census was taken in the year following, which was also a very good building year. On the other hand, the 1920 census was taken just following a period of several years during which building was sub-normal, and before the present building recovery had achieved any considerable headway. A natural result of this state of affairs was that men who had formerly been employed in building operations had been forced to find other work, and most of these, naturally, were reported by the census as engaged in these other occupations which they had taken up.

TABLE I—WORKERS IN CERTAIN TRADES, 1910 AND 1920, AS REPORTED BY CENSUS BUREAU

Trade	1910	1920
Electricians.	120,241	212,964
Structural iron workers (building)...	11,427	18,836
Plumbers and steam and gas fitters...	148,304	206,718
Carpenters.	817,120	887,379
Painters, glaziers and varnishers (building)...	273,441	248,497
Brick and stone masons	161,781	131,264
Roofers and slaters .	14,078	11,378
Plasterers	47,682	38,255
Paper hangers ..	25,577	18,746
Laborers, building, general and not specified	869,478	623,203
Laborers, road and street building and repairing..	180,468	115,836
Stone cutters	35,731	22,099
Total.	2,705,328	2,535,175

It is also an important fact in this connection that the 1910 census was taken in midsummer when building operations were active, while the 1920 census was taken in January when building is always at the minimum, and many men whose normal occupations was on construction work doubtless were doing, temporarily, something else. Many of these, undoubtedly, were enumerated as belonging to the occupation in which they were engaged at the time rather than to the trade in which they really belonged. The obvious conclusion is that the census figures reflect the relative activity of building in the two periods when they were taken much more accurately than they do the number of workers qualified to work in the building trades.

The sloping line marked "Normal" in Fig. 1, represents the trend in building operations in the 50 cities from the year 1900 to the year 1916. If each of the columns covering this period reached up to this normal line and stopped there, the sum of the heights of all the columns would be the same as it actually is, and the increment in height of each column over the preceding one would represent the normal annual increase in building. This line is obtained by a mathematical process based on the theory of least squares, and may be described as the best line which can be drawn to represent the trend in building operations over this period. The portion of the line to the right of 1916 is simply an extension of the other part and is drawn on the assumption that if the war had not occurred, building would have continued to fluctuate about this line in much the same way as it did before. Perhaps the most noteworthy fact revealed by this line is that the year just passed is the first one since 1912 when building operations have been up to normal.

The figures on which this chart is principally based were first computed by Col. Leonard P. Ayres, Vice President of the Cleveland Trust Co., and published in a monograph entitled "The Prospects For Building Construction in American Cities." In that work he shows that building construction in these 50 cities was on the average at the end of 1921 two and one-half years in arrears.

According to my computation, building in these same cities for 1922, represented by the last column in Fig. 1, was 26 per cent above normal. This means that if building should continue as much above normal as it has been this year, for the next ten years, the accumulated shortage of the war period would just about be made up. To accomplish this would mean not merely as much building as this year, but an amount next year greater than this, and the year after that still greater, as indicated by the slope of the normal line. The amount of this annual increment represents a volume of building which, at the present prices, would cost for the 50 cities in question, about 36 million dollars.

Unquestionably there has been some shortage in building trade labor this year. I think nobody could look at the height of the last five columns in Fig. 1 without realizing that there would have to be some shortage. If there were enough men in the country competent to do building work, it is clear that many of them must have been from necessity engaged in some other kinds of activity three years ago, and of course these men could not, all at once, be transferred from their other occupations into the building industry. It does, however, seem altogether probable that there are not enough men available for these trades to carry on building work at the intensity corresponding to the greatly increased volume of permits issued and contracts let during 1922. Undoubtedly many of the men who have taken up new vocations during the prolonged period of sub-normal building will refuse to return to their old trades. Also it is clear that conditions of the past several years must have prevented many men from learning the building trades, who in normal times would have done so. Another fact of importance in this connection is that since the outbreak of the war in 1914 inmigration has been at a very low ebb, so low that in some of those years more workers have left the country than have come in.

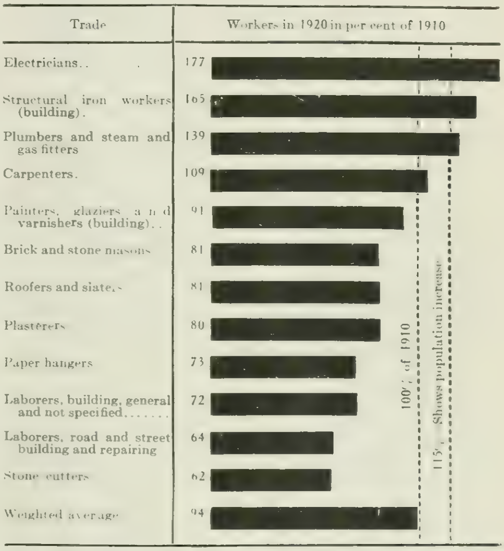


TABLE II—BUILDING TRADES WORKERS, 1920 AND 1910

Workers in certain trades in 1910 in per cent of the numbers in the same trades in 1920, as reported by the Census Bureau. If the number of people in any trade had remained constant the bar would reach to the 100 per cent line. If the workers had increased in proportion to the population the bar would reach to the 115 per cent line.

One of the important facts affecting the supply of building labor is that the industry is seasonal. More men are employed at it in summer than in winter. If a uniform number could be employed throughout the year considerably fewer men would be required. When we come to analyze this situation, however, and inquire how many more men are employed at the height of the season than on the average, we find the available information very meager and unsatisfactory. The heavy, solid, irregular line in Fig. 2 shows the way in which building permits vary in our American cities during an average year. The figures from which the line is plotted are taken from monthly averages of permits issued in 177 cities during 11 years. They show that 5.8 per cent of the total value of the year's permits are issued in January, 6.1 in February, and so on, reaching a maximum of 10.3 in April, and ending with 7 per cent in December.

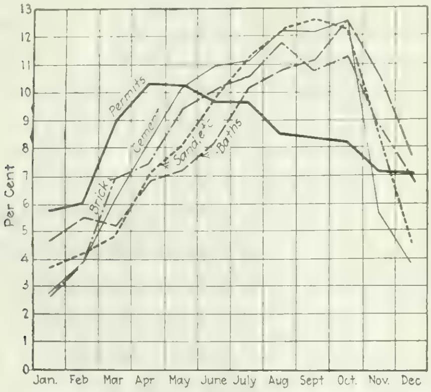


FIG. 2—ANNUAL CYCLES OF BUILDING PERMITS AND MATERIALS PRODUCTION

Annual cycle of building activity, as shown by the per cent of the yearly total included in each month for building permits issued, face brick shipped from yards, cement shipped from mills, sand, stone and gravel loaded on cars and bath tubs shipped from factories.

It is quite customary to speak of building activity as increasing during the time when these monthly permit figures are going up and as decreasing when these figures are going down. This, however, is obviously wrong because the building activity in fact comes after the issuance of the permits, and it is perfectly certain that the month when the greatest number of men are employed in building is much later in the year than the month when the greatest value of permits is issued. The other four irregular lines in Fig. 2 represent the relative monthly volume of shipments of four kinds of commodities used in building; namely, shipments of cement from the mills, shipments of sand, stone and gravel by rail, shipments of face brick from the yards, and of bathtubs from the factories.

Unfortunately all four of these sets of figures are for one year only, that of 1921; this being the only full year for which they are available. If averages over a longer period were to be had, doubtless these lines would present fewer irregularities. As it is they represent a remarkable degree of likeness; all of them culminate in August, September or October, and none of them is any where near a maximum in April when permits reach their highest figure.

Obviously these materials cannot be incorporated in buildings until after they arrive, so that these figures point to a culmination in actual building activity even later than the time at which shipments reach their peak.

The heights of the columns in Fig. 3 represent the relative building activity of each month of the year on the assumption that that activity is correctly determined by averaging the percentage distributions throughout the year of the four classes of building material shipments shown in Fig. 2. If these assumptions are correct only 3.4 per cent of the year's building is done in January while the peak is reached in October with 12.2 per cent, and the year ends with 5.7 per cent in December. On this basis about 3.6 times as many men are employed in building in October as in January, and there have to be about 47 per cent more men engaged in building in order to meet this October peak than there would have to be if building could be conducted uniformly throughout the year.

I am discussing this seasonal effect in building at some length because it is altogether probable that we are by no means through with the effects of labor shortage in the industry, and one of the ways by which that condition can be alleviated will be by spreading the work more uniformly over the year. In fact, I do not hesitate to say that if this could be completely accomplished, there would be no shortage at all of skilled labor in the building trades. I am not so sure, however, that this observation applies to common labor.

I have said that building could go on at a rate even greater than that of this record year for a period of ten years before completely catching up with the present building shortage. This, however, is not going to happen. Neither building nor any other kind of industry ever continues as smoothly as that would imply over so long a term of years. There are sure to be periods of business depression and of prosperity during the coming decade which will have their effect upon the building industry. It would be folly to attempt a prognostication of the time or extent of these fluctuations. It will be sufficient, perhaps more than sufficient, to venture on a prediction for the coming year. There are no indications that the present building boom has reached its end. On the contrary, recent figures show less than the usual seasonal reduction and indicate that, considering the time of year, the building boom shows greater strength now than in mid-summer.

I believe 1923 will be a year of great building activity. I do not believe, however, in spite of recent figures that it will witness a total of as much new building undertaken as has 1922. I have several reasons for this conclusion. One is that I think the edge has been taken off the demand, that is, the most urgently necessary building has already been started. Another is that money rates are going up and, I believe, will continue to rise practically throughout the coming year, and a rise in money rates always has a deterrent effect on building. Another reason, or another phase of what is really the same reason, is that general business prosperity is increasing, and experience has shown that during times of increasing prosperity, we stop spending money for speculative building enterprises and put it instead into industrial expansion, where it seems to hold out prospects of a greater return. I think, then, that while 1923 will probably not witness quite so much building as 1922, it will, nevertheless, be a very active building year, and will develop a demand for building trade workers only slightly below the demand experienced during the past year.

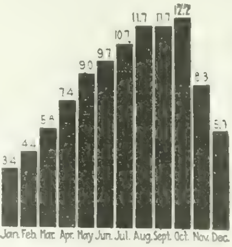


FIG. 3—MONTHLY VOLUME OF BUILDING ACTIVITY

Per cent of total year's work performed each month. Estimate based on rates of shipment of three important building materials and one building equipment item.

Immigration as Affecting the Labor Situation

By Magnus W. Alexander
Managing Director, National Industrial Conference Board, New York

FROM 1820 until Nov. 30, 1922, altogether 34,936,599 immigrants came to the United States. The causes of this gigantic migration have been various, but more important than any others are the *economic factors*, having their root either in the lack of economic opportunity in European countries which has become even more acute with the breakdown of European economic life since the war, or in the opportunities for work and advancement which the United States has in the past held out to immigrants.

Immigration in Relation to Industry—The immigrants coming to the United States seek work in our factories and mines. By this they exert a two-fold influence: they affect our business interests and business development and they also affect the great bulk of native and foreign born workers already employed in our factories. Between 1900 and 1920 the number of wage earners rose from 4,712,763 to 9,096,372, an increase of about 93 per cent. During this same period the number of persons engaged in gainful occupations rose from 29,073,000 to 41,046,000, or 69.8 per cent. During this same period, however, the population rose from 75,994,000 to 105,710,000, or 39.1 per cent. It will be seen from this that the rate of growth of industry has exceeded that of population. The influence of immigration here is difficult to indicate with exactness but it is undoubtedly a prominent factor. Our development would probably have been retarded if our industries had not had the labor supply which immigration made available.

Economic Objection to the Immigrant—The influx of immigrants into the industrial community has met with objection. Immigrants on entry are largely untrained in industrial work. They are in the main peasants from the farms of southern Europe, fitted to do agricultural work but actually going into industries as common labor. The amount of money which they show at the port of entry is small and they need work immediately. They therefore compete with the workmen already in the United States, and since their standard of living is generally lower they are able to work for less.

The increasing demand for labor accompanying our industrial growth has, according to others, prevented the increase in wages which would have come because of the presence of the large supply of recent immigrants. The competition between the immigrants themselves and the immigrants and natives, according to some writers, has resulted in the standard of wages being fixed not by skill or family requirement but by the amount for which the lowest grade worker is willing to work. Organized labor is definitely prejudiced against the immigrant because of the steady wage competition with the organized wage earner, which the former fosters. On the other hand it has been pointed out that while the immigrant may have kept general wages from advancing, their effect in this direction has not been great, due to the expansion of industry which has given new work to new workers, the service of labor organizations in standardizing wage rates within the fields in which they are organized, and the character of the immigration itself. The immigrants come here to get money; they are mobile, going where industry requires them, and returning to Europe in hard times.

Another objection to immigration is of a different character; it is claimed that immigration by bringing in more workers than can be given employment except in most prosperous times tends to increase the margin of unnecessary workers so that the danger from unemployment is increased, and in periods of declining industry suffering is heightened.

Moreover, the immigrant is charged with having a detrimental effect upon working conditions since, as the Immigration Commission states, "when the old employees have found unsafe and unsatisfactory working conditions prevailing in mines and industrial establishments and have protested, the recent immigrant employees, usually through ignorance of mining or other working matters, have manifested a willingness to accept the alleged unsatisfactory conditions."

It is held, besides, that the immigrant is generally an inefficient worker at best. This is predicated on the ground that his inability to speak English and his high percentage of illiteracy make it impossible for him to understand instructions either in English or any printed foreign languages, so that in consequence he is more prone to accident and is on the whole less productive as a worker. The Massachusetts Commission on Immigration reports that of 489 employers questioned, 360 found the southern and central European workers less efficient than the north and western group.

Finally, the new immigrants are pointed to as an economic liability because of the large amounts of money which they send out of the country. The U. S. Immigration Commission estimated that in 1907 altogether $275,000,000 were sent out of the United States by foreign workers; of this, $85,000,000 went to Italy.

Economic Advantages of the Immigrant—Despite the economic disadvantages already pointed out, the fact is generally recognized that the industries of the United States have been built up in a large measure through the immigrant labor supply. The foreign born male in the United States is essentially here to work. The 1920 census shows that in general 89 per cent of all male foreign born whites, ten years of age and over, in the United States, are gainfully employed; in the New England and Middle Atlantic states 91 per cent of them are gainfully employed. This is in contrast with a general average of 75 per cent of the native whites so employed and 81 per cent of the negroes. In agriculture the foreign born are almost negligible, but in the mining industry they represent 35 per cent of all those gainfully employed. In the manufacturing and mechanical industries 28 per cent of those gainfully employed are foreign born and 23 per cent more are of foreign or mixed parentage. Of all foreign born workers in the United States 47 per cent are employed in the manufacturing and mechanical industries.

The fact that immigrant labor constitutes a fluid supply that comes when it is wanted and departs when labor conditions are unfavorable, makes it economically advantageous. Moreover the immigrants arrive predominantly at the working age. The census figures of 1890, 1900 and 1910 show that about 85 per cent of the foreign born are in the age groups of 16 to 64, which is the predominant working span, whereas only about 57 per cent of the white persons of native parentage are in this group.

Social Aspects of Immigration—Whatever the importance of the immigrant industrially, however, if his presence in our society means a weakening of the fabric of our civilization the immigrant should obviously be excluded. If the immigrant cripples the machinery of democratic government, if he is mentally or morally unsatisfactory in our kind of living, if he cannot be assimilated, or if he is a burden on our social institutions, he ought obviously not to be admitted. These are matters, however, which cannot be determined with mathematical exactness.

Illiteracy is one of the things counted against the southern and eastern European in the past. The 1920 census showed that 13 per cent of the foreign born whites were illiterate as against 2.5 per cent for the native Americans. The Immigration Law of 1917 excluding those over sixteen years of age who are unable to read from thirty to forty simple words of some language has done away with an increase of illiteracy, but this test of literacy is so simple that it does not necessarily mean the ability to read and understand complicated instructions. Moreover it should be remembered that the children of foreign born in the United States show the lowest rate of illiteracy of any class in the population (0.8 per cent), which shows that the foreign born not only is capable of education but that he is eager to secure it for his family. This low percentage is due to a degree, however, to the fact that the foreign born are concentrated in the northern states where compulsory school laws exist and are enforced. The school attendance of foreign born white children is less in proportion to their number in the population than that of either native whites or natives of foreign parentage. Only 42.2 per cent of the foreign born from five to twenty years of age are in school as against 66.9 per cent of native whites of native parents and 65.8 per cent of native whites of foreign or mixed parentage.

The army mental tests are frequently cited as showing the low ratings of the southern and eastern Europeans, but these intelligence tests cannot be so used. In the words of Professors Yoakum and Yerkes, who devised the army group test, it was "not prepared for civilian use and is applicable only within certain limits to other uses than that for which it was prepared." The question of mental inferiority of the southern and eastern Europeans is but one phase of the idea that the foreigners are inferior racially and that their blood will tend to "pollute" that of the present American stock. Here again we are in a field where scientists differ and where we are only at the beginning of the research which should precede definite assertions. Students such as Professors Boas and Giddings of Columbia University, Ripley of Harvard, Jenks of New York University and Kelsey of the University of Pennsylvania hold that there is no harm in racial intermixture.

With respect to insanity and feeblemindedness, foreigners so mentally deficient have been excluded from entry into the United States since 1882. The federal censuses of insanity in 1904 and 1910 show a higher percentage of insanity among the foreign born than for other portions of the population. It is significant, however, that the nationalities most heavily represented among the insane in 1904 and 1910 were the Irish, Germans and Scandinavians. The Italians, Russians and Austrians, who in recent years have made up the bulk of our immigration, show a negligible amount of insanity. The census shows further that the native whites of foreign and mixed parentage are less liable to insanity than the foreign born, which would seem to indicate that the process of adaptation may have something to do with the unbalancing of the minds of many foreigners, and that their children who are freed from this handicap are not permanently liable to insanity.

Another charge against the foreigner is that he increases crime out of proportion to his numbers in the population, and that crimes of violence in particular have increased because of the presence of large numbers of southern and eastern Europeans. The foreign born were 28.2 per cent of the white prison population in 1890; 23.7 per cent in 1904, and 22.5 per cent in 1910. Examination of these statistics shows, however, that the native whites are responsible for more serious crimes than the foreign whites. The offences chargeable to the foreign born are mainly violation of ordinances and arise probably from ignorance of the law.

With respect to *pauperism* the statistics of 1910 show that one-third of the total number of paupers in alms houses are foreign born. The nationalities chiefly represented are the Italians and Germans, the former making up 17 per cent of the total and the latter 8 per cent. It is significant that two-thirds of the foreign born paupers have been in this country twenty years or more. Paupers of foreign or mixed parentage constitute only 12 per cent of the total number, indicating that the second generation is apparently no more subject to pauperism than are the natives. A complete record of charity cases in forty-three cities was made for the Immigration Commission by organized charity societies. The period covered ran from December, 1908, to June, 1909. Out of 31,685 cases assisted 38 per cent were foreign born and 7 per cent were cases of native born of foreign parentage. The races represented by one hundred or more cases in order of numerical importance are Germans, Poles and Irish. The percentage for Europeans of southern and eastern nativity are low in every instance.

The foreign born congregate in national groups and do not mingle with the native population, thus forming little cities within a city and having their own shops, restaurants, banks, fraternal societies and newspapers. This represents, however, a natural tendency. Americans in foreign countries in a similar way form their own colonies. Natives of any country naturally seek the closest social contact. Since most immigrants come here for the purpose of earning a living they are drawn to places where the industries are situated and thereby to the cities. In order to secure quarters at the low rent which they are willing to pay they invariably go to the districts which have been deserted by the more progressive of the older foreign and native white stock. The Massachusetts Commission on Immigration points out that the first point of contact which the foreigner makes in the United States is his home. High rents force overcrowding among those with lower incomes and bad sanitary arrangements and dirty streets make it difficult to maintain decency and health. This circumstance is closely allied with pauperism.

Political Factors—Desirable as the immigrant may be economically, his presence here creates also a political problem, since obviously the value of residents within a country arises from their interest in its government and institutions and their participation in them. Americanization studies by the Carnegie Foundation show that the immigrant in the United States waits on an average of 6.8 years after arrival before filing his intention to become a citizen and about five years longer before filing his final petition for naturalization. In other words he takes close to twelve years on an average, whereas the law permits citizenship within a period of seven years. This, however, is taken to indicate that not until the foreigner is adjusted to his environment does he feel ready to take part in the government.

The charge of radicalism against the foreigner is difficult to judge. The foreigner tends at first to bring with him the racial and other prejudices which maintain in his native country and to see our life in terms of his past experience and environment. Figures of the average paid membership in the Socialist Party show that of a total of 81,000 members, 29,000 are foreign born. Over 9,000 of these are Finns; 5,000 are Germans; 3,000 are Jews; and 2,600 are southern Slavs. The Communist Party has 35,000 foreign born members out of a total membership of 58,000. The strength of these groups, however, is small. On the other hand it may be noted that a large number of the foreigners come to the United States because they appreciate the advantages of a democratic government.

The Operation of the 3 Per Cent Limit Act—The present law is the culmination of a movement toward greater restriction which has grown up during the past two decades, based chiefly on social considerations, reflecting the point of view of organized labor and of those who feel that immigration has raised serious social problems. It has been felt that the preponderance of eastern and southern European types in the immigration of the past twenty years has had unfavorable effects upon working and living conditions, largely due to the difficulties in assimilating these alien types. The chief idea in the limiting of immigration to 3 per cent of the number of foreign born living in the United States at the time of the 1910 census of population was that by this means the immigration of desirable races would be promoted and that of undesirable types restricted.

The law, however, has had unforeseen effects both as to the volume and character of the immigration during the first fiscal year of its operation. The number of immigrant aliens admitted during the fiscal year (1920) *preceding* the present law was 805,228, while 247,718 immigrant aliens departed, leaving a net increase of population by immigration of 557,510 persons. During the first fiscal year of the law's operation, that is from July 1, 1921, to June 30, 1922, the number of immigrant aliens admitted was 309,556, and the number leaving 198,712, making a net increase of population by immigration of only 110,844, or less than one-fifth the gain in the preceding year.

The northern and western European countries exhausted only 46.4 per cent of their quota, the southern and eastern European countries and Turkish territory in Asia exhausted 95.3 per cent of their total quota. The quotas assigned to northern and western Europe would have permitted more than half of the total immigration to come from the ten countries in that group. During 1921-1922 only 36.8 per cent of the total immigration came from this source, whereas 63.2 per cent came from the new sources. In the first group, only Belgium and Switzerland exhausted their quotas; in the second group Russia was the only country whose quota did not approach exhaustion. The act has therefore reduced the numbers coming even further than was expected by giving higher quotas to certain countries than they were likely to fill.

The effect of the law is still more striking when the racial and occupational character of the arriving and departing immigrants is studied. The largest net immigration was of English, French, German, Irish, Scandinavian and Scotch peoples, in short, of the races from which the skilled rather than the common labor of American industry has been recruited. Of the Hebrews, who are chiefly traders, rather than industrial workers, 53,524 entered while only 830 left.

Occupations of the immigrants are as follows:

No occupation	131,050
Miscellaneous occupations (including 32,726 laborers)	115,963
Skilled workers	51,588
Professionals	10,955

During the same period the emigrants departing were classified as follows:

No occupation	54,944
Miscellaneous occupations (including 100,058 laborers)	122,497
Skilled workers	17,958
Professionals	3,313

The classification of a departing emigrant is based on the occupation followed while in this country and is not entirely comparable with the occupation classification of an immigrant. Yet it is significant that nearly three times as many laborers left the country as came in and that, including all skilled and miscellaneous workers, there was only a net increase of 27,096. These figures present a decided contrast to the figures for the pre-war period covering the years from 1909-1910 to 1913-1914. The proportion of persons without occupations has greatly increased. The proportion of farm laborers has greatly decreased. The net immigration for the four main working groups (skilled workers, unskilled workers, farmers and miscellaneous occupations) has decreased from 517,618 to 27,096.

Comparing the number of immigrants admitted with those departing, we find that there was a net gain of only 6,518 males and 104,334 females. The number of persons between the ages of 16 and 44 departing represented over 60 per cent of the number admitted. The largest percentage gain was in the group under 16.

When the 3 Per Centum law was put into effect the difficulties of administration increased rather than diminished. The immigration officials seem to think, however, that there will be less trouble in the future now that the steamship companies have been taught the danger of bringing immigrants in excess of the quotas and now that the countries of Europe are exercising more care at the ports of embarkation. There have been numerous instances of great injustice and hardship in individual cases. Many of them were due as much to the difficulty of administering the law as to the discrimination in the law itself.

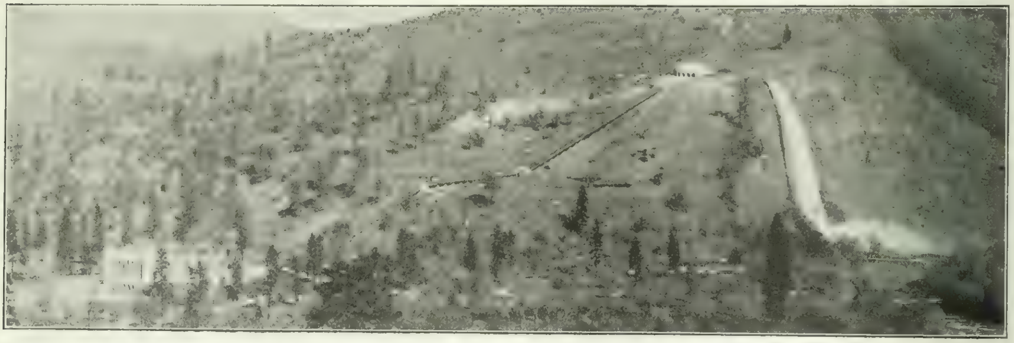
The most definite point upon which the immigration law is now being questioned concerns the present condition of the labor market. It is here that the effect of restriction is likely to be most noticeable after a single year's operation. The effects on assimilation and naturalization, on the other hand, cannot be accurately gaged after so short a period.

Outstanding Features of Western Water-Power Development in 1922

Forward Steps in Design and Construction—A Stabilized Tendency Toward Municipal Ownership or Control—Economic Aspects of the Western Water-Power Situation

MORE than any previous year 1922 stands out as a year of water-power development in the West. The amount of construction under way has been very large, important projects have been launched or completed, new high-voltage records have been made, and all lines of business identified with hydro-electric development have felt the stimulus of busy times. In such a period of activity and concentrated thought, it is natural that progress should be made. There have been important improvements in details of waterwheel design—such as the invention of rubber seal rings for reaction turbines—and at least one new departure has been suggested affecting the application of fundamental hydraulic principles; namely, the experiments with turbo-type impulse runners.

In the construction field there has been a full measure of progressive ideas. Typical of these are (1) the two masonry dams, completed this year in California, in the construction of which concrete aggregate containing rock up to 14 in. in length was put through the mixer; (2) an economical system of handling bulk cement used on the Hetch Hetchy Dam; and (3) a portable, self-contained piece of apparatus for placing concrete lining in long power tunnels which is taken into the tunnel and moved along as the work advances, carrying with it facilities for storing materials, a concrete mixing plant and a "gun" for delivering concrete by the pneumatic process.



RECENTLY COMPLETED PLANT NO. 1 ON THE PIT RIVER

Discharge from top of cylindrical surge chamber at head of penstock line causes the waterfall at the right.

A table published in *Engineering News-Record*, Jan. 5, 1922, p. 25, lists twenty-eight Western water-power projects that were under way at that time or definitely projected for development in the near future. The total capacity of the plants there listed amounts to about 1,500,000 kw. Taking each kilowatt as representing an investment of about $300, when substations and distributing systems are included, the total investment represented in that list of projects is about $450,000,000. This figure, which represents current work alone, indicates (1) the potential power demand, (2) the extent to which capital is essential to and (3) the extent to which capital is already interested in the Western situation.

Taken as a whole, the outlook in the water-power field in the West is very promising; the rush of construction activity that followed the 1915-1920 period during which practically no water power was developed, has now ceased, but on the other hand the several large companies have adopted the policy of programing their work five to ten years ahead and this is sure to have a stabilizing effect on the construction field. More detailed comment on some of the outstanding features of the Western water-power situation is presented in the following:

Extensive Power Development in 1922—Water-power projects under way during 1922 in the Pacific Coast states amounted to about 70 per cent of the total for the entire United States. So far as known, none of the projected developments listed in the *Engineering News-Record* table referred to in the foregoing has been postponed and a few more have this year been added to the list. Some of the plants not included in that table but which are now scheduled for construction in 1923 are listed in the accompanying table.

New Features In Design—The experience of the year is in keeping with the reputation which the West enjoys as a prolific source of new ideas in design. The development of rubber seal rings for reaction turbines (*Engineering News-Record*, Nov. 9, 1922, p. 789) greatly extends the range of application for units of this type in comparison with impulse wheels by removing some of the principal drawbacks to the reaction type, namely, wear of seal rings, leakage and loss of efficiency. In short, the advent of this improvement is expected to put reaction turbines in a new and more favorable light in selecting the type of wheel best suited to given conditions. Experiments with the turbo-type impulse runner (*Engineering News-Record*, Oct. 26, 1921, p. 707) indicate that this departure from long-established standards will put on the market a type of impulse runner embodying some of the chief advan-

SOME OF THE MORE RECENTLY STARTED PACIFIC COAST POWER PROJECTS

(These are in addition to those listed in the *Engineering News-Record* table published January 5, 1922, p. 25.)

Name or Location	Company	Capacity* (Horse Power)	Static Head (Feet)
At Ocean Falls (British Columbia)	Pacific Mills, Ltd.	6,300	140
On Hood River (Oregon)	Pac. Power & Light Co.	8,700	(average) 190
El Dorado Plant (American River, Cal.)	Western States Gas & Electric Co.	28,000	1,900
On McKenzie River (Oregon)	City of Eugene, Ore.	2,000	(approx.) 50
Fourth Unit at San Francisquito No. 1 (Los Angeles Aqueduct	City of Los Angeles	16,000	940
San Gorgonio River, Unit No. 1 (near San Bernardino, Cal.)	San Gorgonia Power Co.	2,330	1,775
San Gorgonio River, Unit No. 2 (near San Bernandino, Cal.)	San Gorgonia Power Co.	1,030	900
Third Unit, Big Creek No. 1	So. Cal. Edison Co.	21,300	2,131
**Oak Grove Plant	Port Ry. L. & P. Co.	35,0	960
Bullard Bar Plant	Yuba Development Co.	9,000	175
Exchequer Plant	Meced Irrigation Dist.	35,000	310

* Capacity given is that for units being installed at present.

** Notable change in size and head since last year's table was published. (35,000 hp. in one Francis turbine under record head of 960 ft.)

tages of the reaction type. This will aid in the provision of equipment suitable for heads between 800 and 1,000 ft., as well as in other ranges where designs thus far available have not been all that could be desired.

Results in the operation of the reaction turbines under the record head of 806 ft. at the Kern River No. 3 plant of the Southern California Edison Co. have been highly satisfactory and it is doubtless due in large measure to their success that the Oak Grove project in Oregon will use a 35,000-hp. reaction turbine designed for a head of 850 ft. Experience with that installation in turn, may be expected to lead to the use of reaction wheels under still higher heads.

The record-size, double-runner impulse units in the Caribou plant of the Great Western Power Co. have been developing 32,500 hp. under a 1,008-ft. head since the plant was started a year ago. This experience will be helpful when occasion arises for the construction of similar units under higher heads. High heads are not uncommon in modern practice—two plants with static heads exceeding 1,700 ft. are now under construction in California—but only infrequently is there occasion to use very large units under such high heads.

Progress in 1922 has not been limited to the hydraulic units; originality and ingenuity have been manifest in many other parts of recently constructed projects. The surge chamber on one plant finished this year has a circular spillway, 30 ft. in diameter, from which the overflow is gathered in a circumferential trough; on another project an 800-sec.-ft. flume is designed to spill over both sides, the overflow on the uphill side being carried beneath the flume to join the waste-way from the opposite lip; on still another job an earth dam is being built by both hydraulic-sluice and dry-fill processes simultaneously—the two methods being used on opposite sides of a concrete core wall which is "articulated" by numerous vertical and horizontal joints.

Tunnels under pressure are not avoided where they are necessary to economy in construction; the Newhalem plant in Washington is served by an unlined tunnel whose lower end, with an overburden of less than 100 ft. of rock, is under a head of 250 ft. The Gorge plant on the Skagit project, now under construction by the city of Seattle, will have a tunnel subjected to a maximum head of 380 ft.

Siphon spillways have gained popularity rapidly and their use now ranges from the largest dams down to canals that serve forebays.

Progress In Dam Construction—Prominent in the past year's practice in the construction of large masonry dams is the use of coarse concrete aggregate in lieu of plums. Lively discussions have resulted on the comparative advantages and costs of the two methods. Local conditions will always govern, of course, but experience at Don Pedro and Barrett dams indicates that coarse aggregate is worthy of being considered more frequently in planning massive concrete works.

At Don Pedro Dam (*Engineering News-Record*, June 1, 1922, p. 896) water worn boulders up to 14 in. in maximum dimension were put through the mixers. On the Barrett Dam (*Engineering News-Record*, July 27, 1922, p. 157) crushed quarry rock of similar maximum size was successfully put through the mixer. By occasionally replacing vanes in the mixers and liners in the spouting chutes, even with the sharp corners of crushed rock the wear was not prohibitive nor was there unusual difficulty in mixing and delivery.

DIABLO DAM SITE ON SEATTLE'S SKAGIT PROJECT

The economy of handling cement in bulk on the Hetch Hetchy Dam (*Engineering News-Record*, March 2, 1922, p. 352) suggests the more extensive use of this plan wherever it can be employed. While manifestly unsuited to small jobs, on large work bulk cement affords a two-fold advantage and a reduction in common labor requirements. With labor conditions as they have been in recent years the latter advantage is perhaps the more important.

Any dam 500 to 700 ft. high would command world wide attention and from the standpoint of both design and construction there is a lively interest in the dams now being proposed for the Colorado River. Plans have been brought forward for earth, loose rock, masonry and multiple arch designs for storing Colorado River waters, in each case with logical reasoning in favor of the particular type proposed. Among these is the interesting scheme for a multiple-arch type of unusual design some 400 ft. high.

An investigation of arch dams that has recently been undertaken by Engineering Foundation will probably be of special importance in Western power development. In these studies, arrangements for some of which have already been made in the West, it is hoped that by measuring and analyzing deflections, stresses, temperatures, etc., in existing structures and also in test dams to be built for this special purpose, a safe and reliable basis may be established for building arch dams of more economical construction.

Radio Aids Construction and Operation—Two Western companies—the Southern California Edison Co. and the San Joaquin Light & Power Corporation—are now carrying on construction work in which radio is successfully taking the place of the telephone or telegraph wire for all communication. In itself this is not unique, but it has led to a very important application of radio in hydro-electric operating practice, namely, the use of transmission lines as carriers or guides for radio waves. By this means the remote generating station may be kept in touch with headquarters independently of wire lines.

Means of calling the operator to the apparatus, which meet a serious objection to systems heretofore proposed, have recently been developed and can now be accomplished without relays or other sensitive and easily deranged apparatus. Dr. L. F. Fuller, with but little precedent to work on, has developed carrier radio communication systems for the Caribou and Pit River transmission lines in California. The former has been operating successfully for some months over the 110,000-volt, 200-mile line and the Pit River system is now being installed.

220,000-Volt Transmission Line—Power lines of the Pacific Coast are retaining their lead in both voltage and length. This year steel towers of the 250-mile, 150,000-volt line of the Southern California Edison Co. are being raised 10 ft. without interruption to service and the plan is to raise the voltage on this line to 220,000 volts. Voltage on the 200-mile Caribou line is to be raised from 110,000 to 165,000 volts this year and the 200-mile Pit River power line recently completed by the Pacific Gas & Electric Co. will be operated at 220,000 volts.

The interconnection of high-tension transmission lines along the Pacific Coast has been continued so systematically that when a connection now under way at Springfield, Ore., and another to bridge a gap of 100 miles in Eastern Oregon are completed there will be a continuous system from British Columbia to the Mexican line. From the northernmost generating station on this system to the Mexican border, the shortest route along this interconnected transmission system will be about 2,000 miles.

Programing Development Ten Years Ahead—The present-day policy of Western power companies is to lay out their construction program for five to ten years in advance. This has the advantage that efficient construction forces can be organized and maintained and the high cost of rush construction can usually be avoided. There are still greater advantages, however, in the co-ordination of financing, purchasing, operation and sales departments. In fact, a more or less flexible program and yet one which proposes definite lines of extension for years to come is a decided advantage to all departments.

Governmental Interest in Water Power—In its political aspects the Western water-power situation is complex. On every large development, such as those on the Colorado and Columbia rivers, the question of securing the approval and perhaps the financial support of the federal government has always been considered, but federal influence has been potential rather than active. Of late the federal government has become a more active factor; not only has the Federal Power Commission been carrying on work of a departmental and supervisory character affecting all undeveloped sites, but the Colorado River Commission, another federal agency, has taken the initiative in calling together representatives of seven Western states to co-operate in establishing and to agree upon a definite policy in allocating the benefits to be derived from the Colorado.

Municipal Ownership of Water Powers—With Hetch Hetchy and Skagit power projects well under way, San Francisco and Seattle, respectively, are developing their own sources of power; while Los Angeles has been partially served for some years by municipally owned plants. In addition to these three largest coast cities numerous smaller communities have taken steps in the same direction. This condition has come about in answer to a popular demand for municipal ownership.

However, where there is progress and more or less freedom from precedent, there is attractive opportunity for the radical, and to deal firmly with radical schemes without closing the door to originality and to worthy development along new lines has been an ever present Western problem. An example in point was the State Water and Power Bill submitted to California voters on the November ballot. This measure, discussed editorially in *Engineering News-Record*, April 27, 1922, p. 676, proposed what was without question the most radical experiment in state development and ownership thus far brought forward in this country. Municipal ownership on a sane basis has doubtless come to stay, but that the trend in that direction is not to be stampeded and that reasonable restraint and regulation may be expected, is indicated by the defeat of this measure by a majority of more than two to one.

The question of whether the trend to municipal ownership will at some later time swing beyond reasonable limits and so make the West, for a time, playground for radical and political experimentators, will have an important bearing on the financing of future power developments. Industries are attracted by abundant power at reasonable costs and without power industrial communities do not progress. The future of the West, therefore, is closely interwoven with power development which in turn hinges on the availability of large sums of money. Where there is a fair spirit between well managed municipal systems and private power companies, municipal ownership has not been an obstacle in obtaining capital for further private development. On the other hand, where municipal ownership has led to duplication of service, rate wars, etc., with the ordinance-making and other political powers of the municipalities aligned against the private companies, capital has been discouraged.

A Pictorial Review of Engineering Construction in the United States

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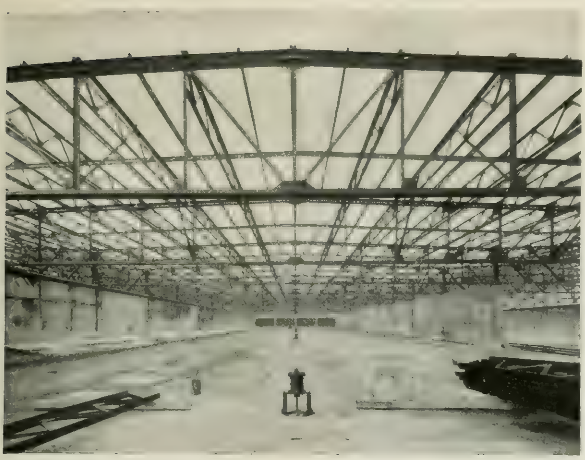
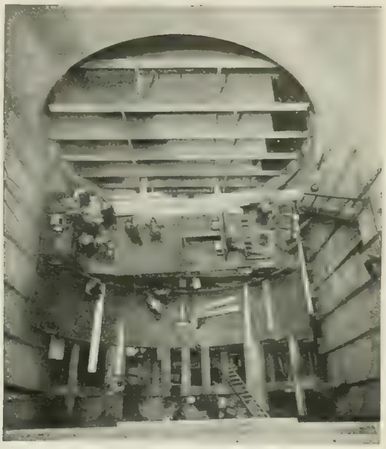
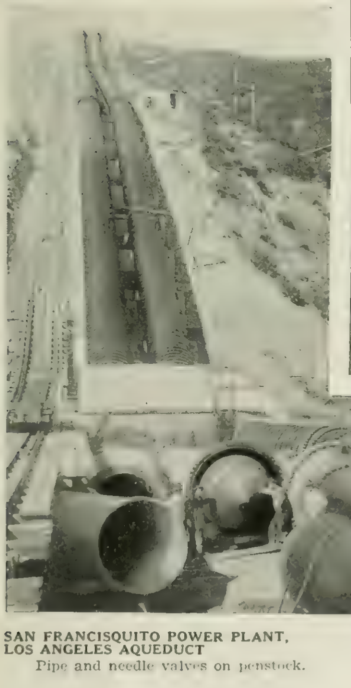
Twenty-Four Views of Work Just Completed or Now Under Way



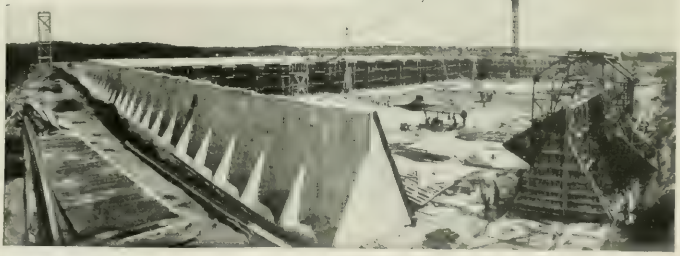
DETROIT FILTRATION PLANT
Structural-steel roof over coagulation basin.



HUDSON RIVER VEHICLE TUNNEL
Erecting shield in New York shaft. The circular opening (closed by temporary bulkhead) through which shield will leave shaft is shown in upper part of photograph.

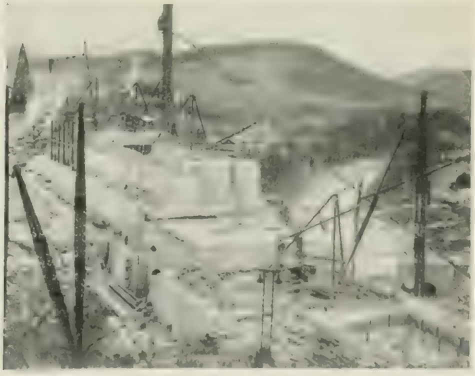


SAN FRANCISQUITO POWER PLANT, LOS ANGELES AQUEDUCT
Pipe and needle valves on penstock.

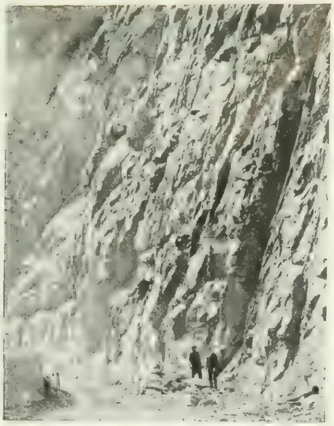


ST. PAUL FILTRATION PLANT
16,000,000 gal. low-service reservoir to carry 19 ft. of water.

GRANT PARK STADIUM, CHICAGO
Machine grading for new municipal stadium.

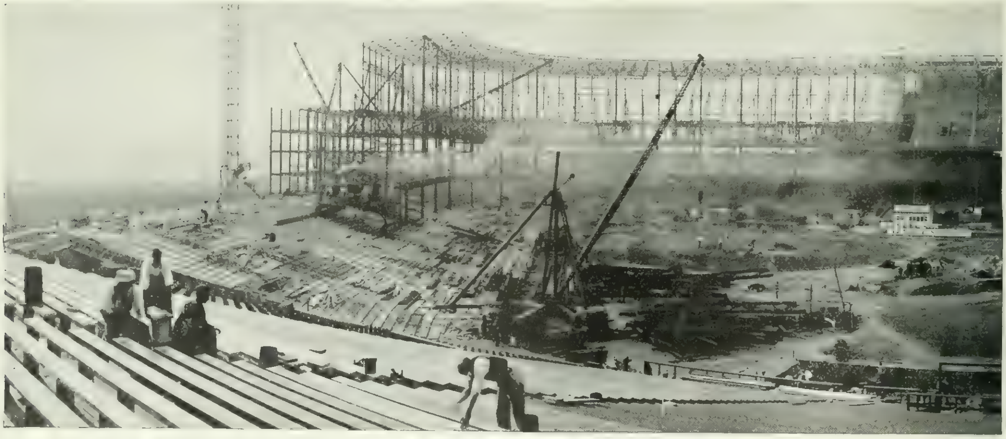


GILBOA DAM, NEW YORK CITY WATER SUPPLY
Maximum height 160 ft.; gravity masonry structure. During 1922 144,000 cu. yd. of masonry were placed, 100,000 cu. yd. of excavation done and 168,000 bbl. of cement were used.



STORM KING HIGHWAY, NEW YORK
A 120-ft. cut in ledge rock around the nose of the mountain.

240,000-KW. CAHOKIA POWER STATION, EAST ST. LOUIS
Driving the cutoff wall at river face of station, employing 18 x 21-in. reinforced-concrete interlocking sheetpiles, 75 ft. long.



YANKEE BASEBALL STADIUM
Steel and concrete stands for the American League New York team. Half of structure shown. Wooden bleachers in foreground.

EMSWORTH DAM NEAR PITTSBURGH
New structure replaces old dams 1 and 2, and is first fixed dam to be constructed in Ohio River. Will greatly improve port and harbor facilities of Pittsburgh.

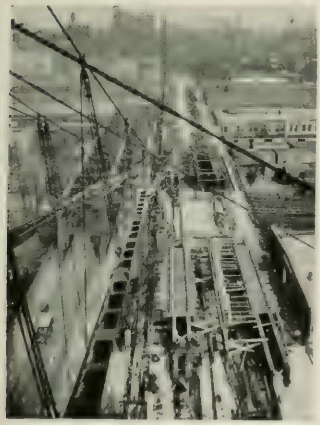
IDEAL SECTION, LINCOLN HIGHWAY, INDIANA
10-in. concrete pavement reinforced with 80 lb. of steel to 100 sq.ft.; 100 ft. right-of-way.

CHICAGO TEMPLE BUILDING
556-ft. skyscraper in business district to have church on main floor.

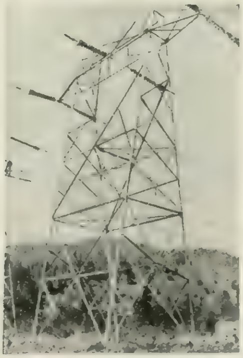
SCITUATE DAM, PROVIDENCE, R. I.
Earth fill dam for Providence water supply.

WATER TOWER AND PUMPING STATION, MANISTIQUE, MICH.

CASTLETON BRIDGE OVER THE HUDSON
Looking east from fill toward site of New York Central bridge over the Hudson below Albany.



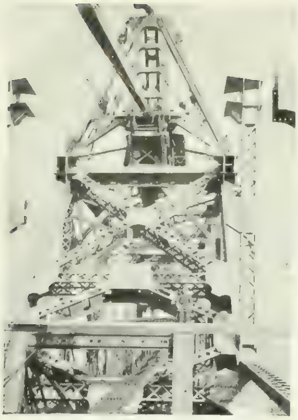
WIDENING ROOSEVELT ROAD, CHICAGO
New concrete structure doubles width of existing street over railway tracks.



SNOW TOWER FOR 200,000-VOLT TRANSMISSION LINES
Pacific Gas and Electric Co., Pit River project.

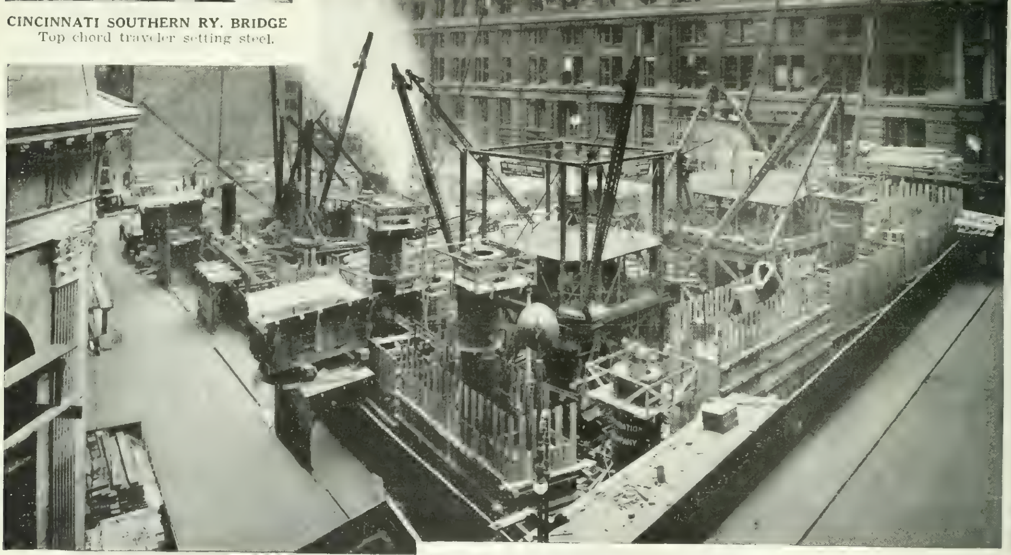
MARICOPA COUNTY CONCRETE ROAD
25 two-batch cars carrying concrete on industrial railway near Phoenix, Ariz.

MEDICAL ARTS BUILDING, DALLAS, TEX.
Reinforced-concrete structure 255 ft. from basement to roof.



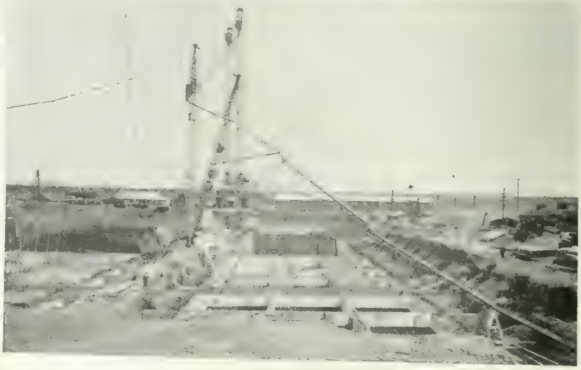
CINCINNATI SOUTHERN RY. BRIDGE
Top chord traveler setting steel.

BELLE ISLE BRIDGE, DETROIT
Cantilever arch structure rapidly nears completion.



FEDERAL RESERVE BANK, NEW YORK
Sinking compressed-air caissons for foundation.

18-MILE SHANDAKEN TUNNEL
Under construction to augment New York City's Catskill water supply by utilizing flow from Schoharie watershed, 100 miles north of city.



PHILADELPHIA SEWAGE WORKS
Building Imhoff tanks by gravity chuting.

The Mississippi Problem in Light of the 1922 Flood

Arguments Favoring Spillways on Lower River and a Defense of the Levee System—To be Followed by Hydrologic Records of Floods on the River

In May and June of 1922 the Mississippi River below Cairo rose to the highest levels in the history of the river. Following the subsidence of the water there were many demands for a new study of the flood protection problem and several authoritative expressions of disagreement with the established method of control, that is, by levees. The most generally expressed demand was for spillways in the lower river, namely in the vicinity of New Orleans. The following series of articles is intended to eliminate this phase of the river control problem. They comprise, first, the argument for the spillway by a group of New Orleans engineers and second, a defense of the Mississippi River Commission's established method of control and an argument against the spillway by probably the leading authority on the river, Col. C. McD. Townsend, long president of the Mississippi River Commission. A third article giving the hydrologic record will appear in an early issue.

New Orleans Engineers Recommend Spillways Near City

AN ENGINEERING sub-committee of the "Safe River Committee," composed of 200 men from New Orleans and vicinity, has prepared and circulated a report on the Mississippi control situation as it affects the lower river. This is in effect a plea for spillways and a condemnation of the policy of the Mississippi River Commission to resort to levees as the sole means of protection. The committee was composed of John Klorer, city engineer of New Orleans, *chairman*, Prof. W. B. Gregory, of Tulane University, A. M. Shaw, consulting engineer, J. P. Kemper, civil engineer, Hampton Reynolds, general contractor and Allison Owen. The main part of the text is as follows:

The engineers forming this sub-committee are all members of this community, and all have the welfare of the city and state at heart. All have the highest regard for the ability of the Mississippi River Commission and the Engineer Corps of the U. S. Army. Some of the members of the committee have, in the past, firmly believed in the methods of control of the Mississippi River as advanced by the Mississippi River Commission, and have subscribed to the policy of "levees only" until the occurrence of the recent high water, while one, at least, for many years has advocated spillways as a method of relief.

Due to the peculiar conditions that obtained during the flood of 1922, more fully described hereafter, doubt has developed in many minds as to the soundness of the policy of "levees only." A study of the data has presented arguments in favor of a spillway for the protection of New Orleans that are apparently unanswerable. The problem is a large one, and only a limited amount of time has been available, due to individual duties and the brief period in which this report must be prepared. It is presented, therefore, as embodying our findings with present knowledge and with the assurance that our minds are open to conviction if errors can be shown in the data or the deductions.

High Water Records Over-Topped—The history of high waters in Louisiana has been one of recurring record-breaking floods. Unlike St. Louis, the metropolis of the upper Mississippi, we cannot look into the past as far back as 1844 for our highest water record. It seems that each eight or ten years the highest water record at this end of the valley is superseded by a new high-water elevation. When it became known in 1914 that the Mississippi River Commission had finally concluded as to what was going to be the ultimate high water, the people of Louisiana took heart at the prospect that the upward tendency of levee grades had finally come to an end. Their disappointment can therefore be imagined when the rising tide of the 1922 flood not only obliterated the 1912 highest water records, but overtopped the "ultimate high water" elevation from 0.5 ft. to 1 ft. at Natchez, Red River Landing, Baton Rouge and Plaquemine, and certainly would likewise have overtopped it at Donaldsonville and New Orleans, except for the lowering effect of the crevasses below the city. But what was more disconcerting was the fact that the record breaking stages on the lower river were attained this year, notwithstanding a stage of 1 ft. below the previous record at Cairo, and 4 ft. below the record at Memphis, and 2 ft below the record at Helena and 15 and 20 ft., respectively, below the record at Louisville and Cincinnati on the Ohio. It must be concluded therefore that insofar as future floods are concerned, the 1922 flood height can by no means be considered as the ultimate high water elevation.

Channel Not Enlarged—There seems to be no doubt on the point that the expected enlargement of the channel of the Lower Mississippi has failed to materialize. The most ardent advocate of the levee system is hard pressed, after two decades of the application of the levee theory, to prove that the river has not even lost some of its cross-section area. It is true there has been some increase in the river discharge at Carrollton during the period referred to, but this increased discharge is wholly attributable to the increase in gage height and slope, and not to any enlargement of the bed of the river. This statement admits of no argument, for the 1,000,000 sec.-ft. that passed the city with the gage reading 16 ft. 25 years ago, still passes the city at no lower reading on the gage.

The committee believes that there is no part of the Mississippi River from Cairo to the Gulf upon which the confinement theory can be said to have been given a fairer trial than that part of the river from Baton Rouge to the Forts. The cross-section, to begin with, was more ideal than that of the upper river, and the channel-enlarging effect expected from levees should have been more pronounced in this section of the river, on account of the practically uniform and comparatively close distance from the edge of the bank at which these structures have been erected. Yet, recent high waters, those of 1920 and 1922 show, if anything, an impairment of the discharge capacity and this year with the highest water of record, we find that the maximum discharge quantities of previous floods have not even been equalled. (Fig. 1).

The community is therefore confronted with the stubborn fact that the provision for passing greater river discharges must be made by either increasing the high water cross-sectional area of the river through raising the levee heights, or by providing lateral openings in the shape of spillways controlled to operate only at a certain agreed upon elevation of the river.

Approved Grade Too Low—Your committe believes that the present Mississippi River Commission grade is not sufficiently high to protect the city adequately against future floods. This grade is equivalent to 25 ft. on the Canal St. gage. Had there been no crevasses and had there been unfavorable winds it is likely that the 1922 high water reading in front of New Orleans would have been nearly 24 ft. on this gage instead of 22.7. A margin of 1 ft. between the approved grade and a deduced water line of a past flood is not considered sufficient freeboard to afford protection against floods of the future.

Difficult to Build Levees Higher—If protection is to be afforded by levees alone, then the consequent raising of the levee grade above the present approved Mississippi River Commission grade, brings us face to face with a problem in construction already beginning to make itself noticed on the lower river.

There is no lack of evidence that the supporting power of the soil along the river banks from New Orleans down and even for a distance of 30 or 40 miles above the city, is being tested nearly to its load limit by the size and weight of the present levees erected on these banks. There has not been a new levee erected in the past ten years within the above limits that has not shown indications of settling foundation.

The records of the Board of State Engineers show that as the natural elevation of the ground decreases, the sustaining power of the soil also decreases and although a levee 20 ft. high may be built without subsidence when the ground surface is, let us say 25 ft. above Gulf level, a levee 12 ft. high cannot be built where the ground surface is 5 ft. above Gulf level without experiencing two or three feet subsidence during construction and continued slower subsidence thereafter. How aggravated this physical condition may become in future levee construction when building to a grade of say 3 ft. higher than the present grade, or how critical such a tendency to subsidence may become in times of high water due to an increment of saturation added to the embankment resting on a softened base or foundation "must give us pause."

Foundation Defects Disclosed at High Stages—The higher floods for which provision is to be made with the higher levees of increased section, often disclose foundation defects for which no provision has been made nor can well be made. To illustrate: the Ferriday levee on Lake Concordia, which failed this year through a foundation defect, showed no weakness in the previous high water when the Natchez gage read 53.5 ft. but "blew out" when the same gage read 55 ft. The foundation under the Hymelia levee that broke in 1912 withstood without suspicion a stage of 20.3 on the Canal St. gage, the previous highest water, but blew out when that gage read 21.5. Nothing was done to this levee in the interval from 1903 to 1912 except to add to its height and cross-section. What levee foundation might have blown out in 1922 had the river stage reached one foot higher, no one knows.

Difficulty of Closing Crevasses—Higher levees to hold out higher waters entail another drawback, and that is the relatively greater destruction caused by their failure, should they fail. The difficulty of closing a crevasse is almost in geometrical ratio with respect to the depth of the water. A crevasse in a levee holding out 5 ft. of water can be closed without difficulty at slight expense; if the levee is holding out 10 ft. of water it may be closed at a great expense; if there is 15 feet of water it cannot be closed at any expense because the time necessary to complete a structure adequate for the purpose would exceed the usual time taken for the river to get back within its banks.

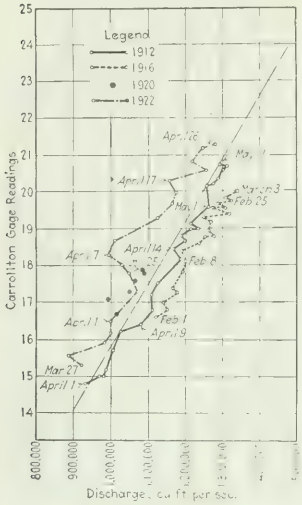


FIG. 1. GAGE-DISCHARGE AT CARROLLTON

Showing observations on the Mississippi for floods of 1912, 1916 and 1922.

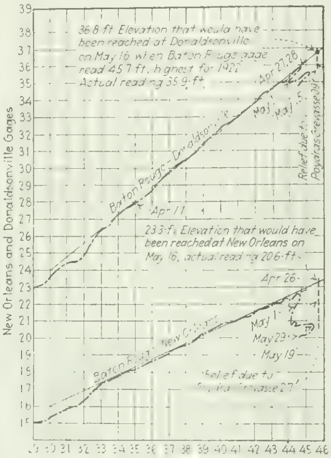


FIG. 2. EFFECT OF POYDRAS CREVASSE ON NEW ORLEANS GAGE

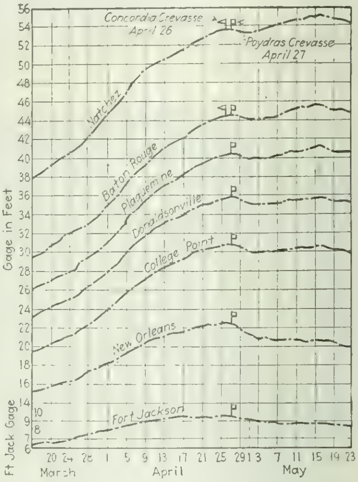


FIG. 3. HYDROGRAPHS OF 1922 FLOOD ON LOWER RIVER

Lower dotted line in Fig. 2 is Baton Rouge gage plotted against New Orleans gage. Lower full line is slope of this gage-relation before Poydras break. Theory advanced that if break had not occurred New Orleans would have been 23.3 gage on May 16 instead of 20.6, difference of 2.7 ft. being relief due to break.

With the above facts before us—being developments of a levee system with progressively higher grades—it is necessary and important that a flood relief device for lowering flood heights should invite attention and study.

Relief from Poydras Crevasse—The committee believes that the oft-expressed statement that "the relief in flood height afforded by crevasses is negligible and local in extent," was not borne out in the case of the Poydras crevasse, which in width and volume could hardly be classed with such crevasses as Belmont or Nita, or the later Hymelia, but on account of discharging practically into tide level, caused a reduction in flood height, actual and in prospect, of nearly 3 ft. at New Orleans within a period of two weeks. (Fig. 2.) The committee furthermore believes that the lowering effect of the Poydras crevasse on river gages instead of being local is traceable as far up the river as Donaldsonville and as far down the river as Fort Jackson, a combined length of river of 160 miles.

The committee believes that there is room for doubt in the generally accepted statement that the sedimentary material carried in suspension is at all times to the limit of the river's capacity to so carry material. This is an assumption that the opponents to the spillway theory have used with telling force in discussing this question, the line of reasoning being as follows: The operation of a spillway will cause steeper slopes and greater velocities in that part of the river above the spillway and flatter slopes and slower velocities in that part of the river below the spillway; That the silt-transporting power of a stream varies as the sixth power of the velocity, consequently any reduction in slope is followed by a reduction in velocity and will cause a reduction in the silt-transporting power of the stream to a surprising degree, with the result that material carried in suspension is deposited in the main channel below the spillway and in a short time will form a bar or will reduce the cross-section of the river below the spillway to such an extent that the cross-section area of the river below the opening plus the area of the spillway will be no greater than was the area of the river before the spillway was constructed.

It is acknowledged that if such were the case, namely, that if the slightest reduction in the velocity of the main stream would cause a deposition of the sedimentary matter carried in suspension, then it would be futile to pin any hopes of getting permanent relief by means of a spillway.

Silt Carrying Data—In the absence of any readily available published data bearing upon this important point, your committee consulted the records of the New Orleans water purification plant where daily observations are made of the turbidity of the raw water, and has platted results which it is believed will be interesting to students of the Mississippi River. (Fig. 4.) The intake of the pipe to this plant is located at the lower end of the mattress-protected Carrollton Bend at an elevation of about 4 ft. below low water elevation, and the pipe is carried on a trestle extending more than a hundred feet beyond the shore line. The samples taken from a pipe located as above described, are believed to be fairly representative of the condition of the Mississippi River water with respect to its content of suspended material.

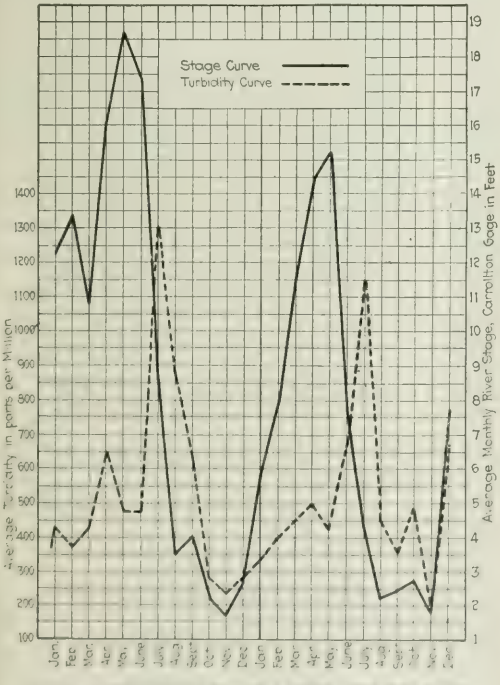


FIG. 4. TURBIDITY STAGE ABOVE NEW ORLEANS

To show that turbidity in river at New Orleans waterworks intake has no relation to stage.

The chart shows that contrary to prevalent opinion there is no direct ratio between the higher gage heights and the degree of turbidity of the water during floods and the impressive fact is that the maximum turbidity in flood years occurred when the Carrollton gage was less than 14 ft. Therefore if the river is capable of carrying in suspension its maximum load of silt with slopes such as it has at stages 6 or 7 ft. below the maximum height, the fear that it may drop its sedimentary load as a result of lowering its height below the spillway may justly be questioned.

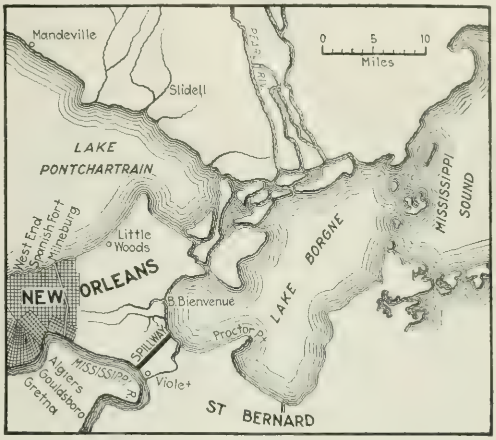


FIG. 5. PROPOSED LAKE BORGNE SPILLWAY

The committee is of the opinion that unless it can be demonstrated as a fact by measurements that a shoaling has occurred below the Poydras crevasse which cannot be removed by the ordinary flood stages of 16 ft., or less, the spillway project recommends itself and presents no difficulties in construction that cannot be overcome within reasonable cost.

Proposed Spillway—To obtain the greatest benefit for New Orleans such a structure should be located as near as practicable to the city. Three locations were discussed, (a) one above the city discharging into Lake Pontchartrain, (b) one below the city, on the west bank, discharging in the bayous and bays to the west of the Mississippi, and (c) one below the city discharging into Lake Borgne.

It was recognized that a spillway of proportions ample to afford the desired relief if located above the city and discharging in Lake Pontchartrain would involve the greatest disturbance to existing lines of communication entering the city from above, and would complicate the drainage of all that territory located between the river and the lake raising the level of Lake Pontchartrain several feet. The hazard of overflow in the rear of the city in the event of a storm while the spillway was operating was also an adverse condition to be reckoned with.

A location (Fig. 5) six miles below the Barracks, on the city side discharging into Lake Borgne which is an open body of water connecting with the Mississippi Sound, was most favored, on account of its short direct route being slightly over five miles, the absence of any complicated disturbance to drainage conditions, a minimum interference with rail or vehicular communication with the territory below, and finally on account of this location involving the least cost. It was also noted that at this location the present cross-section of the river is approximately 10 per cent in excess of the cross-section of the river at Carrollton and could therefore stand shoaling to some extent should such a condition materialize following the operation of the spillway.

As to tentative dimensions and capacity, the committee suggests a width of 6,000 ft. with a discharge of 250,000 sec.-ft. when the river reaches a stage of 21 ft. on the Canal St. gage or 20 ft. at Carrollton, and with the crest of the dam fixed at an elevation of 16 ft. on the Canal St. gage or 15 ft. on the Carrollton gage.

The discharge through the spillway and the relief in flood height obtained at various stages is indicated in the statement below:

Carrollton Gage, Ft.	Canal St. Gage, Ft.	Discharge through the Spillway Cu.Ft. per Sec.	Velocity Ft. per Sec.	Relief in Flood Height at N. O. Ft.
15	16	0	0	0
16	17	30,000	5.0	0.5
17	18	65,000	5.4	0.9
18	19	115,000	6.4	1.9
19	20	180,000	7.5	3.0
20	21	250,000	8.3	4.2

It is estimated that such a flood protection measure can be completed at cost of between $4,000,000 to $5,000,000 including the purchase of land for right of way, construction of side levees, river bank protection work at the location of the spillway, concrete spillway, protective aprons and creosoted timber bridge for existing railroad and highway communication.

Recommendation—The committee does not advocate the construction of the spillway in lieu of undertaking the raising of the levee line to the Mississippi River Commission grade. Its recommendation is that the spillway should supplement the proposed levee construction as an additional factor of safety not sufficiently provided for by levees built to existing standard grades. It knows of no instance in this country or in Europe where the superelevation of the crest of a dam above past high water heights is as little as in the case of Mississippi River Levees. In the absence of any topographical area near this city sufficiently elevated that might serve as a refuge for the thousands of persons who would be driven from their homes in the event of an overflow, the protection of this city against inundation by the flood waters of the Mississippi River is the paramount necessity facing this community. Conservatism in this regard cannot be excessive.

Why the Spillway Will Not Solve The Mississippi Problem

By C. McD. Townsend

Colonel, Corps of Engineers U. S. A. (retired); formerly President, Mississippi River Commission, Brooklyn, N. Y.

After the flood of 1912, I submitted to the Mississippi River Commission a paper on various methods of controlling floods (published in Vol. VII of the Memoirs of the Corps of Engineers, U. S. Army) in which I express the following opinion:

> In applying these principles to spillways in the vicinity of New Orleans, it is to be noticed that the conditions governing the flow of water through a spillway differ materially from those through a crevasse or outlet. When a crevasse occurs there is a violent change in the regimen of the river. The flow through the crevasse at first suddenly accelerates velocities above it and retards them below.
>
> A sudden increase in velocity is conducive to scour, and the formation of sand waves. The retardation of velocities below the crevasse tends to cause a deposit both of the sand waves and of the material intermittently in suspension. But, due to the frictional resistance of the river bed, this scour and fill is confined to a comparatively short distance, and as soon as the reservoir capacity of the river adjusts itself to the new conditions abnormal velocities both above and below the crevasse cease.
>
> As soon as the flood subsides to a bank full stage, there is a tendency for the river to return to its normal form filling the channel scoured above the crevasse and removing the deposits below.
>
> When the river rises above the crest of the spillway, no sudden change will occur either in the reservoir capacity, slope, or velocity. Above it the slope and velocity will gradually increase; below, they will also increase, but the increment will be less, and, due to the proximity of New Orleans to the Gulf, and absence of any tributaries to the river below that city, the changes in these increments will not be as great as are liable to occur at localities further up the river from the sudden inflow from tributaries, particularly at the mouth of the White and Arkansas Rivers.
>
> A spillway also differs from an outlet in that the outlet is discharging at all stages, and diminishes the flow at low water, when the crossings are being scoured, and all the water that can be utilized should be employed to increase such action. The spillway abstracts water from the river only at high stages when the crossings are filling. It will affect the amount of oscillation of the bars more than the ultimate depth of the crossings at low water.

These views were accepted by the majority of the Mississippi River Commission, which since 1912 has practically endorsed spillways properly located, as a means of reducing flood heights. In fact two spillways have been maintained, one at the head of the Tensas Basin and the other at the mouth of the Red River, both of which discharged during flood stages about 300,000 sec.-ft.

The spillway at the head of the Tensas Basin was the result of dire necessity. Its flow flooded a large area in the back parishes of the basin, but it was recognized that the levees in front of the Tensas Basin and those opposite in the lower portions of the Yazoo Basin were not sufficiently strong to resist the increased flood heights that its closure would produce. Therefore, the levee districts affected were given six years to enlarge their levees, and then at the earnest request of the engineers of the State of Louisiana, the commission authorized its closure.

The increased heights attained by the flood of 1922 in Louisiana over that of 1912, were the logical results of this authorization. However, the action of the commission in permitting the closure has been vindicated, since the levees of the Yazoo district have withstood the strain and the damage caused to planters by the discharge through the crevasses in Louisiana was small when compared to that which had been caused by the discharge through the spillway.

There have also been repeated requests to close the spillway at the mouth of the Red River, which the commission thus far has refused to authorize. The discharge from this spillway flows down the Atchafalaya River and the damage it causes to planters along that river can readily be controlled by extending its levee system. This locality furnishes an ideal location for a spillway. It materially lowers flood heights along the levees below it and its discharge causes a minimum damage to the country through which it flows. Annual dredging, however, is required to maintain a navigable channel during low stages between the Red River and the Mississippi. If this dredging were discontinued the discharge capacity of the spillway would rapidly diminish. For this reason it should be classed as a spillway instead of an outlet.

Herein I have confined myself to an examination of the project for a spillway near Lake Borgne.

Problem of Spillway—The problem of the spillway is not what will happen to the water and sediment which remain in the river, but what the discharge of the spillway and the sediment which it contains will do. The greater part of the report of the committee, therefore, has nothing to do with the case. The most ardent supporter of the levee theory will admit that when channel depths over bars exceed 60 ft. at low water, as is the case at New Orleans, the question whether levees improve navigation is purely academic, and of no practical importance. The problem of navigation by ocean vessels is confined to the river's mouth. The committee also ignores the question what a discharge of 250,000 sec.-ft. will do while passing through the spillway.

Humphreys and Abbot state that there is a difference of level of 8 ft. in a distance of 3,000 ft. from the river bank and that thence to Lake Borgne there exists a marsh which is practically at Gulf level. On a slope of 8 ft. in 3,000 heavy rainstorms will gradually create incipient gulleys even in glacial drift, as can be seen by examining any field in the northern states where such a slope can be found. The alluvium which forms the banks of the Mississippi River below New Orleans is much more subject to erosion.

While the slope at small discharge may closely conform to that of the ground, a discharge of 250,000 sec.-ft. will attain Gulf level in Lake Borgne and have an elevation of over 20 ft. at the river bank, or an average slope of 4 ft. to the mile. Such a slope can only be maintained when a river flows over a bed of rock and some conception of the force so generated can be obtained by gazing on the lower rapids of the Niagara River.

When a volume of water represented by a discharge of 250,000 sec.-ft. over a weir moves on a slope of 4 ft. per mile over the alluvium of lower Louisiana, it does not require the expenditure of $200,000 for a model river in a laboratory in Washington to foretell what will happen. Every river that flows through lower Louisiana is a better model than can be created from the soils of Washington, and nature has provided a perfect one in front of the city of New Orleans without cost, since the low water discharge of the Mississippi River at that locality is about 250,000 sec.-ft. This model teaches that when a flow of 250,000 sec.-ft. in Louisiana alluvium has adjusted its bed to its discharge, it has a slope of less than 0.1 ft. per mile, and an area of cross-section exceeding 150,000 sq.ft., a depth varying from 60 ft. to 140 ft., a width varying from 1,800 ft. to 2,300 ft., and a mean velocity of about 1.5 ft. per second.

In the distance of five miles from the river to Lake Borgne, it will be impossible for a river to adjust the bed to the discharge, but it will strive to make such an adjustment. The flow down the Atchafalaya River has not yet attained an equilibrium, yet channel depths of 80 ft. exist when the discharge is 250,000 sec.-ft. There is, however, little probability of this channel extending to the Red River spillway for many years on account of the large lake which is created at the lower end of the Tensas basin by the overflow.

Dangers from Spillway—It is noted that the plans of the committee provide for a creosoted timber bridge for existing railroad and highway communication, which is presumably to be located between the river and Lake Borgne. The piers of such a bridge will form a considerable obstruction to the flow of water and scour around them will result. Before a discharge of 250,000 sec.-ft. is attained, a section of the bridge will be found placidly floating on the water of Lake Borgne, and a channel similar to that which now exists in the Poydras crevasse will be in process of creation at the site of the bridge. The least dangerous solution of the bridge problem across the spillway would be a concrete structure on the weir itself, but even in such a location the piers would create irregularities of flow which would induce scour. The piers of the Eads bridge at St. Louis score the alluvium to bedrock, during floods in the Mississippi. The diameter of the particles of sand, which form the river bed at this locality, largely exceeds that of those found in Louisiana soils.

But even if it is assumed that the bridge is not constructed, when the spillway begins to discharge, irregularities of flow would be created by the protective apron of the weir, by a half sunken log or even by an abandoned fence post. Such variations of flow would start a small scour which will rapidly enlarge as the discharge increases.

A crevasse discharging 250,000 sec.-ft. rarely occurs in lower Louisiana without a hole being scoured somewhere in its path to depths of 50 or 100 ft., and if the flood is prolonged there is a decided tendency for this hole to develop into a channel at right angles to the river bank. Such action moreover takes place when the surface slope does not exceed one foot to the mile, as in the crevasses which have occurred near Lake Providence. In a crevasse the causes which produce the hole are unknown, but in a spillway the protective apron to the weir would create a scour, and if by any chance the unknown causes which create a hole 100 ft. deep in a crevasse should begin operations in the scour started by the apron, serious consequences would result.

The settlement of levees described in the report of the committee does not usually result from a movement of the surface soil, but from the squeezing out of a layer of clay of a muddy consistency from 10 to 20 ft. below the levee. Such a settlement is usually accompanied by a raising of the surface of the ground in the vicinity. In constructing a levee across the lower end of Lake Providence, the settlement created a banquette 12 ft. high, lifting up with it cottonwood trees 2 ft. in diameter. When the Lake Beulah crevasse was closed the ground rose behind the levee to an elevation higher than the banquette.

I have no knowledge of the nature of the subsoil in the vicinity of Lake Borgne. There is, however, a possibility that the marsh which exists around the borders of the lake originally extended to the Mississippi River, and that the banks of the river have attained their existing heights from sediment deposited during overflows. Under such conditions the soil would be of a character similar to that described by the committee and the erosion of the surface soil would expose a soft strata to a pressure both from the weir and from the river, without an opportunity for an equilibrium to be established by an elevation of the land surface.

A concrete weir 8 ft. high will exert a pressure on its foundation equal to that of a high levee, since concrete weighs considerably more per cubic foot than earth, and the weight is concentrated on a narrower base. In this connection attention is invited to the statement of the committee which is considered of such importance that it is printed in double-sized capitals, that "foundation defects are disclosed only at extreme stages when it is not practicable to correct them." If foundation defects should occur under the weir when it was discharging 250,000 sec.-ft. and the flood stage was 21 ft., it is pertinent to inquire what would happen to it.

I do not pretend to solve such a problem, but I do predict that if a portion of the weir should happen to slide into the hole that had been excavated, a Poydras crevasse would also exist at the site of the weir, and that the only thing that would prevent the Mississippi River from creating a new outlet would be the narrow marsh between the weir and Lake Borgne over which a flow exceeding 400,000 sec.-ft. would be concentrated by the levees of the spillway. Whether the Poydras channel would be excavated to Lake Borgne would depend on the duration of the flood after the break in the weir occurred. There is a possibility that the weir may stand but the chances favor its destruction.

A weir of the cross-section adopted by the committee for computing the discharge is a hazardous experiment even before the water begins to flow over it. It has a width of base about ten times its height, and a smaller factor of safety against percolation than the levee section adopted by the Mississippi River Commission for firm soils. In the alluvium of lower Louisiana, dangerous sand boils are not infrequent during floods, where the path followed by the water is 20 times the head.

There is also a strong probability that even if the weir remained upright after discharging 250,000 sec-ft. for a month, such a scour would occur in the spillway that the people of New Orleans would become panic stricken. Neither an academic discussion of the influence of spillways nor an experiment with Washington soils then would satisfy them. They are too familiar with the treacherous character of Louisiana soil from building construction within the city.

How High Should Levees Be?—But while the arguments of the committee are considered irrelevant in discussing a spillway at Lake Borgne, they have a bearing on the important question of the *elevation to which levees must be constructed to resist future floods* and therefore merit analysis.

The committee invites attention to a fact long known to river engineers that the amount of sediment carried by the river in suspension at New Orleans bears an obscure relation to flood heights, but they appear to be ignorant of the cause of the phenomenon. The explanation is simple. The Missouri River flowing through the bad lands of Montana, and the prairie soils of the western states is more saturated with sediment than the Ohio River which derives its discharge from a hilly country. In the one a large component of the sediment is a light clay, in the other a heavy sand. The stage curve submitted by the committee (Fig. 4) conforms to the discharge curve of the Ohio River and the turbidity curve to that of the Missouri River though both are modified by the inflow from other tributaries. When a river discharges either clay or sand, deposition takes place at any stage if the velocity is checked, but the amount deposited in a river transporting clay is greater than in one transporting sand.

They also emphasize another well-known fact, that the river discharge at a given stage constantly varies. A river's discharge is dependent not only on the area of its cross-section but also on its slope. Another important factor is the reservoir capacity of the river bed. These two factors have caused a variation of 30 ft. in the flood heights of the Ohio River at Cairo in discharges attaining a height of 50 ft. at Cincinnati. Humphreys and Abbot state that they have reduced a flood discharge at Cairo about 400,000 sec.-ft. when it arrived at Natchez.

When slope is ignored, the published discharges of the Mississippi River can be utilized to prove almost any proposition by a skillful selection of discharges. For example, on Fig. 1 of the committee's report the discharge of 1916 when compared with that of 1912 as conclusively proves that the river is enlarging its cross-section as that of 1922 proves that the bed is filling. The stage at Cairo exceeded 50 ft. twenty-two days during the flood of 1912, twelve days during the flood of 1916, and fifty-five days during the flood of 1922, a sufficient cause for gentler slopes on the lower river during 1922 than in preceding years, without taking into consideration the inflow from tributaries.

Levee Margins—The emphasized statement of the committee that "a margin of 1 ft. between the approved grade and a deduced water line of a past flood is not considered sufficient freeboard to afford protection against floods of the future" is true (the commission prescribes 3 ft.) but the means adopted to arrive at such a conclusion are open to criticism. The only statement that cannot be questioned is that the flood of 1922 attained a height on the Carrolton gage 3 in. above that of 1912. This is 0.9 ft. lower than the height the commission estimated floods would attain at New Orleans after the levee line was completed.

Any attempt to determine flood heights after the slope of the river has been disturbed by large crevasses is futile. The committee submits diagrams (Fig. 2) in which they appear to assume that the flood of 1922 would have culminated at New Orleans on May 16 instead of April 26 if no crevasses had occurred in the levee lines. If the gages on the upper river are examined it will be found that the flood culminated at Vicksburg, the lowest river gage unaffected by crevasses on April 18, and if no break had occurred in the levee line a hydrograph similar to that at Vicksburg would have been transmitted down the river to New Orleans, though modified to a certain extent by the discharge through the spillway at the mouth of Red River. The assumption that a crest of a flood is propagated in one day from the mouth of Red River to New Orleans, a distance of 192 miles, is approximately correct but it is absurd to assume that it required seventeen days for the same crest to move from Vicksburg to the mouth of Red River, a distance of only 170 miles. Something must have occurred in that stretch of river during the interval to seriously modify the river slopes. That something is the Concordia crevasse of April 26, which ultimately discharged over 600,000 sec.-ft. into the lower end of the Tensas Basin. The Atchafalaya River has a discharge capacity of about 400,000 sec.-ft., and the surplus water had to find an outlet either over the levees of Red River or through its mouth. The crests of the hydrographs of May 15 and 16 from Red River Landing to Donaldsonville have resulted from a secondary rise in the Mississippi having superimposed upon it the discharge from Red River. If the crevasse had not occurred, instead of water flowing from the Red River into the Mississippi when the second rise reached lower Louisiana, the Red River spillway would have been discharging about 300,000 sec.-ft.

Under such conditions the crest of the flood would have passed New Orleans by May 3 and its hydrograph published in Fig. 3 clearly indicates that the flood of 1922 if confined between levees would not have exceeded the crest of April 26 at New Orleans by more than 6 in., and would still be 3 in. below the height which the commission estimated that the confined flood of 1912 would have attained at that locality.

No two floods have the same slope and discharge, and in establishing a grade line, normal conditions during a great flood have to be employed. Local variations exceeding 1 ft., however, are to be expected. To provide a factor of safety for such variations and for errors in estimates, the commission has recommended the construction of levees to an elevation 3 ft. above the estimated heights of floods, which corresponds to the one meter provided in European levees. Along the fronts of large cities a factor of safety which would result from constructing levees to a height 5 ft. above the flood line is warranted, but in a levee system 1,800 miles long, where local authorities are resorting to excessive taxation to establish the grade recommended by the commission, such a factor of safety would be an expensive luxury.

Lessons From Flood—The principal lesson to be derived from the flood of 1922 is the vital importance of maintaining the existing spillway at the mouth of the Red River. When the levee line is completed to commission grade, there is a possibility of floods at New Orleans attaining a height exceeding those estimated by the committee, if that spillway should be closed. It limits the discharge below it to about 1,500,000 sec.-ft., which, under normal conditions, would be reduced at New Orleans to 1,450,000 sec.-ft., by the reservoir capacity of the river.

New Orleans is not yet as safe from the floods of the Mississippi River as Boston, as was proclaimed by a league of business men prior to the flood of 1912, but there is less danger of a crevasse occurring at this locality than in any other part of Louisiana below Vicksburg, if the existing project of the Mississippi River Commission is completed.

What Cities Must Spend Annually for Their Water Supplies

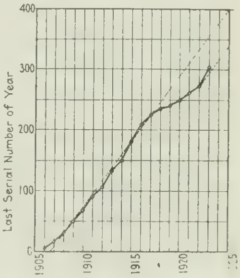
REASONING from prewar figures of cost, compiled by the Bureau of the Census, corrected by present day indexes, the average city of 100,000 people must spend about $5,200,000 for new water-works construction during twenty-three years, the period in which it will double in population. Since there are about twenty million people in the 105 cities of more than 30,000 population in the census referred to, the average annual expenditures for these 105 cities is $45,000,000. Charles B. Burdick, consulting engineer, Chicago, gave the basis for these figures in a recent paper presented to the Iowa Section of the American Water Works Association. Further abstracts from his paper are as follows:

> The latest available United States census statistics, which refer to prewar conditions, indicate that the average investment in municipal water-works is $32.60 per capita of the cities supplied. The average operating expense was $1.48 per capita. Allowing 6 per cent for interest on the investment, and 1 per cent for depreciation, the fixed charges would be $2.28, making the cost of water $3.76 per capita, including operation and fixed charges.
>
> At the present time our works are operating upon a higher scale of prices, although somewhat lower than those obtaining two years ago. Cast-iron pipe, which is the largest item in water-works construction, was worth about $25 a ton at Chicago before the war; $85 at the peak early in 1920, and about $49 at the present time—100, 355, and 200 per cent respectively as compared with the prewar basis. Common labor, using 1915 as the 100 per cent basis, increased to about 225 per cent on the average, and has receded to a little under 200 per cent. Other items entering into the cost of water-works are, however, now upon a lower price basis, particularly construction costs, which were very high and uncertain two years ago. Recent appraisals of several plants in detail indicate a total price basis approximating 160 per cent as compared to 100 per cent prewar. Applying this ratio to the census figures indicates that at the present time new water works construction costs not less than $52 per capita.
>
> The review of operating expenses presented by Leonard Metcalf in the September *Journal* of the American Water Works Association indicates that the per capita operating expenses probably approximate 175 per cent at this time as compared to a 100 per cent prewar base, and, therefore, probably approximate in the neighborhood of $2.60 per capita per annum. Seven per cent to cover interest and depreciation on $52 per capita investment is equivalent to $3.64, which added to the present operating expenses makes the cost of water about $6.24 per capita, or approximately 170 per cent of the prewar figure.

Water-Supply Permit Applications in New York State, 1905-22

By Russell Suter
Senior Assistant Engineer, Water Control Commission, Albany, N. Y.

STATE approval prior to construction has been required in New York State for most new water-supply projects since 1905 and for all such projects since 1907. This jurisdiction has been exercised, successively, by the Water Supply, Conservation, Water Power and Water Control Commissions. Although not the best measure that could be devised, the number of such applications received within a year parallels somewhat the water-supply activity during that year and a plotting of these numbers from the beginning (see cut) seems to give a reasonably accurate picture of the effect of the war and of the present conditions in this particular field.



WATER-SUPPLY PROJECTS IN NEW YORK STATE

Serial number of final application of each year is plotted as a solid line. This gives an approximately straight-line with an average of 21 applications a year up to the close of 1916. The dotted line indicates that the applications for the six years ending with 1922 had fallen behind the equivalent of three years normal progress.

Somewhat remarkable general uniformity existed during the normal period from Jan. 1, 1908, to Dec. 31, 1916, showing a yearly average of about 22 applications. Slacking up due to the war is most marked, reaching its maximum at the end of 1921, when the actual progress was 60 applications short of the average.

Demand for the construction of these delayed projects, intensified by the dry weather of 1920 and coupled with marked decline in interest rates, construction and material costs, caused increased activity during 1922, but this was curtailed early in the season by the abrupt increase in the price of cast-iron pipe, lesser increases in other costs and difficulties in getting deliveries of material.

Future progress probably depends more on the price of pipe than on any other one factor. Even greater demand exists than is shown by the curve, as many projects approved since 1916 have not yet been constructed. Whether the ground lost will be recovered seems doubtful and perhaps when conditions become stabilized a lesser rate or progress will prevail.

At present water-supply permits in New York State are granted by the Water Control Commission, composed of the conservation commissioner, attorney general and state engineer.

Irrigation Opportunities and Duties of Federal Government in Western Land Reclamation

May Reclaim 20,000,000 Acres More, or Ten Times Present Accomplishment—Human Problem Dominant—Further Development Rests on Government Action

By F. H. Newell
Chief Engineer 1902-1907, then Director to 1914, now
Consulting Engineer, U. S. Reclamation Service

THE public domain, which rightly may be considered as the heritage of all the people, is held in trust by the Federal Government. Until the government disposes of this estate its duty and responsibility in administration must continue. By far the largest part of this property is in the West where are 180,000,000 acres of vacant public land. Here for many years to come the opportunities and corresponding duties of the government will be greatest. Up to a comparatively recent date the attitude of Congress has been that the development of these resources was the proper subject of private initiative. Under this policy, vast areas were donated to individuals, to corporations, or to states for various objects. Some of the states promptly disposed of these lands. Thus enormous tracts were acquired under different laws, or passed to individuals by reason of evasion of law and laxity in administration.

During the quarter of a century preceding the enactment of the Reclamation Law, Congress was importuned to undertake the development of the public domain, but aside from investigations, surveys, and withdrawals of some reservoir sites, no definite step in this direction was undertaken until 1902. Meanwhile, the West had gone through several periods of exploitation in connection with state and private enterprises, the majority of which left the promoters bankrupt and disillusioned. These undertakings absorbed most of the attractive opportunities for development. Upon the entrance of the government in the field, its engineers were compelled to take up projects which, by reason of natural obstacles, interstate and legal complications, and relatively high costs had been passed over by others.

Success of Government Reclamation—The success which has followed the completion of the government reclamation works is due to causes readily understood. The investment bears no interest, and the settler acquires at cost the water for his land. In the case of private enterprise the accumulation of interest and overhead during the period of construction and of settlement of the land frequently equalled the construction costs, with resulting bankruptcy for the promoters, whose works, however, were not necessarily failures except financially. Liquidation enables the farmers to acquire the property at low valuation; in many instances prosperous and permanent communities have been established which are aiding in building up the state. The national projects, burdened with no interest and seeking no profit, could wait for the coming of the settler, and when necessary could defer repayment of the annual installments on cost until the crop production enabled the farmer to make these.

It has never been the policy of the government to interpose obstacles in the way of private capital seeking to promote irrigation. On the contrary, it has done everything possible to aid by topographic surveys and water measurements, grants to states under the Carey Act and other ways. Many attempts were made by exploiters to hold up construction by filing on reservoir or dam sites, by claiming water rights and by other methods; and in many instances the government, temporarily at least, withdrew from the field.

May Reclaim 20,000,000 Acres More—Inasmuch as most of the remaining cultivable lands of the West are arid and can be developed only by the construction of works of even greater magnitude than those already built, and as private enterprise can see no legitimate reward for the risk, it is obvious that future development of these areas can be brought about, if at all, only through government agencies. Possibly 20,000,000 acres more can be reclaimed—furnishing homes for a half million families.

The problems of national reclamation are varied, numerous, and often complex. The types of many of the larger structures were quite new; they called for a venture into the unknown. Inaccessibility of location, the necessity of highways in mountainous regions, erratic character of the streams, management of construction camps remote from food and material supplies, building of railways, telephones, power plants, and a thousand and one other needs, have taxed the ingenuity of the builders and have developed initiative and efficiency not called for on works of this nature in the midst of established communities.

Human Problem the Greatest—The greatest problem of reclamation, and its most important one, is not wholly solved. It is the human problem. From the outset this was so recognized, and efforts have been made continuously to devise methods of solution. The problems have become more complex by reason of omission in the organic law creating the Reclamation Service. This did not provide authority for selecting the farmers who should acquire the land after reclamation. In every instance after the lands were opened to reclamation, the incoming tide of homeseekers carried a considerable percentage of those who lacked capital or experience adequate for the hard task of pioneering. The right to file on the land could not be denied to the citizen. The main qualifications were that he had not previously used his right, and did not own 160 acres of land somewhere else. While it is a matter of gratification that under these circumstances the failures were so few, yet it can not be questioned that the entry of so many of those who were unfit brought needless suffering and privation and has retarded the orderly progress of land development.

Apparently no useful purpose has been served by the Government in issuing to the homeseekers the warnings as to the requirements of physical strength, experience, and capital, necessary to meet the vicissitudes of life in a new country. The proportion of those unqualified for such life, who appear at every opening of new projects, has not fallen off thereby.

Since the inflation due to the war's aftermath, the need for a new phase of engineering has arisen, in order that a more definite understanding of the human equation on the projects may be obtained. This work takes the form of an economic survey, which has just been undertaken by Secretary Fall, and which it is hoped will disclose certain facts and factors now unknown, or at least not well understood.

The Present Dilemma—The plan of the national reclamation, unique in that it provides for the return of the investment of federal funds by the beneficiaries, is little appreciated by the public. The government occupies the position of creditor; the farmers are debtors. In times of prosperity the collections are easily made, but in times of distress, like the present, a different story is told. To a certain extent the debtors are justified in assuming that their creditor—the government—will not oppress them. Which horn of the dilemma shall the government take? If, in answer to the plea of some of the debtors for a general postponement of charges during the next few years, it brings about a cessation of present works and a postponement of future undertakings, what will be the fate of the present engineering organization, built up by many years of earnest and efficient work? What of the thousands of settlers who have been waiting on the desert for the waters necessary to make their lands productive? On the other hand, if the government insists upon the collection in its entirety of the just debt, and by so doing forces its debtors into bankruptcy, what then?

Fortunately, the situation is not as serious as might be inferred. On a few of the projects conditions are known to be bad financially. Partly at least, this is blamable upon the easy credit offered to the farmers; but mostly it may be attributed to the same causes which are affecting our agriculture elsewhere. Bad crops are not one of the causes. The 1922 harvest is perhaps the largest known, but with corresponding low values. With prices below production costs, with markets shot to pieces, or with transportation facilities wholly inadequate, the plight of the farmers on some of the projects is deplorable, but not worse than that of farmers elsewhere.

The Larger and More Far-Looking View—The arguments for additional government construction or activity in reclaiming the waste lands of the West, or of any part of the country, whether in public or private ownership, must be based primarily, *not* on immediate financial gains, but on the larger and more compelling needs of the country for opportunities for more homes, for creating these homes wherever they may be well located, especially in the less densely settled parts of the country. Such reclaimed places serve primarily as homes of citizens, and, secondarily, as rallying points for innumerable industries; they form the base upon which may be erected the fabric of the commonwealth.

The great need of the United States for the present is not for more wealth, but for more self-sustaining small farm homes from which comes the manhood of the nation. President Harding, in his first address to Congress on Dec. 6, 1921, states: "The base of the pyramid of civilization which rests upon the soil is shrinking through the drift of the population from farm to city. For a generation we have been expressing more or less concern about this tendency. Economists have warned and statesmen have deplored." While it will be difficult to produce any notable change in this direction so far as the East is concerned it is practicable to take advantage of the attraction which the West offers, and to create there, with less opposition, conditions which will add to our rural life and which will build up a rural population in accordance with the ideals of many statesmen.

To repeat: It is not the money-making side which should be emphasized in this connection but the higher, more far-reaching needs of the commonwealth, which should be met by making available on these waste lands the opportunities which have been enjoyed up to the present generation by the homeseekers who could go West and take up fertile government lands. Such opportunities as those following the Civil War no longer exist because the good prairie plow-lands have been taken up but similar chances may be created through the vision and skill of the engineer, who, carrying out the thought contained in his designation—that is, "the man of ingenuity" can remove the obstacles which nature has interposed, and can make many of these waste places suitable for human occupation.

A Corps of Skilled Engineers Developed—The government has already developed this skilled body of engineers who, through the expenditure of over $130,000,000, have constructed works which are already furnishing water to nearly 2,000,000 acres, of which 1,200,000 acres were cropped in 1922, with a gross production of $50,000,000 for that year, and of $475,000,000 in the years 1906 to 1921. The acreage return of these crops exceeds the average of the farm lands of most of the states of the Union. In spite of low prices and difficulties of transportation the farmers of these government projects are better off as a whole than their brethren elsewhere. Enough has been done under government direction to demonstrate that work of this kind is being and can be carried on with economy and efficiency.

All notable progress in the development of the West, whether of public or private lands, now practically rests upon governmental action. Experience has shown that the individual states cannot or will not undertake this work. One reason is that many of the projects are interstate, or involve legal questions which cannot be readily solved. But more important is the fact that the western states are relatively poor; they do not have the necessary funds for the work; nor have they been able to develop a continuity of purpose of engineering organizations such that the people have sufficient confidence to tax themselves to undertake great projects within the state. All are appealing to the national government to utilize its resources in money and men made capable by years of experience in successfully handling these large problems, not solely for money-making but for the higher ends for which the government exists, for stabilizing the government and its institutions and for the better insuring of "life, liberty and the pursuit of happiness."

Southern Pacific Adopts 110-Lb. Rails

In adopting the 110-lb. rail section of the American Railway Engineering Association the Southern Pacific Ry. is said to be the first road west of the Mississippi River to adopt a rail of such weight as its standard. The railway has ordered 50,000 tons of rails of this section from the Tennessee Coal, Iron & Railroad Co.

Traffic—A Major Engineering Problem

Two Articles on the Growing Demand on the Engineer to Solve the Difficulties of Travel on Both City Street and Country Road

City Traffic Regulation

By E. P. Goodrich
Vice-president, Technical Advisory Corporation, New York

STREET traffic regulation in the United States practically started with the placing of policemen on Broadway, New York City, about twenty years ago largely to protect pedestrians against the near-criminal action of the truckmen who used the roadway. Besides reducing profanity and protecting pedestrians against accident it was soon discovered that traffic was materially expedited, vehicle accidents reduced and money saved to vehicle owners thereby.

At first there was opposition to the extension of the police power when directed explicitly toward newly discovered benefits but in the course of several years the public saw the benefits elsewhere secured through traffic regulation and no protest was made or has since been registered. Thus the regulation of traffic under the police power has grown from the idea of crime prevention so as to include accident prevention and the expediting of travel. The introduction of these two ideas carried traffic regulation into fields distinctly within the province of the engineer.

Early Manual Control—At first regulation was purely manual on the part of the police officer. Even in some of the larger cities the manual method is exclusively used today; Cincinnati may be cited as an example. Inventive ability soon saw the ease of applying mechanical signaling devices to the problem and scores, if not hundreds, of patents have been granted in increasing numbers for traffic-control devices. Naturally, the earlier devices were somewhat crude. In one city large beach umbrellas were supported in light standards and had the words "Stop" and "Go" painted at the proper points on the canvas. The traffic officer stood beneath the umbrella and turned it through angles of 90 deg. by a handle attached to the stick. Sometimes he had to step out from under his protection in order to see which way his signs were pointing.

Much experimentation has been made by various cities with different devices, a traffic survey of Cleveland disclosing four different types along Euclid Ave. With the lapse of time devices have been becoming more and more complicated, primarily with the objective of extending the zone of control. The Fifth Ave. tower type is well known and has been adopted in such other cities as Detroit and Atlanta. In Atlanta additional lights suspended over the street intersections have been installed for several blocks in each direction along the streets which meet at the central tower. All the distant lights are operated simultaneously from the tower. Throughout the central business district in Los Angeles a system of combined semaphores and lights has been installed upon special posts directed at each curb corner. These are operated from a central station so that traffic is controlled throughout a considerable area.

The manual system has the advantage over mechanical systems thus far put into operation that traffic can be controlled so that it is almost continuously moving in all directions at all times, whereas the mechanical system introduces alternate stopping and starting at frequent intervals. In Springfield, Mass., the traffic officers control manually as many as 750 vehicles per hour at congested intersections more satisfactorily than is the case in some other communities where the mechanical system is used with much less traffic.

Field for Improvements—Considerable improvements still seem possible in perfecting the mechanical systems. These will call for expert engineering knowledge on the part of structural engineers, mechanical engineers, electrical engineers and illuminating engineers. In addition to securing mechanical, electrical, structural and luminary improvements it is believed that the most fertile field of possible betterment lies in a radical change of the method of control. Instead of using the "stop-and-start" or "block" system it has been shown to be entirely possible to effect regulation by what may be designated a "platoon" system. Under the latter scheme traffic would move in platoons or companies from end to end of a thoroughfare in each direction, such movement being controlled by a system of semaphores operated from a central station practically on the principle of the well known railroad block signaling system. Cross traffic at principal intersections can be handled in the same manner and so interlocked with that on the first mentioned street that vehicles once joining a company need never stop while moving in any given direction along any thoroughfare except under emergency conditions, such as fires, traffic accidents or similar contingencies in connection with which the traffic officer could intervene as occasion demanded.

Reducing Traffic Accidents—In the field of accident prevention there is opportunity for engineering ability in several directions. Automotive engineers can still further improve the accelerating power and the efficiency of vehicle brakes so as both to expedite travel and diminish accident. The investigations in Cleveland made with reference to the proportional number of accidents during daylight and night hours has conclusively demonstrating that the illuminating engineer has a great opportunity to improve street lighting fixtures and efficiency, especially at congested points and bad intersections so that accidents will be materially reduced.

The advent of the "silent policeman," especially of the flashing light type, has helped in this direction. Large mirrors, redlighted "mushrooms," unlighted red glass reflectors, and other schemes are being successfully introduced and the possibilities of improvement seem almost limitless. Co-operating with the illuminating engineer in the improvement of such devices as those above mentioned the highway engineer has enlarged the radius at curb intersections, improved sewer inlet designs, bettered the tractive efficiency of pavements without sacrificing pavement smoothness, improved grades and cross sections at difficult side hill and other intersections and otherwise contributed to easing traffic movement.

Traffic Economics—The subject of economics is coming more and more to the front in highway and pavement design and has been found to be one of the important elements in traffic regulation. The creation of "one-way" streets, the segregation of different kinds of traffic on parallel thoroughfares, the detouring of through traffic to avoid delays at congested points are all based primarily upon economic motives. Their study and further analysis is eminently an engineering problem. Traffic tallies, estimates of time lost through delays and a comparison of the enhancement in value of real estate, all compared with estimated costs of construction, showed that the introduction of a diagonal street in Newark, N. J. would pay for itself within a period of five years. A proposed cut-off street in Philadelphia would save certain through travel a distance of seven miles. The City of Worcester, Mass., was estimated to be losing $6,300 per day through delays, due to traffic congestion, which would largely be reduced by the creation of a diagonal thoroughfare, the estimated cost of which, including the taking of real estate, would be much less than the capitalized value of the daily community loss.

Whether to widen a main downtown congested thoroughfare by the setting back of expensive building fronts, by the arcading of sidewalks within the first floors of buildings or the relieving of the congestion by the creation of parallel thoroughfares through the less valuable centers of blocks is an economic problem constantly confronting city planning engineers—and one which should be answered along the lines indicated only after exhausting the possibilities of effecting congestion relief by increased stringency of traffic control, if the best economics of the problem are to be considered.

Highway Traffic Engineering

By Howard H. Parsons
Traffic Engineer for Erie County, N. Y.

PRODUCTION of motor vehicles, increasing from over a million cars in 1916 to two and one-half million in 1922, has resulted in a correspondingly large number of accidents on highways to persons and property. Law enforcement alone will not decrease the number of accidents, nor the damage done. The problem requires, first, adequate traffic planning, and, second, proper enforcement and regulation according to the plan as advised.

Traffic engineering is simply the application of those fundamental principles of engineering to traffic which bring organization and efficient movement out of disorder. Traffic engineering, by a study of each specific problem, reduces accidents and damages, and tends to result in an even flow of traffic on roads designed especially to meet the required tonnage. Careful investigation of traffic in the past has shown that 75 per cent of general accidents is due to causes which invite accidents, and that 90 per cent of the damage done to highways is through overloading of trucks on highways not constructed heavily enough to carry such traffic. By taking a traffic census on the various roads and by careful computations will be found the cost per ton mile. In the future, types of roads can be selected to carry best the kind of traffic permitted. The selection of the type and the width of any given new highway to be built should be based upon trained observations of traffic with reference to the number of cars and the tonnage. Where it is seen that the traffic is too congested and the road can be widened and improved, then the traffic engineer's recommendations are of great value. Should there be a parallel road, the traffic can be segregated by proper notice and routing. This, too, is a problem for the traffic engineer.

Highways should be properly sign-posted. The carelessness of the general motorist lies in not expecting or looking for obstructions, stub ends of roads, bad turns, steep grades, intersecting roads, railway crossings, etc. If all of these are properly and adequately posted, the element of accident is lessened.

The promiscuous lighting of highways by town and village boards should also be regulated. The height of lights above the road, as well as the character and power of lights should be uniform. As it is now, the lights are being placed too low and at points where, due to the shadows cast, driving is hindered instead of benefited.

Another subject is the regulation of speed. Our state law limits the rate of speed in incorporated villages to 15 miles per hour, and on all other highways outside of villages to 30 miles per hour. If traffic is to be expedited, more intelligent speed regulations must be devised.

Law enforcement alone cannot regulate all of the traffic evils. There must be whole-hearted co-operation by all highway users. In 1921, there was approximately 2,000,000 traffic accidents, with about 43 per cent of the accidents occurring at night, so one readily sees that 24-hours-a-day traffic protection and regulation is necessary.

The Traffic Census—On Nov. 21, 1922, a 24-hour-day traffic census was taken in the Village of Lenmore, N. Y. During the 24 hours, a total of 5,989 vehicles passed the checking point. Of these, 1,225 were trucks, or about 21 per cent of the total vehicular traffic, and only 2 per cent horse-drawn traffic. The total tonnage of vehicles, computed by taking the average weights of the different classes, was found to be 8,600, or approximately 3,000,000 tons per year. Then, a computation of the cost per 100-ton-miles, based upon the original cost of the road as 5 per cent bonds carried over a period of 20 years and the average yearly cost of maintenance, gives a cost of 16.2 cents per 100 ton-miles. Traffic censuses such as this taken on the several different through-routes will eventually show what the correct type of construction and the proper width of a new highway must be, as well as the amount of money which it is justifiable to spend.

The life of a $2,000 car is about 100,000 miles, or 2c. per mile, on good roads; 80,000 miles, or 2.5c. per mile, on fair roads; and 3c. per mile on poor roads. Then, taking 2 to 3c. as a vehicle mile expenditure, 2,000 vehicles per day would justify an annual expenditure of from $15,000 to $20,000 per mile. However, the true estimate of the expenditure can be more accurately computed on the traffic census basis where the tonnage is considered.

The above are just a few of the various branches of the main subject of traffic engineering, and as the advancing motor traffic brings out new industries and new ideas in transportation,, so will traffic engineering bring into play its usefulness to assist in the overcoming of the difficulties which will naturally arise with this certain advancement.

A Résumé of Criticisms of the Joint Committee Report

Abstract of the High Points in the Discussion of Concrete Specifications Being Prepared for Final Submission

The Progress Report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete was presented to the constituent societies in June, 1921, in the form of a tentative specification for concrete and reinforced concrete. The structures covered in the specification included all types of buildings and retaining walls. Since the appearance of this Progress Report, considerable discussion has taken place in the societies represented on the Joint Committee, and among engineers and contractors generally. The nature of the discussion and the points most prominently considered reflect, to a considerable degree, those elements in reinforced-concrete construction which are receiving deepest consideration at the present time by thoughtful engineers acquainted with standard practice and the results of recent experimentation. It is the purpose of the present article, by an engineer who has had an opportunity to study most of the discussions, briefly to summarize the main issues under discussion developed through the issuance of the Progress Report of the Joint Committee.

PERHAPS no feature of the Joint Committee report received greater attention than the proposed clauses covering the proportioning of concrete mixtures. Three alternate methods of specifying the quality of concrete were offered, any one of which was to be selected at the discretion of the engineer who was making use of this specification. One of these methods proposes specification of concrete by the strength to be attained in a given period of time. A second method calls for predetermination of the strength of the concrete by tests of various mixtures of the materials to be used in the work, and based upon these tests, to specify the concrete for the work by the proportions shown by the preliminary test to be most satisfactory. The third method is the one now generally in use, in which the proportions of the ingredients entering into the concrete are arbitrarily fixed.

The discussion centering around the possible use of the first of these three methods, namely, the specification of concrete on the basis of resulting strength, irrespective of how this strength is acquired by the builder, has been both stormy and voluminous. It is contended by many that considerable improvement in the quality of concrete work can be obtained through exercising a more vigorous control over the proportioning and mixing of the concrete than at present obtains on average work. It is thought by many that such a clause in a specification would make it difficult for those contractors to obtain concrete work of consequence, who were not properly versed in the art, or who did not give proper thought and study toward obtaining satisfactory work.

It is pointed out by many engineers and contractors that the manner in which the concrete to be obtained is specified involves the respective duties of the engineer, on the one hand, and the builder, on the other, toward obtaining a desired quality of concrete in the finished structure. Some say it is the duty of the engineer to make tests from the materials which the contractor has to use on the work, and from these tests, to determine the proportions which he will put into the specifications by which the builder is to carry on his work. Others hold that the builder is undertaking to erect a structure, and that it is his responsibility, rather than that of the engineer, that the concrete which the builder puts into his structure be of a quality of a specified standard. It is agreed by many, holding either of these views, that there is room for considerable advancement in the study of the art, so far as proportioning and control are concerned, and that any clause which will require greater study and more careful performance of this phase of the work, is unquestionably a progressive step.

There is a feeling among some engineers and builders that the proposed clause to specify concrete by resulting strength, is logical and possible, and will ultimately be the prevailing form of specification, but that there still remains considerable study and experimentation, chiefly on the part of contractors, before this method can come into universal use without undue pressure on any of the parties to the work. In the meantime, it is obvious to these men that great interest has been aroused among engineers and builders, and a very great deal of study is now being given by builders and engineers to work out satisfactorily field methods and practical control features to obtain desired results with a fair certainty of ability to predetermine these results.

It is recognized that in many portions of the country the proportions usually considered to produce 2,000 lb. concrete in 28 days produces really 1,400 lb. or 1,500 lb. concrete. Ultimately the strength advances to 2,000 lb. or better. Consideration must therefore be given to the selection of the strength to be attained in the required time.

Test Requirements—It has been proposed that in the event the required strength of concrete is not obtained in the construction, further tests on the completed structure are to be made at proper intervals, and, if necessary, special means of curing resorted to, to bring the structure up to the desired strength.

Several schemes have been discussed for conducting field control tests during construction. The slump test is suggested for controlling moisture content or consistency. Cylinders made at the same time from concrete about to enter the forms, form the basis of strength control. It is suggested that half of these cylinders be stored alongside the point in the structure where sampling took place, and the remaining specimens be stored under laboratory conditions of temperature and moisture. Tests of these cylinders would be made periodically from both lots.

It is believed by many that the variation among cylinders of the same age and make-up is so great as to prevent a sufficiently accurate judgment of the average strength being obtained without a large number of specimens being tested. To make workable such a scheme of tests, it would necessitate, it is claimed, a tolerance or permissible variation below the required specified strength, within which some given percentage of the cylinders tested would be permitted to fall.

It is recognized that in many cases the duration of the concreting operation is short, and hence the results of field tests would not, in some instances, be of use in further adjustment of the proportions. In such instances it would necessitate accurate knowledge on the part of the builder, prior to construction, of the materials from which his concrete is made.

Comparison With Building Codes—Another subject which has been given wide consideration is the cost of structures designed under the proposed design regulations of the Joint Committee specification, as compared with practice permitted by various city building codes.

Building codes, unfortunately, are not the direct result of test data, as interpreted by a committee having wide representation, but are the results of interpretations by as many groups as there are building codes. Furthermore, these codes are the result of work done at different times and hence based on varying amounts of available research data. The Joint Committee proposals, as to design, are based upon more recent data than are any of the building codes, and yet they too are arrived at independently without directly following any of the existing building codes.

The result of such procedure is that the Joint Committee's proposed specifications for design coincide in some instances with certain building codes, and in other instances, vary considerably therefrom in one direction or the other.

It has been pointed out repeatedly that the requirements of the Joint Committee would increase the cost of a reinforced-concrete building, of typical form, by something like 5 per cent over the cost of the same building constructed under the New York Building Code. In the one instance of columns alone, some critics have pointed out that the Joint Committee requirement increases the cost of the columns something like 30 per cent. Other engineers, from other parts of the country, call attention to the fact that this is perhaps not so important as it may seem because building codes of other cities can be shown to require a more expensive building than the Joint Committee requirement would produce. It is even pointed out that in some cases, the Joint Committee has been more liberal in column design than the building code for that particular city.

Thoughtful engineers see in this discussion a more important element than that of the commercial viewpoint. They realize that because one city permits a liberal design of column, and experience to date in that city does not disclose any failures traceable to this source, considerable weight should be given to the success of such liberality. On the other hand, they are not inclined to place entire reliance upon such seeming success when column safety factors are undetermined, and existing tests do not support such liberal design.

Waterproofing — The Joint Committee undertakes recommendation of waterproofing for concrete structures. Among the clauses on this phase of the work is a provision that integral compounds shall not be used. At the present time, integral waterproofing compounds are used by many engineers and builders. Few subjects in concrete construction are held in such variance of view as is the effectiveness of waterproofing by the integral method.

Some engineers inquire whether a distinction is made between inert admixtures to the concrete, and those compounds which are held to react with the lime in the cement to produce a water repellant coating of the particles or a sealing of the pores in the mass. Some engineers prefer to invest the equivalent amount of money that might thus be expended in additional cement, and still others hold that unless the waterproofing treatment will waterproof cracks subsequently formed in the structure, as well as the mass itself, there is little cause for its use. The discussion brings out the general admission that too few engineers understand waterproofing compounds and their effectiveness.

Expansion Joints—The Joint Committee recommends the placing of expansion joints in buildings every 200 ft., where the length exceeds twice the width. Many engineers call attention to a great number of buildings of much greater length performing satisfactory service without any expansion joints. Some engineers have the erroneous theory that additional reinforcement will resist the tendency of the concrete to expand or contract through temperature change. Many engineers suggest 300 ft., others 400 ft., as the proper maximum spacing of expansion joints in buildings. The lack of thorough evidence, and the variety of personal opinions point to the need for study of this important subject.

In summing up the discussion arising from the progress report of the Joint Committee, it is evident that interest has been aroused along lines of interpreting into practical building methods the results of experimentation. Out of it must come more extended knowledge of the uses of concrete, and, in general, considerable progress in the development of the art.

Status of the Government Concrete Ships

THE concrete ships built by the United States Shipping board during the war are not now in service, with the possible exception of one which has been sold to private parties. Two of the ships were lost at sea; the others are tied up at piers. The present status of the ships is given in the accompanying table from the Shipping Board.

CONCRETE VESSELS CONSTRUCTED FOR UNITED STATES SHIPPING BOARD EMERGENCY FLEET CORPORATION—NOV. 4, 1922

Name	D.W.T.	Type	Builder	Date of Delivery	Remarks
Atlantus	3,000	Cargo	Liberty S. B. Co. (Ga.)	11-11-19	Made 6 coastwise voyages. Now tied up at Claremont
Cape Fear	3,078	Cargo	Liberty S. B. Co. (N. C.)	11-19-19	Made one voyage to West Indies and W. C. S. A. Sunk 10-29-20.
Cuyamaca	6,313	Tanker	Pacific Marine Constr. Co.	9-17-20	Made 7 voyages Gulf Mexican Trade. Now tied up Mobile.
Dunsmore	7,500	Tanker	A. Bentley & Sons	1-31-21	Never made a voyage. Now tied up Mobile.
Latham	7,500	Tanker	Fred T. Ley & Co.	5-18-20	Made 2 voyages in Gulf Mexican Trade. Now tied up Mobile.
Moffitt	7,500	Tanker	A. Bentley & Sons	3-15-21	Never made a voyage. Now tied up Mobile
Palo Alta	6,171	Tanker	San Francisco S. B. Co.	9-18-20	Never made a voyage. Now tied up San Francisco
Peralta	6,171	Tanker	San Francisco S. B. Co.	1-31-21	Never made a voyage. Now tied up Alameda.
Polias	3,500	Cargo	Fougner C. S. B. Co.	10-23-19	Made 3 coastwise voyages. Grounded off Chilly Ledge, Me. Total loss.
San Pasquale	6,298	Tanker	Pacific Marine & Constr. Co	10-18-20	Made 5 voyages Gulf & South-Pacific Mexican Trade. Now tied up New Orleans.
Sapona	3,000	Cargo	Liberty S. B. Co. (N. C.)	1-14-20	Made 5 coastwise voyages. Now tied up Claremont
Selma	7,500	Tanker	Fred T. Ley & Co.	[illegible]-20	Made one voyage Gulf Mexican Trade. Sold by Insurance Div. 3-14-22.

News of the Week

Program for Annual Meeting of Am. Soc. C. E. Announced

Engineering Education, Research and City Planning Will Be Chief Topics

The seventieth annual meeting of the American Society of Civil Engineers will be held in the Engineering Societies Building, New York City, Jan. 17-19. Discussions on the opening day will be devoted to engineering education. An excursion will occupy the second day. A series of talks on city planning will be heard on Jan. 19. Prior to the opening of the engineering discussions honorary memberships will be bestowed and the various society medals and prizes awarded.

On the morning of Jan. 17 the annual meeting will be called to order by the president of the society, John R. Freeman. Transaction of business and reports of committees will then follow. Honorary membership will be conferred on Leon Jean Chagnaud, Paris; Sir Maurice Fitzmaurice, London; Clemens Herschel, past-president of the American Society of Civil Engineers; John Frank Stevens, New York; and William Cawthorne Unwin, London. The following awards of medals and prizes will be made: The Norman medal to Charles H. Paul, for his paper on "Core Studies in the Hydraulic-Fill Dams of the Miami Conservancy District;" the J. James R. Croes medal to William Cain of Chapel Hill, N. C., for his paper on "The Circular Arch Under Normal Loads;" the Thomas Fitch Rowland prize to Gustav Lindenthal, consulting engineer, New York City, for his paper on "The Continuous Truss Bridge Over the Ohio River at Sciotoville, Ohio, of the Chesapeake & Ohio Northern Ry;" and the James Laurie prize to Arthur T. Safford and Edward P. Hamilton for their paper on "The American Mixed-Flow Turbine and Its Setting."

During the afternoon session in which special attention will be given engineering education, the society will have a joint meeting with the Society for the Promotion of Engineering Education. Charles F. Scott, president of the latter society; and William G. Raymond, dean of the College of Applied Science of the University of Iowa, will be the principal speakers. Discussions will follow. During the afternoon other phases of engineering education will be taken up by Magnus W. Alexander, consulting engineer of the General Electric Co., and managing director of the National Industrial Conference Board, and by John L. Harrington, consulting engineer of Kansas City and president of the American Society of Mechanical Engineers. On Thursday evening, Jan. 18, the smoker will be held, preceded by an address on "Transportation Keyed To Production," by Julius H. Barnes, president of the U. S. Chamber of Commerce.

Engineering research will be the subject of the meeting on Friday morning, Jan. 19. Arthur N. Talbot, past-president of the American Society of Civil Engineers; Alfred D. Flinn, director of the Engineering Foundation, and chairman of the division of engineering of the National Research Council; George K. Burgess, chief of the division of metallurgy of the U. S. Bureau of Standards; and Otto B. Blackwell of the American Telephone & Telegraph Co., will be the chief speakers. During the afternoon of Jan. 19 at the session on city planning Nelson P. Lewis, consulting engineer, New York City; Linn White, chief engineer of the Chicago South Park Commission; Morris Knowles, chairman of the Pittsburgh City Planning Commission and head of the engineering firm which bears his name; and George H. Norton, city engineer of Buffalo, N. Y., will present the chief discussions.

The president and honorary members' reception will be given the evening of Jan. 17 at Delmonico's. The reception will be followed by a dinner dance.

Through the courtesy of the Bethlehem Steel Co., Lehigh University, Rodgers and Hagerty, Inc., contractors, and of the Chamber of Commerce of Bethlehem, Pa., the society will make a visit to that city on Jan. 18, to inspect the Hill-to-Hill bridge and the Bethlehem Steel Co. plant.

Railroad Bridge Across Newark Bay Finally Authorized

Secretary of War Weeks, on Dec. 30, gave final approval of the plans of the Central Railroad of New Jersey for a bridge across the lower end of Newark Bay to replace the present trestle and drawbridge. This marks the end of a long and determined effort of the City of Newark to prevent the construction of the bridge permit for which was first given some years ago. The city contended that the bridge, in spite of a wide lift span across the channel, would form an obstruction to the marine traffic seeking the port of Newark, and an effort was made to force the railway either to tunnel the bay, at expense many times that of the bridge, or to divert its main line above the the city's main port. Secretary Weeks' approval letter says that the railroad plans provide, in the way of drawbridges, ample openings for navigation, particularly as the channel to Newark is otherwise far from perfect.

Presumably, work on the bridge will be started immediately. Its cost is estimated at $9,000,000.

More Power at St. Paul

Plans have been announced by the Northern State Power Co. in St. Paul, Minn., that that company is about to start a ten-year construction program involving the expenditure of $80,000,000 for steam electric and hydro-electric power in northern Minnesota. The first unit is a new steam plant on the banks of the Mississippi at St. Paul, to which it is intended to bring the coal by barges up the Mississippi. The second unit is a hydro plant on the St. Croix River near St. Paul and will not be built until next year.

Seven Indicted for Fraud in War Camp Contracts

Federal Grand Jury Charges 50 Overt Acts Against Former Members of Emergency Construction Committee

Seven former members of the Emergency Construction Committee of the Council of National Defense have been indicted by a federal grand jury in Washington charging defendants with fraud in connection with contracts for the erection of cantonments, port terminals, warehouses and fortifications during the war. Those indicted are:

Benedict H. Crowell, former Assistant Secretary of War and President of the construction firm of Crowell-Lundorff-Little Co.

William A. Starrett of New York, architect and engineer, member of the firm of Starrett & Van Vleck.

Clemens W. Lundorff of Cleveland, vice-president and general manager of the Crowell-Lundorff-Little Co.

Clair Foster, formerly associated with the George A. Fuller Co., New York City, and the Thompson-Starrett Co., New York City, and during the war a major in the Engineer Corps.

Morton C. Tuttle, general manager of the Aberthaw Construction Co., Boston.

James A. Mears, of Boston, formerly with Fred T. Ley & Co.

John H. McGibbons of Baltimore, representative of a bonding company.

The indictment, which is the first to result from alleged fraud growing out of the cost-plus system of contracts, does not detail various and specific acts of the defendants. However, defendants are charged with conspiring to defraud the government by unlawfully delaying and hindering the administration of the laws and policies and procuring, to be paid to contractors for building army cantonments, sums of money in excess of what was reasonably earned and due under the contracts.

The indictment further recites that the defendants "conceived the fraudulent scheme and plan of getting control, for their own gain, profit and benefit, and for the gain, profit and benefit of their past and future clients and employers and their friends, of the administration of the immense emergency construction program of the United States during the war, including the determination of the policy to be followed, the form of contract, grossly, unconscionably and fraudulently favorable to the contractors, and in a like manner and to the same extent unfavorable to the United States."

Belgium Present Stanford "U" With Hoover Statue

Through an official representative Belgium has dedicated at Stanford University, Palo Alto, Calif., a bronze statue in recognition of the services rendered to that country during the World War by Secretary Hoover, who is a graduate of the California institution.

Dust Explosion Damages C.P.R. Grain Elevator

The Canadian Pacific Railway's concrete grain elevator in West St. John, N. B., was badly damaged Dec. 20 by spontaneous combustion of grain dust. The explosion occurred on the bin floor which is situated at the top of the concrete walls. Above the concrete walls the sheathing was shattered. Some of the conveying tubes were also badly damaged but the machines did not appear to have suffered to any extent. Following the explosion fire broke out in three or four of the bins where thousands of bushels of grain were stored. This, however, was easily extinguished.

The elevator is of a 1,000,000-bu. capacity and was practically full at the time of the explosion.

Drainage Contractors Approve Standard Specifications

At the annual meeting of the Levee & Drainage Contractors Association, held in Chicago on Dec. 28, it was voted to appoint a committee to co-operate with a committee of the National Drainage Congress in a final revision of standard specifications for excavation work. This joint committee will select an attorney to pass upon the legal features of the specifications as already adopted by the Association. A special feature of these specifications is an arbitration clause which is expected to avoid much litigation over disputes arising during construction.

The address of the president, R. H. McWilliams, dealt with the proposed amendment of laws in Alabama and a constitutional amendment in Louisiana to facilitate drainage development and the marketing of securities of drainage districts. Another matter considered briefly was the securing of lower rates for contractors' second-hand equipment when shipped from one job to another. This question is being taken up with the Interstate Commerce Commission. Officers were re-elected as follows: President, R. H. McWilliams of the McWilliams Dredging Co., Memphis, Tenn.; secretary, C. S. Gannon, Arcade Building, St. Louis, Mo.

Cornell Engineers to Hold Annual Reunion

The seventeenth annual dinner and reunion of the Cornell Society of Engineers will be held at the Fifth Avenue restaurant, 200 Fifth Ave., New York, Jan. 19, 1923. All Cornell men are invited. President Livingston Farrand and Dean Dexter S. Kimball will speak. Carroll R. Harding, president of the society, will be toastmaster. Moving pictures from Ithaca will be shown.

Short Course for Texas Water and Filter Plant Operators

The fifth short course for Water and Filter Plant Operators in Texas will be held at Dallas, Jan. 15 to 20, 1923, under the auspices of the Dallas Health Department, with the Texas Board of Health and the Texas Water Works Association. The director of the school will be Dr. W. T. Davidson, director public health, Dallas, from whom particulars may be obtained.

George Sears Greene, Jr.

George Sears Greene, Jr., whose death was noted last week in these columns, was formerly a director, treasurer and vice-president of the American Society of Civil Engineers, and well known as a consulting engineer in New York City and as former chief engineer of the Department of Docks. His father was one of the twelve organizers of the American Society of Civil Engineers, and served for many years as director and from 1876 to 1877 as its president. His son, Carleton Greene, is a present director of the society.

Mr. Greene was born in Lexington, Ky., in 1837. He entered Harvard University in 1856 but left before graduation to study civil engineering under his father. His early professional experience was gained on the Croton Aqueduct, where he was employed as assistant engineer, on various Cuban railroads, and in copper mines in the Lake Superior region.

In 1875 Mr. Greene became engineer-in-chief of the Department of Docks of New York City, a position which he held for twenty-two years. During that time he designed and built the bulkhead or sea wall which surrounds a large part of Manhattan Island. Mr. Greene also originated, designed and partly completed the Chelsea Improvement on the North River between Charles St. and 23rd St. This consisted of the excavation of a strip of filled-in land covered with factories and other buildings about 3,100 ft. long by 400 ft. wide, which now accommodates the 800-ft. piers occupied by steamship lines.

From 1911 to 1914 Mr. Greene was a member of the board of advisory engineers of the State Barge Canal, during which time the Scotia, Delta and Hinckley dams were constructed, as well as the Medina Aqueduct.

Mr. Greene also was an inventor, having invented the drifting head which is in use on all engineers' transits.

He was a member of various technical and social clubs in New York and an honorary member of the American Institute of Architects.

Defective Supporting Timber Causes Concrete Collapse

A curious accident occurred in the concrete building being built for James Butler at Nelson and School Sts., Long Island City, on Dec. 9. In this reinforced-concrete building the floors are carried on columns about 18 ft. center to center. Forms to carry the concrete second floor were supported by trusses resting on uprights footing on the first floor. One of these uprights came directly over a scale pit about 4 ft. 6 in. square, and to receive it an 8 x 8-in. timber had been placed across the pit. It turned out that this 8 x 8-in. timber was defective, containing a large knot and when the concrete for the floor form was being poured the 8 x 8 broke, dropped the upright and its supported truss, and consequently pulled down the forms and the fresh concrete floor for an area of about 60 ft. square.

Engineering Employment Steadily Increases; Salaries Rise

Engineering employment has been getting better every month during the past year, according to the employment department of the American Association of Engineers. Each month there was a smaller number of unemployed; and many made fairly lucrative connections. During December employment was comparatively dull due to the usual year-end pause.

For the next year, there is every indication that a big shortage of technical men will be experienced, especially during the first few months. Already the demand for designers on all classes of work is far below the supply, with a larger demand certain as new work is started.

Conditions in all sections of the country are fairly good. A slight pause in employment is noticed in the northwest and northern sections but when construction opens there will be plenty of employment. The southwest and southern sections are booming with practically no unemployment. In the central states the demand has already exceeded the supply. Conditions in the East are fair. There is probably a larger number of unemployed in the East at this time than elsewhere.

The following table shows the trend of employment:

	Nov. 1922	Oct. 1922	Nov. 1921
Applications for employment ..	1,379	1,232	1,661
Positions received	336	425	335
Men referred.....	977	1,277	1,639
Men placed......	130	161	193

Salaries for the past year have been on a gradual increase in the more basic positions. Where an electrical engineer was receiving $200 at the beginning of the year, the same position is now paying about $220. Where a structural engineer was receiving $225 at the beginning of the year, the same position is carrying a salary near $250. Most of the salaries that were decreased are in the county and municipal fields, occasionally on industrial and manufacturing work, and some railroad positions.

The average salary for graduates was considerably higher last year than was the average before the war. The graduate in 1914 was receiving a salary on an average of $60 to $75 a month. Last year's graduates received on an average $125 a month.

Concrete Arch of 125-Ft. Span Collapses

According to a brief preliminary report in *Beton und Eisen* of Nov. 28, a rib of a 125-ft. three-hinged concrete arch span under construction over the Bigge River near Siegen, Germany, collapsed on Nov. 3 just after centers were struck. The span was to consist of four ribs carrying an open spandrel deck construction. The crown and skewback hinges were of the plate or spring type. Before striking centers the apparent weakness of the concrete, due to failure to set properly, had been remarked upon. After lowering the centers the rib remained standing free of the centers for half an hour, but then collapsed completely. The accident happened during the noon hour, and in consequence there were no casualties. A full report of the circumstances and causes must await more complete investigation.

Fifth East River Bridge Planned by New York City

New Crossing Between Manhattan and Brooklyn to Be Located at Eighth Street—To Serve Road Traffic Principally

Plans were laid before the Board of Estimate of New York City on Dec. 29 for a new city bridge across the East River, to serve the rapidly growing highway traffic between Manhattan Island and the Boroughs of Brooklyn and Queens. Grover A. Whalen, commissioner of Plant and Structures, in submitting the plans, asked for an appropriation of $200,000 to make borings and surveys and to prepare detailed plans. The general project, however, has already been worked out quite fully, as two drawings reproduced herewith indicate.

At the location selected, Eighth St. (Manhattan), the river is somewhat wider than at the site of the three suspension bridges farther downstream, the Brooklyn, Manhattan, and Williamsburg bridges, the longest one of which has a main span of 1,600 ft. Accordingly, the new bridge will require a span of 1,800 ft. between centers of towers which will be longer than any existing suspension bridge span in the world and exceed by 50 ft. that of the Philadelphia-Camden bridge, now under construction. Structurally it will follow the general type of the Manhattan bridge, the last built of the existing suspension bridges, in having steel towers with fixed base and parallel-chord stiffening trusses continuous from tower to tower and from tower to anchorage. As in the Brooklyn and Manhattan bridges, also, the shore spans will be loaded. The plan shows diagonal stay cables like those of the Brooklyn bridge, which are said to have proved thoroughly satisfactory in that structure. There are to be four cables, carrying a double-deck floor 97 ft. wide center to center of outer stiffening trusses and 114 ft. wide over sidewalks. Two-thirds of the floor space is given over to roadway use, the total width of the four roadway spaces being 118 ft. The stiffening trusses are 30 ft. deep.

While no explorations have been made, it is expected that rock will be encountered at depths not exceeding 100 ft. at the tower and anchorage sites. Basing the substructure calculations on such a depth, the estimate of cost of the structure complete amounts to $27,000,000 (including approaches). Real estate costs will amount to an additional sum of $14,820,000 (properly figured at present assessed valuation). This sum includes more than $9,000,000 for approach roadways, however. The full scheme, including all approach roadways and one item of street widening at some distance from the bridge, amounts to $41,820,000.

Essential features of the approach roadways are a wide boulevard on the Manhattan side, extending back to Fourth Ave. and embracing the block width between Eighth and Ninth Sts.; a large plaza on the Brooklyn side; two street extensions leading from this plaza through the blocks to existing main thoroughfares (Bushwick Ave. and Meeker Ave.); and a viaduct approach connecting the bridge with the Greenpoint district, crossing over McCarren Park. These items of terminal development have been provided in accordance with the traffic demands as shown by experience with the present bridges, including the Queensboro cantilever bridge at 60th St.

Provision of the unusually large roadway width on this bridge (as compared with 57 ft. of roadway on the Queensboro bridge) reflects the fact that the bridge is built essentially for roadway service, and that none of the existing bridges has sufficient roadway capacity to meet the peak-load demand at the present time. Traffic growth has greatly exceeded expectations, as

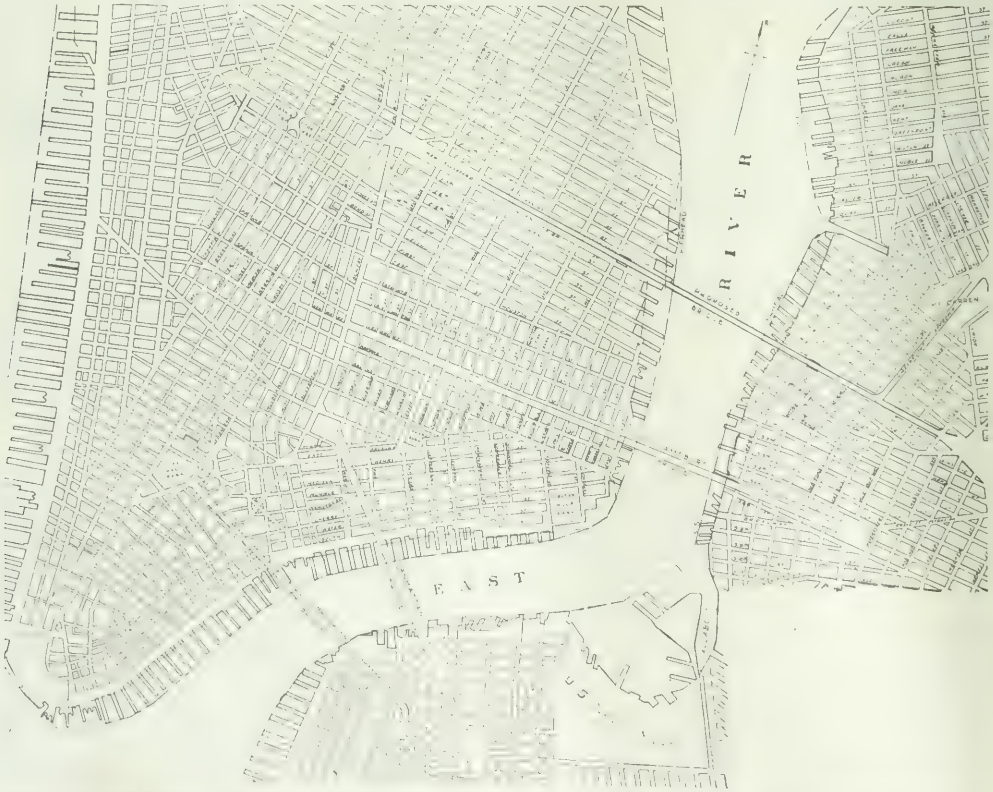


FIG. 1—EIGHTH STREET LOCATION OF NEW BRIDGE, WITH BROOKLYN OUTLETS BY FOUR MAIN THOROUGHFARES

shown by the fact that the Williamsburg bridge traffic increased in ten years from 6,000 vehicles per day to 23,000 vehicles per day, and that on the Manhattan bridge from 5,000 to 38,000. The Queensboro bridge traffic, intermediate between the two, has shown similar growth. Vehicle traffic over the Brooklyn bridge has always been of much smaller volume, on account of the fact that the bridge accommodates only a single line of traffic in either direction, and has decreased since motor vehicles were barred from the structure last summer in order to segregate horse and motor traffic in the interests of developing maximum bridge capacity. The aggregate traffic capacity of the four bridges is at present fully taxed during peak hours, and congestion often occurs, particularly in the approach roadway.

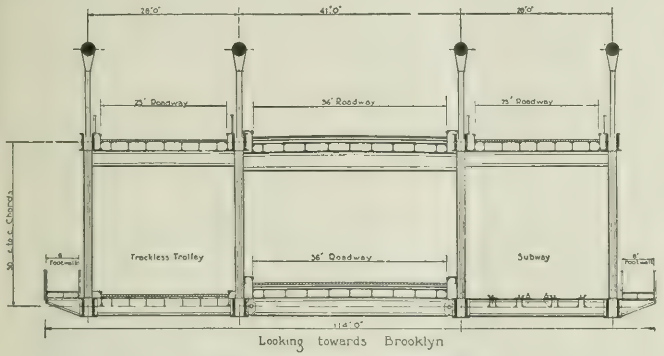


FIG. 2—DOUBLE-DECK, 4-CABLE SUSPENSION BRIDGE OF 1,800-FT. MAIN SPAN

The project for the new bridge has been developed since last summer, when the decision was reached to reroute bridge traffic so as to restrict the Brooklyn bridge teamways to horse-drawn traffic. At that time study was begun of possible reconstruction of the Brooklyn bridge, and also of the erection of an additional bridge, and the department stated that its policy would be to endeavor to build a new bridge before undertaking any steps toward the reconstruction of the Brooklyn bridge. Mr. Whalen's statement of Dec. 29 to the Board of Estimate, in addition to presenting the results of this study for a new bridge, reported that the study of Brooklyn bridge rebuilding is not complete and will require six months' further time.

Personal Notes

Fuller & McClintock, consulting engineers, New York City, announce the opening of a branch office at 1001 Chestnut St., Philadelphia, for the practice of engineering. The Philadelphia representative will be C. A. Emerson, who for the past nine years has been chief engineer of the State Department of Health of Pennsylvania. Mr. Emerson is a graduate of Beloit College and of the Massachusetts Institute of Technology and previous to his work in Pennsylvania was connected with the construction of the water filtration and softening plant at Columbus, Ohio, the preliminary studies, design and construction of the Baltimore sewage works and various other projects. Fuller & McClintock at present have branch offices in Toledo, Ohio; Memphis, Tenn., and Kansas City, Mo.

John T. Farmer was chosen chairman of the Montreal branch of the Engineering Institute of Canada at its meeting, Dec. 21. **O. O. Lefebvre** was chosen vice-chairman.

D. C. Willett has resigned his position as assistant structural engineer with the California State Highway Commission to accept the position of superintendent of construction with the Division of Architecture of California.

Golden, Storrs & Co. have recently opened an office in Hartford, Conn., for the practice of architecture and engineering. Mr. Golden was formerly with Lockwood, Greene & Co. of Boston, and Mr. Storrs has had fifteen years of experience in Worcester, Mass.

L. L. Rush, assistant engineer of the Kansas Highway Commission, has resigned to accept a position on the engineering force of the Chicago Union Station.

W. V. Buck, assistant engineer of the Kansas state highway commission, has resigned to enter the automobile business at Newton, Kan.

Thomas H. Mather, city engineer of Syracuse, N. Y., has been granted a short leave of absence on account of illness. **Nelson F. Pitts**, junior assistant city engineer, will be in charge of the office during Mr. Mather's absence.

William A. Gere, deputy city engineer of Syracuse, N. Y., will retire on pension Jan. 12 at the age of 60, having served 23 years in the city engineer's department.

C. G. Gillespie, after some absence from the department, has returned to the directorship of the Bureau of Sanitary Engineering, California State Board of Health. He succeeds **Ralph Hilscher**, who recently resigned.

Mandes Golder, formerly division engineer of the Department of City Transit of Philadelphia, Pa., has opened a consulting engineering office at 274 South 20th St., Philadelphia.

Ernest Statham, Great Kills, N. Y., and **Cecil M. Shultis**, New York City, have been appointed junior engineers on the construction of the Hudson River vehicular tunnel.

Obituary

Charles F. Healey, assistant city engineer of Chicago, died suddenly Dec. 24, 1922, following an operation for appendicitis. Mr. Healey had been in the service of the city of Chicago since his discharge from the Army as engineer of contracts and then as assistant city engineer. Prior to the war he was also connected with the Chicago city engineer's office as a special investigating engineer. Mr. Healey was born in Aurora, Ill., in 1877. His early professional experience was gained with the Illinois Central R.R. and a subsidiary, advancing from rodman to assistant engineer in charge of 500 miles of maintenance-of-way. After leaving the Illinois Central he became associated with the Chicago, Milwaukee & St. Paul Ry. on location and construction and in that work located some of the most difficult parts of the line across the Rockies. In October, 1908, he became associated with Fuller & Manley, consulting engineers of Tacoma, Wash., and for a time he was also a member of the firm of Creelman, Putnam & Healey, engineers and contractors, of Tacoma. During the war Mr. Healey was a captain in the Transportation Division of the American Expeditionary Force

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting, Washington, Jan. 11-12.

AMERICAN ROAD BUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. [illegible]

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17-19.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Chicago, [illegible]

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, [illegible]

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 13-15.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Review of Developments During 1922 in the Field of Construction Equipment and Materials

IN THE field of construction equipment and materials the year 1922 was notable not for radical innovations in types, but rather for a multitude of detailed improvements to machines whose basic features of design had become well stabilized through years of manufacture and use. This was to have been expected, for construction has long since become established as one of the nation's great industries and with its growth and the progress made both in engineering design and contracting methods the development of tools has kept pace. To the mechanical genius and the commercial enterprise of the builders of construction plant must be given a large share of the credit for the remarkable results now attained in completing both large and small projects speedily and economically. In the variety and the ingenuity of the mechanical appliances that the constructor finds available for his use the United States occupies an enviable position.

A REVIEW of the year's offerings by equipment manufacturers indicates a few well-defined trends. In so broad a field as that of engineering construction, however, it is difficult to generalize, for each class of work has developed its special mechanical tools and little is gained by attempting to draw conclusions from, let us say, the improved features of a concrete mixer and those of a steam shovel. Nevertheless, a survey of the year's developments shows that manufacturers have been devoting particular attention to the mounting of their equipment and in many cases are altering designs to increase mobility. There has been a decided widening of the field of use of crawler traction, and this type of mounting is now furnished for both light and heavy steam shovels, locomotive cranes, concrete paving mixers, elevating bucket loaders, trench excavating machines, and tractors. Wheel mountings, of course, are still supplied and widely used, but almost every manufacturer of the type of equipment noted above has produced models to meet the growing demand for crawler traction.

EQUALLY marked has been the trend toward the use of rubber tires on a wide variety of construction plant. In this development is seen a desire not merely to increase the mobility of equipment, but also to protect both machines and road surfaces from damage due to the bumping and jolting of heavy bodies when carried on non-resilient tires. It should be recalled that, not so long ago, construction equipment was hauled by horses at slow speeds from one job to another. The motor truck, however, opened up the way for greatly reducing the time lost in such moves, but obviously with ponderous machines on steel-rimmed wheels the potential speeds of the trucks could never be utilized.

The rubber tire, therefore, was the obvious solution to this problem. Under present traffic regulations, also, state highway and city paving officials are insisting upon the protection of road surfaces from the damage by heavy, fast moving vehicles. This condition has been responsible, in part at least, for the wider use of rubber tires on construction equipment, particularly within city limits. Today manufacturers are supplying either solid rubber or pneumatic-tire mountings for such a range of machinery as steam shovels, concrete mixers, portable air compressors, and other types of mobile plant. A further step has been taken by mounting upon motor-truck chassis such machines as concrete mixers and elevating loaders.

OTHER developments during the year have been mainly in details designed to increase the strength of machines, simplify their control, increase their output, and lower their cost of operation. Based upon the results of a canvass of manufacturers by *Engineering News-Record*, the following recital of the year's progress is presented. The material has been grouped into divisions representing the main classes of construction equipment and materials. In each division a summary of the more important improvements precedes more detailed statements covering the products of each manufacturer from whom replies were received:

Scope of Review

Power Shovels
Chuting Plant
Industrial Locomotives
Elevating Loaders
Rock Crushers
Gasoline Engines
Air Compressors and Pneumatic Tools
Concrete Mixers
Hoists
Locomotive Cranes
Reinforcement
Cableway Excavators
Buckets
Road Building Equipment
Trucks and Tractors
Pipe
Dump Cars and Wagons
Road Rollers

Power Shovels

IN THE power-shovel field the outstanding developments of the year included: (1) the application of the Diesel engine, as the source of power, to a type of equipment ordinarily operated by steam and gasoline engines or electric motors; (2) increased use of the continuous-tread type of mounting—particularly the introduction of crawler traction for the heavy-duty type of railroad shovel; (3) improvements in power steering equipment from the cab; and (4) rubber-tired wheels for work involving frequent moves from one job to another over paved streets within city limits. In addition, scores of less important improvements have been made. In general, the aim of changes in design is to produce equipment which one maker describes as "abuse-proof." This result is being sought by the introduction of larger bearings and heavier shafts at points of severe wear. In other words, the manufacturers are providing oversize parts at critical points. Cut gears are now generally employed and a more liberal use of manganese steel, both for gears subjected to vibration and shock and for dipper fronts, is indicated.

A number of improved features have been incorporated in the design of the revolving type shovel to facilitate the conversion of this equipment for dragline or clamshell bucket use. In addition, the standard types may be equipped with special booms for high lifts.

While the use of crawler traction for power shovels dates back considerably further than the year just passed, manufacturers have been devoting a great deal of attention to this feature of their equipment. Particular stress has been laid upon the development of crawler treads to avoid clogging with mud or small stones and to prevent cutting or otherwise damaging paved surfaces. With these ends in view some designers have called for steel castings which overlap and which have rounded edges. Treads and links have been combined into integral steel castings with smooth surfaces. The use of chains in the driving mechanism for the crawler treads has, in some cases, been eliminated. For the revolving type shovels the crawler mounting usually consists of two units, one on each side, but in the case of the heavier railway type of shovel four crawler units are provided, two at the forward end replacing the usual jack arms and two at the rear.

On the whole there have been during the past year few changes in the basic design of power shovels, although a great many details have been altered to facilitate operation, increase the strength and ruggedness of the equipment, enhance its mobility, and simplify interchangeability for dragline or crane-bucket work. In the following paragraphs are noted some of the detailed improvements that have been made by individual power-shovel manufacturers.

Bucyrus Co.

ONE OF THE most important developments was the equipment of a Bucyrus 1-yd. shovel with a 55-hp. mechanical injection oil engine of the Diesel type, for which substantial economies are claimed. To date the use of this type of engine has been limited to the 1-yd. shovel and dragline, but the company expects, in the near future, to install it on other sizes. The Diesel power unit is a four-cycle, slow-speed, heavy-duty, 8x10½-in. engine, operating at 360 r.p.m. Where a shovel or dragline line is handling an average of 600 to 700 cu.yd. of material per day under normal operating conditions, the company claims that the Diesel engine consumes from 1¾ to 2¼ gal. of fuel oil per hour. At a cost of 6c. per gallon, the expense for fuel for an 8-hr. shift figures at between $1 and $1.25.

A new feature on the revolving shovel was introduced to improve and simplify the thrusting operation. It involves the use of a rope-thrust, eliminating a power unit on the boom and the usual belts, chains and telescopic shafting. With the power transmission scheme adopted it is also possible to shake the dipper.

Improvements in the ¾-yd. revolving shovel included a two-part hoist, two propelling speeds, and the making of the dipper with rounded corners to free itself more easily from sticky material.

The Bucyrus Co. claims to be the first manufacturer to employ crawler traction mounting for the heavy railroad type of shovel. This type of mounting may be had with new machines or applied to shovels already in the field. The mounting consists of two forward and two rear sets of crawler units. Propelling is accomplished through the front crawlers. The use of this equipment, it is pointed out, eliminates the necessity of rail and jacks, and allows the shovel to be quickly moved out of the way during blasting operations.

Erie
Steam Shovel Co.

HEAVIER shafts and larger bearings at points of severe wear have featured improvements on Erie shovels during the year. The idea has been to make the equipment not only oversize for ordinary service, but practically abuse-proof. A propelling shaft 3¾ in. in diameter has been adopted to withstand severe strains, caused, for example, when the treads of a crawler type machine freeze into the ground. Split collars are provided on the rear axle of traction wheel machines to throw propelling gears out of mesh when the shovel is towed by a truck or tractor.

An automatic tripping device has been introduced. It consists of a drum which turns with the dipper shaft and keeps the trip rope taut. Another detail is the auxiliary exhaust through which water may be blown out instead of projected through the stack.

Fairbanks
Steam Shovel Co.

A FEATURE introduced on the ¾-yd. Fairbanks power shovel was a horizontal digging boom and dipper handle, intended to give a longer reach and dumping range than is obtainable with other types. The dipper handle is hinged to a trolley which is operated back and forth on the horizontal digging boom by cables fastened to a small drum on the trolley and a friction drum on the A-frame.

Marion
Steam Shovel Co.

WHILE STEAM still maintains the leading position in shovel construction, according to the Marion Steam Shovel Co., it no longer lays claim to dominance in such industries as have standardized with electric equipment or in localities where coal costs are high, smoke ordinances in force, or boiler feed water difficult to get. These conditions led to the introduction, on three models—¾, 1¼ and 1¾-yd.—of independent three-motor electric drives for the hoisting, rotating and crowding operations. On the all-electric type a direct-connected motor generator set is installed, while on the gasoline-electric outfit the power unit consists of a heavy-duty vertical type gasoline engine and electric generator.

On a new line of small revolving steam shovels in three models a power steering arrangement is provided which is entirely controlled by the operator without outside assistance. All clutches may be disengaged when the shovel is to be towed from one site to another. A four-belt flexible type of crawler truck is furnished for the ¾-yd. shovel if preferred to the two-belt type. Other optional mountings include rubber-tired wheels.

The Marion company also has adapted crawler traction to its railroad type shovels, an improvement which is regarded by the company as the most important that has been made to railroad type shovels during the past 15 years.

Osgood Co.

IMPROVEMENTS designed to increase the speed and ease of operation of its ¾ and 1-yd. shovels have been introduced by the Osgood Co. Among them are included a simplified continuous tread mounting with improved power steering; a redesigned main body; and a new type of dipper. The crawler tread links are in one piece and have high guiding flanges moving over round rollers set in rigid side frames, holding the treads in their course and preventing side slipping. Round tumblers with teeth on the sides engage with the guiding flanges, thus driving the tread belt and eliminating sprocket holes which become clogged with dirt and stones.

Driving power is delivered direct to the axles by gears, bearings have been reduced to a minimum and sprockets and drive chains eliminated.

The revolving shovel is convertible for dragline or clam-shell work and has drums powerful enough to handle the buckets with a single line. This feature, it is pointed out, does away with a set of sheaves on the buckets, reduces wear on lines, and materially speeds up operation.

Thew
Shovel Co.

ONE OF THE most important improvements in Thew shovels has been in the continuous tread truck, to which has been added a power steering equipment and two speeds. The treads are of the semi-flexible type with chain drive. They are 26 in. wide and are cambered on the end as well as beveled, to minimize damage to pavements and subgrades during turning. The opening between pairs of treads is claimed to give greater traction. The two speeds with this type of machine are 65 and 42 ft. per minute.

On the company's gasoline shovel a four-cylinder, heavy-duty type engine has been substituted for the two-cylinder engine formerly used.

Concrete Chuting Equipment

CONSTRUCTION work calling for the distribution of substantial yardages of concrete over relatively large areas has led to many developments in chuting equipment. Such projects as covered reservoirs, large industrial plants, bridges, and sewage disposal works offer fertile fields for the application of this type of plant. Major improvements during the year have included equipment for handling aggregate in which large stone is used, particularly on dam construction, changes in details of the system of double-counterweight chutes, and the design of equipment for the so-called smaller concrete jobs such as buildings, short-span bridges, retaining walls and silos.

Insley Manufacturing Co. DERRICK-SUPPORTED chutes are now commonly used on a wide variety of large-scale public works construction where concrete is mixed at a point where materials may be delivered easily, then chuted to a mast hopper located on a derrick and distributed from that point as the center. The Insley company states that with its system of double-counterweight chutes concrete may be placed at any point within the area of a 300-ft. diameter circle, the fact that no ground supports, except the main mast, are required for chuting making it easy to clear the reinforcing steel.

The most marked development covered by the year's experience of the Insley organization falls within the class of jobs calling for a comparatively small yardage of concrete. This type of work is represented by retaining walls, small bridges and buildings, and farm structures. Requirements of low first cost and low cost of erection led to the development of simple mast hoist bucket equipment.

Lakewood Engineering Co. AN INCREASING tendency toward the use of steel towers is noted by the Lakewood Engineering Co., which has developed new designs for chuting equipment during the year in which the number of parts has been decreased and provision made for easier panel erection in the field. Details have been changed to increase the strength of towers. One of the important developments during 1922 has been the use of chutes of larger diameter than were before employed. On large dam construction chutes of 18 in. diameter have been developed to distribute concrete in which large aggregate—from 6 to 8 in. in diameter—is distributed.

Industrial Locomotives

WIDER ranges of speed, with gear drive, have characterized the newer types of industrial locomotives. Four speeds, either forward or reverse, are provided for in models announced last year by two manufacturers. One of these was a 4-ton and the other a 7-ton unit.

Fate-Root-Heath Co. SPECIALLY designed transmission, giving speeds of 2½, 4, 8 and 12 miles per hour, either forward or reverse, is the feature of the 7-ton gear-drive locomotive developed by the Fate-Root-Heath Co. Tests of this machine showed a draw-bar pull of 5,250 lb. in low gear with sanded rails. All gears are large and massive, the final drive gear having a 14½-in. diameter and a 4-in. face. The power plant is a Buda heavy-duty, four-cylinder gasoline engine with a Modine sectional core radiator.

Geo. D. Whitcomb Co. TO ITS line of haulage machinery the Whitcomb company last year added a new type of 4-ton gear-drive gasoline locomotive, equipped with four speeds in each direction—3, 6, 9 and 12 miles per hour. This unit is equipped with a 4 x 5-in. Wisconsin over-head valve motor and is designed for the needs of the contractor employing the smaller type of gasoline locomotive.

Elevating Loaders

MOUNTINGS on crawler traction and, in cases where a great degree of mobility is desired in making frequent moves from one job to another, on tractors or motor trucks, are now common in the portable elevating bucket loader field. The increased headroom demanded for loading the larger sizes of motor trucks and provision for various attachments supplied with loaders have resulted in the development of much taller and heavier machines than formerly. These changes in design have naturally resulted in wider and larger wheel bases and axles of greater diameter. Gathering devices to aid the loading of materials spread in thin layers are now standard equipment and overhead storage hoppers to permit the continuous operation of the loaders during the absence of trucks have added to the efficiency of this type of equipment. Swivel spouts facilitate the discharge of material into trucks, while present practice has introduced two and three-speed self-propelling mechanism, for moving and feeding into the pile.

Barber-Greene Co. AN ELEVATING bucket loader with practically double the capacity of its previous models was brought out by the Barber-Greene Co. during the year. The rated output is 1¾ cu.yd. per minute and embodies a number of special features. Among them are a standard motor-truck transmission making possible three speeds when working into the pile and one speed in reverse, as against two speeds in previous types. The machine is mounted on crawlers of increased width and length, the new width being 10 in., as against 8 in., and the new length 60 in. as against 56 in. The buckets also have been increased in size and now measure 20 in. across the cutting edge as compared with 16 in. previously employed. On this new model the buckets are staggered slightly, resulting in a cutting path 22 in. wide. The revolving feeding disks have been improved by an adjustment which enables them to be raised and lowered independent of the boom. The same type of Buda gasoline engine is used as in former models, although increased horsepower has been introduced in the new type.

Geo. Haiss Manufacturing Co. A MOTOR truck mounting for its path-digging bucket elevator, to meet requirements for rapid loading with a single unit at a number of widely separated points, was announced by the Haiss company last year. The regular A-frame supports on which the elevator is pivoted are erected over the rear axle of the truck and the necessary transmission, gearing, chains, etc., are placed as on standard loaders. Revolving propellers aid in feeding material to the bucket.

Increased mobility also was secured in the case of the lighter wagon loaders and portable belt conveyors by mounting these machines on Fordson tractors. During the year a snow-loader was developed in which the loading element consists of a steel pan conveyor with path-digging feeding propellers.

Jeffrey Manufacturing Co. CRAWLER traction with wide treads—12-in. steel plates—is one of the features of the Jeffrey company's new Tanktred bucket loader, designed to dig into a pile to an unusually great depth. The digging edge of the buckets has a cutting clearance at all points and the foot of the elevator is constructed so that the buckets are wider than any other part. Another improvement is the use of a large foot wheel which, by reducing centrifugal force, facilitates the picking up of material and prevents the buckets from kicking away large lumps. On this unit two speeds are provided, one a traveling speed and the other a feeding speed.

A detachable gathering device similar to a road scraper has been designed to aid in gathering up and loading material spread out in a thin layer.

To increase the efficiency of the plant by keeping the loader in operation during the absence of a motor truck, a storage hopper is provided overhead to receive the discharge from the buckets. A universal swivel spout is an additional help in directing the point of discharge of the elevated material. Of late it has been necessary to increase the headroom under loaders and in the case of the present equipment a clearance of 9½ ft. is provided.

Link-Belt Co. A POWER swiveling principle was incorporated in the industrial bucket loader, announced last year by the Link-Belt Co. In operation it backs into a pile of material under its own power and cuts a complete semicircle while digging and loading. The buckets on every machine are of two types, one with round and the other with straight cutting edge, mounted alternately on the same belt. To insure maximum digging efficiency the round buckets are provided with steel teeth at the center while the rectangular buckets have steel teeth on the ends and sides. The equipment is mounted on a four-wheel truck and has a capacity of 45 cu.ft. per minute. The power unit is a 15-20 hp. gasoline engine giving speeds of 5 ft. and 75 ft. per minute forward or backward. An overhead storage hopper of 1-yd. capacity receives the discharge from the buckets and for industrial use, particularly in loading trucks, a swivel chute rotating 180 deg. is provided.

Portable Machinery Co. IN ITS scoop conveyor of the endless belt type the Portable Machinery Co. has adapted to general construction purposes equipment originally designed for coal handling. The principal change has involved a new type of carrying trough, in which the conveying belt travels between, instead of under, the skirt plate. This feature is claimed to reduce friction and increase the life of the belt. The electric motor or gasoline engine power unit on this equipment is mounted over the trough on vibrationless supports to minimize fouling by dust and dirt.

Rock Crushers

SUBSTITUTION of cast steel for the grey cast iron generally used in the frames and crowns of gyratory crushers marked one of the chief advances during the year. For the utilization of local materials in road-building, mobile units comprising rock crushers mounted on wheels and portable screening plants and storage bins have been developed.

Smith ***Engineering Works***

THE NEW Telsmith primary breaker is equipped with the cast-steel frame and crown noted in the foregoing paragraph. To date cast-iron frames and crowns have been regarded as standard equipment. In the past, to be sure, the purchaser who desired a cast-steel crusher could secure it by paying the price. This equipment, however, was special and when ordered had to be made from patterns designed generally for the manufacture of grey-iron castings. Consequently more metal was furnished than was necessary and the cost was high. Now, however, the Smith organization is standardizing on cast-steel equipment and using patterns designed for manufacture in cast steel, thus making it possible to produce these machines at a cost slightly in excess of that for a cast-iron crusher. Advantages claimed for the cast-steel crusher are its durability particularly in the event of "tramp" iron entering with a charge of rock. The accidental entry of this material into a grey iron crusher generally results in serious damage. The cast-steel equipment, it is claimed, will successfully withstand this test.

To Be Continued in Next Week's Issue

Business Notes

NORTHWEST ENGINEERING CO., Chicago, announces that H. A. Hutchins, formerly with the Thew Shovel Co., has become associated with its main office in Chicago. Mr. Hutchins had been with the sales force of the Thew company since 1917 and was district manager of the Chicago territory of that company up to the time of joining the Northwest organization on Dec. 15.

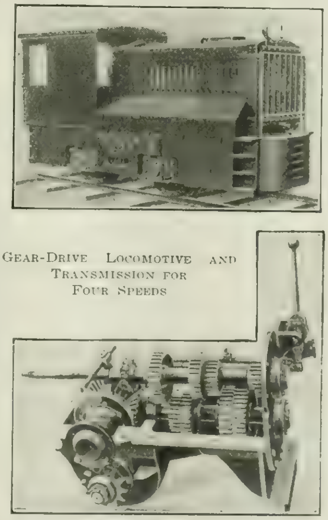
MONARCH TRACTORS, INC., Watertown, Wis., has gone into overtime production of a six-cylinder tractor. The company has spent a year in developing and perfecting this new model.

BUCYRUS CO., South Milwaukee, Wis., announces the addition to its sales force of John J. Gault. He has had many years of experience as construction and locating engineer, having been assistant engineer on the Chicago & Northwestern, engineer maintenance of way on the Chicago & Alton, construction engineer for the United Fruit Co. and assistant engineer on the Chicago, Milwaukee & St. Paul. His latest connection was with the International Harvester Co. as locating engineer on a railroad project. Mr. Gault will be attached to the Chicago office of the Bucyrus Co. at 622 McCormick Building.

Equipment and Materials

Four-Speed Gasoline Locomotive Shows High Draw-Bar Pull

A draw-bar pull of 5,2550 lb. in low gear with sanded rails has been developed by the four-speed, 7-ton gear-drive locomotive announced by the Fate-Root-Heath Co. of Plymouth, Ohio. Among the features of this equipment is the transmission, giving a range of speeds of 2½, 4, 8, and 12 miles per hour, either forward or reverse, and an additional final drive and gear shaft. The gears are large and massive, the final drive gear having a 14½-in. diameter and a 4-in. face. This gear permits of the proper speed reduction and also places the sprocket shaft which it drives in the same plane as the axles. The other gears have 2 and 2½-in. faces respectively.



GEAR-DRIVE LOCOMOTIVE AND TRANSMISSION FOR FOUR SPEEDS

Sliding gears are made in pairs on the second driving shaft. The gears that are driven are the only ones in mesh. Forward and reverse speeds are obtained by large bevel gears with internal gear teeth into which the pinion that drives the main gear meshes, thus eliminating jaw clutches. All gears are of alloy hardened steel, mounted on extra large shafting and ball bearings. These ball bearings are all inside the gear case, from which they receive lubrication, and insure permanent alignment. The final drive is by means of two short heavy chains, one for each axle, driven direct from the transmission.

The power plant is a Buda heavy duty, four-cylinder gasoline engine, with a Modine sectional core radiator. The clutch is of the dry-plate type, with nine driving discs faced on each side with non-burnable facings. The axles are mounted on Hyatt roller bearings and the axle springs are 12¾ in. long to enable the wheels to follow uneven track.

The frame is built close to the track and the cab, of all-steel construction, is fitted with wire-glass windows. The overall length of the locomotive is 144 in., its height, 72 in., and its width, from 51 to 64½ in., depending upon the gage of track. A range of gages from 23⅝ to 56½ in. is provided for.

New Cement Handling and Loading Device Being Perfected

To supplement the service of its Batcherplant for storing and measuring sand and stone and delivering this material into motor trucks or industrial railway cars, the Blaw-Knox Co., Pittsburgh, is developing equipment for the rapid handling and loading of cement into mixers. The device, which is not yet on the market, consists of two main parts. The first part is a steel box-shaped truck partition, from one to four of these being furnished, depending on the number of compartments desired in the truck. The box itself has a bottom gate and a specially designed cover to protect the cement from moisture. In operation the box-shaped cement partition is released exactly in the same way as the ordinary truck partition and as the sand and stone are dumped the cement automatically goes with it. This arrangement is designed to eliminate handling of cement at the mixer when sacks are emptied into the skip.

The second part of the equipment is a rapid cement-loading device. Trucks, before or after receiving premeasured charges of sand and stone, will drive past the cement shed and receive the measured cement from steel batchers or hoppers dumping directly into the cement compartments of the truck. The equipment, its manufacturers predict, will eliminate a number of laborers ordinarily needed in concrete mixing operations, will speed up work, and will reduce cement losses.

Publications from the Construction Industry

Brick Houses—COMMON BRICK MANUFACTURERS ASSOCIATION OF AMERICA, Cleveland, Ohio, has published a 64-page illustrated booklet showing plans and photographs of sixty residential brick houses, for which 10c. is charged. A separate circular giving the range of cost of houses and prices of detailed plans may be secured from the association.

Paving Mixer Performance—T. L. SMITH CO., Milwaukee, is distributing a folder covering performance records of its model 21-E paving mixer. Day-by-day performance data on a large trunk highway job are given together with a number of photographs showing the mixer, which is of the boom-and-bucket type, in action.

Business Side of Construction

Facts and Events that Affect Cost and Volume

A Ten Year Résumé of Construction Cost

On these two pages the E. N.-R. Cost Index is given for every month since 1913, together with the derivation. The Volume Index Number also is given for the months and years of 1920, 1921 and 1922. Spring prices of construction materials are listed for the last ten years.

E. N.-R. Cnnstruction Cost Index Number

ENGINEERING NEWS-RECORD'S Construction Cost Index Number is a national index of general construction cost in the United States. For that reason in its computation only the great basic materials and common labor are considered. Steel, cement and lumber are the fundamental materials of the construction industry, and the rate paid common labor eventually determines the cost of labor.

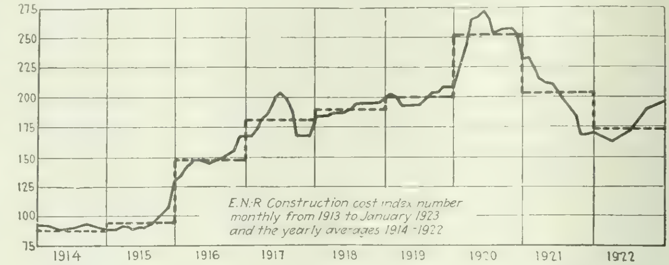
The importance of the cost of brick, sand, gravel, crushed stone, and the rest, is not minimized; but these materials are usually produced locally and their prices are subject to fluctuating local conditions.

The *Engineering News-Record* Construction Cost Index Number is not referred to Boston or Seattle, to Minneapolis or El Paso but to the 3,507,640 sq.mi. of the United States. Change in towing rates on the Hudson River will affect the price of brick or crushed stone, alongside dock, New York, without making any change whatever in the nationwide cost of construction. On the other hand, a price movement in either steel, cement or lumber wields an influence that is almost invariably continental in scope.

The *Engineering News-Record* Construction Cost Index Number is based on the prices of steel, cement, lumber and common labor in 1913. Furthermore, these materials and common labor are weighted according to their relative importance as adjudged by *Engineering News-Record.* These weightings are: Steel, 37.50 per cent; cement, 7.14 per cent; lumber, 17.10 per cent; labor, 38 per cent. The weightings were determined by studying the annual production of the three prime materials and the number of common laborers (exclusive of farm labor) in the United States. The markets considered are structural steel in Pittsburgh, cement without bags f.o.b. Chicago; 3 x 12-in. to 12 x 12-in. Southern pine to contractors in New York, and the average price of common labor in the eighteen to twenty cities listed in *Engineering News-Record* in the first issue of each month. The prices are those obtaining in the last week of each month and published in the first issue of each month. The quantities of these materials and the number of man-hours used in computing the Index Number were selected so that the total cost (quantities multiplied by prices, and added together) for 1913 would be $100 for a "unit of construction."

For example, if the quantities are 2,500 lb. of structural steel, six barrels of cement, 600 ft.b.m. of lumber, and 200 man-hours, and the prices are $1.50 per 100 lb. for shapes, $1.19 per net bbl. of cement, $28.50 per M ft.b.m. of lumber, and 19 cents per hour for common labor, the total computation will be $99.74; 100 is the base *Engineering News-Record* Construction Cost Index Number.

The accompanying tabulation gives the *Engineering News-Record* Construction Cost Index Number for every month from 1913 to December, 1922, while the chart gives both the monthly and yearly numbers. The current index number is presented in its regular form on p. 44 of this section.



ENGINEERING NEWS-RECORD CONSTRUCTION COST INDEX NUMBER—1914 TO 1922

	1914	1915	1916	1917	1918	1919	1920	1921	1922
January	89.22	87.12	130.46	167.75	184.51	198.05	206.55	230.87	168.72
February	89.22	87.36	134.46	167.75	184.51	201.50	225.10	230.67	168.72
March	88.97	87.66	142.96	175.66	184.51	198.05	240.85	224.27	162.04
April	87.97	90.16	147.31	183.41	186.01	191.25	265.20	213.07	164.72
May	88.62	90.16	148.86	187.61	186.01	191.25	268.90	210.82	164.62
June	87.87	88.96	146.51	199.26	186.31	191.85	273.80	209.82	166.62
July	88.12	90.51	145.76	204.01	188.65	193.65	265.65	203.82	169.70
August	90.11	91.76	146.56	198.41	193.85	196.65	252.00	193.07	173.40
September	90.36	93.01	149.56	190.31	193.85	202.85	255.20	188.27	185.00
October	88.51	96.16	152.91	167.11	193.85	202.25	255.20	182.57	188.60
November	87.26	101.06	155.66	166.51	193.55	206.85	255.32	166.32	188.60
December	86.51	107.06	167.15	167.11	194.75	206.85	251.62	167.82	192.60
Averages	88.56	92.58	147.35	181.24	189.20	198.42	251.28	201.78	174.45

E. N.-R. Construction Volume Index Number

The *Engineering News-Record* Volume Index Number, placing the value of contracts let on a 1913 purchasing basis, was announced in the issue of Oct. 20, 1921, p. 670. Its purpose is to show the actual amount of contracts let in prewar years rather than the actual money value of contracts let. It is based on 1913—despite the fact that this was a sub-normal construction year by fifteen to twenty-five per cent—for two reasons: 1913 is the last prewar year and most index numbers (including *News-Record's* Construction Cost Index Number) are based on 1913 basis. The year 1913 was normal neither as regards the volume of construction nor the monthly distribution as shown by contracts awarded. To

E. N.-R. CONSTRUCTION VOLUME INDEX NUMBER

1913 and 1920 to 1922

1913 = 100

	1922	1921	1920
January	91	41	146*
February	100	43	114
March	202*	88*	107
April	150	86	142*
May	179	90	107
June	187	117*	74
July	118	90	85*
August	154*	94	65
September	[illegible]	114*	85*
October	[illegible]	109	73
November	[illegible]	101	51
December	111	118*	58*

* Taken [illegible] *News-Record* during [illegible]

correct the latter condition current monthly volumes are compared with the average monthly value of contracts let in 1913. As an example the value of contracts in December, 1913, which was $63,341,000, is not compared with the value of contracts let in December, 1922, which was $123,143,000, but with the average monthly value in 1913, which was $57,545,000.

Letting C represent the value of contracts let in 1913 (or any fraction of 1913), C_1 the value for 1922 (or the same fraction of 1922), I the *E. N.-R.*, Construction Cost Index Number for all or the considered part of 1913, and I_1 the Cost Index Number for all or the same part of 1921, the formula for computing the Valume Index Number is:

$$\text{Vol. Index No.}\ \frac{\frac{C_1}{I_1}}{\frac{C}{I}} = \frac{IC_1}{I_1C}$$

But I and C are constants—100 and $57,545,000 (for any month of 1913) or 100 and $690,540,000 for the whole of 1913; therefore,

$$\text{Monthly Vol. Index No.} = \frac{C_1}{575{,}450I_1}$$

$$\text{Yearly Vol. Index No.} = \frac{C_1}{6{,}905{,}400I_1}$$

Spring Prices of Materials Since 1913

Engineering News-Record's comparison of spring prices of construction materials has been published once a year since 1919. The large tabulation brought to date is the same as last year's, with the addition of the average common labor rate over the country.

The smaller table shows the per cent change in prices of some of the principal materials from the average spring prices since 1913. Structural shapes and reinforcing bars are 16 and 12 per cent, respectively, less than the average. Linseed oil is 7 per cent under, compared with -27 a year ago.

PRICE SITUATIONS IN SPRING, 1919, 1921 AND 1922

(+indicates increase; — indicates decrease)

Materials	Per Cent Change, January, 1919, from General Average of Spring Prices, 1913-1918	Per Cent Change, March, 1921, from General Average of Spring Prices, 1913-1920	Per Cent Change, Dec. 15, 1921, from General Average of Spring Prices, 1913-1921	Per Cent Change, Dec. 14, 1922 from General Average of Spring Prices, 1913-1922
Crushed stone, New York...	+ 42	− 61	+ 32	+ 22
Sand, New York...........	+100	+ 42	+ 27	+ 23
Gravel, New York.........	+120	+111	+ 14	+ 28
Cast iron pipe, New York...	+ 91	+ 45	− 9	+ 22
Structural shapes, New York	+ 52	+ 14	18	+ :
Tank plates, New York.....	+ 58	+ 17	— 11	+ 3
Linseed oil, New York......	+ 62	— 36	— 27	— 7
Freight Pittsburgh to New York or Chicago on finished steel products..	+ 35	+ 95	+ 76	+ 48
Steel sheetpiling, Pittsburgh mill........	+105	+ 10	— 18	+ 16
Structural shapes, Pittsburgh mill....	+ 56	— 6	— 39	— 16
Reinforcing bars, Pittsburgh mill.	+ 58	+ 6	+ 15	— 12
Reinforcing bars, New York warehouse..............	+ 51	+ 11	— 47	+ 26
Average	+ 69	+ 31	+ 1	+ 13

ENGINEERING NEWS-RECORD COMPARISON OF SPRING CONSTRUCTION MATERIALS PRICES SINCE 1913

All Prices New York Except Otherwise Stated

	Portland Cement, per bbl. net, without bags, **Chicago**	Southern Pine, 3x12 to 12x12, 20 Ft. and Under	Common Brick (per M.)	Crushed Stone (per Cu.Yd., ¾ In.)	Sand (per Cu.Yd.)	Gravel (per Cu.Yd., ¾-in.)	C.-I. Pipe (6 In. per Ton)	Beams and Channels (3-15-In per 100 lb.)	Beams, Etc., **Pittsburgh Mill**	Reinforcing Bars, 2-In. and Larger **Pittsburgh Mill**	Reinforcing Bars, ¾-In. and Larger	Steel Sheetpiling, **Pittsburgh Mill**	Tank Plates ¼-In. and heavier per 100 Lb.	Hollow Tile (6x12x12 per Block), **Factory, Perth Amboy, N. J.**	Linseed Oil (Raw in Barrels)	Freight to Pittsburgh on Steel (per 100 Lb.)	Average Common Labor Rate per Hr for U. S.
April, 1913	$1.19	$28 50	$7.00	$0.90	$0 50	$0 85	$24 00	$2 15	$1 70	$1 50	$2 25	$1.60	$1 61	$0 084	$0 48	$0 16	$0 17
May, 1913	1.19	28.50	7.00	90	50	85	23 50	2 15	1 65	1 50	2 25	1 60	1 61	084	50	16	17
June, 1913.	1 19	28.50	7.00	.90	.50	85	23 00	2 15	1 50	1 50	2 25	1 60	1 61	084	48	16	17
Average.	**$1 19**	**$28 50**	**$7.00**	**$0.90**	**$0.50**	**$0 85**	**$23 50**	**$2 15**	**$1 62**	**$1 50**	**$2 25**	**$1.60**	**$1 61**	**$0 084**	**$0 49**	**$0 16**	**$0.17**
April, 1914	$1 12	$28 50	$5.50	$0 95	$0.50	$0 90	$22 00	$1.95	$1 15	$1 20	$2 25	$1 60	$1 31	$0 084	$0.54	$0 16	$0.18
May, 1914	1.12	30 00	5.50	.95	.50	90	22 00	1.85	1 15	1 15	2 25	1 60	1 31	.084	.54	16	.18
June, 1914........	1 12	30.00	5.60	.95	.50	90	20 50	1 85	1 10	1.15	2 25	1 60	1 31	.084	.53	.16	.18
Average	**$1.12**	**$29 50**	**$5.55**	**$0 95**	**$0 50**	**$0 90**	**$21 50**	**$1 85**	**$1 13**	**$1 17**	**$2 25**	**$1 60**	**$1 31**	**$0 084**	**$0.54**	**$0.16**	**$0 18**
April, 1915	$1 11	$28 50	$5.50	$0 90		$0 85	$20 00	$1 90	$1 15	$1 15	$1 95	$1 60	$1 36	.	. .	$0 169	18
May, 1915...	1 11	28 50	5.75	1 05	.	85	20 50	1 90	1 20	1 15	2 00	1 50	1 32		. . . .	.169	.18
June, 1915	1 15	26 50	6.00	1.05		85	22 00	1.90	1 20	1 20	2 00	1.50	1.37	.	. . . .	.169	18
Average.	**$1.12**	**$27 75**	**$5.75**	**$1 00**	.	**$0 85**	**$20 75**	**$1 90**	**$1 18**	**$1.17**	**$1 97**	**$1 53**	**$1 35**	.	. . . .	**$0.169**	**$0.18**
April, 1916 ...	$1 42	$31 50	$8 50	$0.95	$0.40	$0.80	$30 50	$2 50	$2 50	$2.45	$3 10	$2 50	$2 50	.	$0 81	$0 169	$0.18
May, 1916 .	1.46	31.50	7 25	.95	40	85	30 50	2 50	2.75	2.50	3.25	2 50	2 65	.	81	169	18
June, 1916 .	1.46	30 50	8 00	95	50	1 00	30.50	2.60	2 75	2.50	3 10	2 50	2 75			169	18
Average.	**$1 45**	**$31 00**	**$7 90**	**$0 95**	**$0 45**	**$0 90**	**$30 50**	**$2 55**	**$2 67**	**$2 47**	**$3.15**	**$2 50**	**$2 65**	.	**$0 81**	**$0 169**	**$0.18**
April, 1917	$1 76	$32 75	$9 50	$1.20	$0 50	$1 25	$47.50	$3.75	$3 88	$3 35	.		$5.00		$1 04	$0.169	$0 28
May, 1917	1 90	34 75	11.50	1.25	50	1 35	55 50	3 80	4 00	3 50			5 50		1 21	169	.28
June, 1917	1.91	39.75	10 25	1.25	.50	1 25	55 50	5 [illegible]0	4 31	3 50			7.00		1 31	169	28
Average........	**$1 86**	**$35 75**	**$10 40**	**$1 25**	**$0 50**	**$1 30**	**$51 70**	**$4 15**	**$4 06**	**$3 45**			**$5 80**		**$1 19**	**$0 169**	**$0 28**
April, 1918	$1 96	$42 75	$10 25	$1.75	$1 25	$2 00	$55 35	$4 20	$3 00	$2 90	$4 09½	$3 10	$4 45	$0 14	$1 55	$0 195	$0.37
May, 1918	1 96	42 75	10 00	1.75	1.25	2 00	55.35	4 20	3 00	2 90	4 09½	4 00	4 45	14	1.55	195	37
June, 1918	2 00	43 25	10 25	1.75	1 25	2 00	61 35	4 20	3 00	2 90	4 09½	4 00	4 45	14	1 58	195	.37
Average	**$1 97**	**$43 00**	**$10 15**	**$1 75**	**$1 25**	**$2 00**	**$57 35**	**$4 20**	**$3 00**	**$2 90**	**$4 09½**	**$3 70**	**$4 45**	**$0 14**	**$1 56**	**$0.195**	**$0 .37**
April, 1919	$2 00	$45 00	$15.00	$1.75	$1 25	$2 00	$57 70	$3 47	$2 45	$2 35	$3 37	$2 55	$3 67	$0 159	$1 55	$0 27	$0.46
May, 1919...	2 00	45 00	15 00	1.75	1 25	2 00	57 70	3 47	2 45	2 35	3 37	2 55	3 67	.153	1 63	27	45
June, 1919	2.00	46.00	15.00	1 75	1 25	2 00	52 70	3 47	2 45	2 35	3 37	2 55	3 67	153	1 76	27	.45
Average	**$2 00**	**$45 50**	**$15 00**	**$1 75**	**$1 25**	**$2 00**	**$56 03**	**$3 47**	**$2 45**	**$2 35**	**$3 37**	**$2 55**	**$3 67**	**$0.155**	**$1 65**	**$0.27**	**$0.45**
April, 1920	$2 00	$72 00	$18 00	$2 00	$1 25	$2 25	$72 30	$5 00	$4 00	$4 00	$5 00	$3.65	$5 00	$0.2274	$1 87	$0.27	$0.55
May, 1920	2 08	70 00	18 00	2 15	1 50	2 50	76 30	5 00	4 00	4 00	5 00	3 65	5 00	.2274	1 87	27	57
June, 1920	2.15	70 00	18 00	2 15	1.50	3 00	76 30	4 47	4 00	3 75	5 00	3 65	4 67		1 73	27	58
Average	**$2 08**	**$70 50**	**$18 00**	**$2 10**	**$1 42**	**$2 58**	**$74 97**	**$4 83**	**$4 00**	**$3 92**	**$5 00**	**$3 65**	**$4 89**	**$0 2274**	**$1 83**	**$0.27**	**$0.57**
April, 1921	$2 17	$48 00	$16 00	$1 95	$1 25	$2 50	$63 30	$3 33	$2 00	$2.00	$3 28	$2 55	$2 00		$0 73	$0 38	$0 56
May, 1921	2 17	48 00	15 00	1 95	1 25	2 50	63 30	3 33	2 20	2 10	3.38	2 55	2 40		.67	38	57
June, 1921	2.17	43 00	14 50	1 95	1.25	2 50	58 30	3 33	2 20	2 10	3.38	2 55	2 40	1156	80	38	58
Average	**$2 17**	**$46 25**	**$15 00**	**$1 95**	**$1 25**	**$2 50**	**$61 60**	**$3 33**	**$2 15**	**$2 10**	**$3 35**	**$2 55**	**$2 25**	**$0 25**	**$0 73**	**$0 38**	**$0 57**
April, 1922	$1.97	$44 00	$16 25	$1 75	$1 00	$1 75	$47 30	$2 48	$1 50	$1 50	$2 58	$1 75	$2 48	....	$0 83	$0 38	$0 43
May, 1922.........	1 97	43 00	17 00	1 75	1 00	1 75	47 30	2 58	1 60	1 60	2 68	2 00	2 58	.	91	.38	42
June, 1922 ..	1 97	43.00	20 00	1.75	1 00	1 75	49 30	2 58	1 60	1 60	2 68	2 00	2 58		91	38	43
Average .	**$1 97**	**$43 33**	**$17 75**	**$1 75**	**$1 00**	**$1 75**	**$47 97**	**$2 55**	**$1 57**	**$1 57**	**$2 65**	**$1 92**	**$2 55**	:....	**$0 88**	**$0 38**	**$0 43**
General average .	**$1 69**	**$40 11**	**$11 25**	**$1 44**	**$0 81**	**$1 56**	**$44 59**	**$3 10**	**$2 38**	**$2 26**	**$2 81**	**$2 16**	**$3 05**	**$0 1045**	**$0 97**	**$0 23**	**$0 34**
Dec 14 1922	**$2 20**	**$54 00**	**$15 50**	**$1 75**	**$1 00**	**$2 00**	**$54 30**	**$3 14**	**$2 00**	**$2 00**	**$3 51**	**$2 50**	**$3 14**		**$0 90**	**$0 34**	**$0.47**

December Review Of Volume and Prices

On these three pages the totals of contracts awarded on important construction projects are given for the entire year 1922, as well as for the month of December Comparisons are also made with 1913 and the last three years. Prevailing labor rates and industrial conditions in the various cities reporting to *Engineering News-Record* are recorded, together with current prices on construction materials.

Contracts Let Increased Over 26 Per Cent in Year

The value of contracts let in the United States and Canada on important engineering construction projects, as announced in the four December issues of *Engineering News-Record*, aggregated $123,143,000, compared with $134,697,000, reported in the five issues of November. This represents an average weekly rate of $30,785,750 for December as against $26,939,400 during November. Lettings in the United States for the entire year reached $1,556,550,000, an increase of 26 per cent over 1921 and 2 per cent under the 1920 total.

TABLE III—LAST THREE YEARS CONTRACTS COMPARED WITH 1913

Classification	1913	1920	1921	1922
Waterworks	$24,373,000	$30,772,098	$40,602,948	$36,220,000
Sewers	26,906,000	36,066,577	59,385,042	43,584,000
Bridges	23,290,000	35,213,881	27,330,677	43,477,000
Streets, roads	48,471,000	265,423,491	315,351,427	334,694,000
Excavation, drainage and irrigation	...	16,218,664	19,180,500	19,551,000
Industrial	49,104,000	482,200,884	114,256,054	198,141,000
Buildings	148,687,000	581,324,693	568,261,252	750,762,000
Federal Government	39,405,000	35,281,531	26,607,391	43,552,000
Miscellaneous	135,303,000	99,501,217	60,395,674	86,569,000
Total	$495,542,000	$1,582,013,036	$1,231,370,965	$1,556,550,000

Minimum costs observed in Construction News, on each class of construction, are as follows: Waterworks, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings $150,000.

The December decline in total value of contracts let, represents a purely seasonal condition, pointing to a continuance of the prolonged building boom.

The heaviest falling off was noted in bridge construction, which declined over 79 per cent, since November. Sewer construction dropped over 55 per cent and streets and roads nearly 13 per cent, during the month.

An increase of 6 per cent was realized, however, in industrial building during December, with substantial gains in miscellaneous construction.

The December total of $123,143,000, representing large engineering projects above the minimum costs observed in E. N.-R., added to the estimated total of all smaller contracts let during the month, would aggregate between $240,000,000 and $250,000,000. Likewise the E. N.-R. total of $1,556,550,000 for 1922, combined with the smaller engineering construction awards not covered in these pages, would amount to over $3,000,000,000 for the year, thereby exceeding all records since the 1920 peak.

Engineering News-Record Construction Cost Index Number

January, 1923	191.70
December, 1922	192.60
January, 1922	168.72
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number dropped nearly one point since last month, due to decline in cement quotations. Steel holds at $2.00 per 100 lb., Pittsburgh mill. The average rate for common labor is still 47c. Thus, general construction cost is 13.6 per cent higher than one year ago and 30 per cent under the peak; it is 91.7 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly

December, 1922 (*4 issues of E. N.-R.*)	**111**
November, 1922 (*5 issues of E N.-R.*)	122
December, 1921 (*5 issues of E. N.-R.*)	118
1913	100

Yearly

1922 (entire year)	130
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 111 for the month of December, and 130 for the whole of 1922, as against 100 for 1913. This means that the actual volume of construction in 1922 (not the mere money-value of the contracts let that year) is 30 per cent above the volume of construction for 1913. Our monthly volume number, 111 for December, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

TABLE I—VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA IN DECEMBER, 1922

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Canada	Total
Waterworks	......	$278,000	$761,000	$365,000	$209,000	$41,000	$181,000	$1,835,000
Sewers	.....	789,000	389,000	394,000	238,000	286,000	285,000	2,381,000
Bridges		214,000	406,000	32,000	194,000	494,000		1,340,000
Excavation, drainage and irrigation		....	270,000	75,000	220,000	304,000		869,000
Streets and road	$260,000	982,000	7,647,000	2,001,000	5,969,000	1,237,000		18,096,000
Industrial works	1,175,000	5,358,000	554,000	5,356,000	5,128,000	455,000	1,150,000	19,176,000
Buildings	8,640,000	20,726,000	3,410,000	23,708,000	6,179,000	5,111,000	1,832,000	69,606,000
Federal Government		804,000	303,000	59,000	1,155,000			2,321,000
Miscellaneous	218,000	3,898,000	188,000	2,209,000	71,000	513,000	422,000	7,519,000
Total	$10,293,000	$33,049,000	$13,928,000	$34,199,000	$19,363,000	$8,441,000	$3,870,000	$123,143,000

TABLE II—VALUE OF CONTRACTS LET IN THE UNITED STATES, JAN. 1, 1922 TO JAN. 1, 1923

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total
Waterworks	$2,770,000	$7,435,000	$3,587,000	$6,512,000	$11,340,000	$4,576,000	$36,220,000
Sewers	653,000	10,608,000	4,125,000	18,286,000	6,785,000	3,127,000	43,584,000
Bridges	2,341,000	16,539,000	8,536,000	5,205,000	7,052,000	3,804,000	43,477,000
Excavation, drainage and irrigation	118,000	918,000	9,093,000	1,813,000	4,477,000	3,132,000	19,551,000
Streets and roads	10,573,000	72,961,000	73,944,000	76,136,000	63,614,000	37,466,000	334,694,000
Industrial works	33,744,000	59,587,000	21,767,000	57,365,000	15,753,000	9,925,000	198,141,000
Buildings	65,298,000	281,521,000	44,366,000	225,628,000	72,913,000	61,036,000	750,762,000
Federal Government	2,686,000	16,313,000	8,105,000	3,380,000	4,052,000	9,016,000	43,552,000
Miscellaneous	5,359,000	49,968,000	4,626,000	10,148,000	7,553,000	8,915,000	86 569,000
Total	$123,542,000	$515,850,000	$178,149,000	$404,473,000	$193,539,000	$140,997,000	$1,556,550,000

World Economic Situation For 1923

By Secretary of Commerce Herbert Hoover

The following summary of the world's economic situation and prospects is based upon the special investigation of representatives of the United States Department of Commerce, in each foreign country:

In the large view the world has made distinct economic progress during the past year and the conditions are very favorable to continued progress during 1923. There are in exception three or four states in Europe which give continued anxiety, but these exceptions should not obscure the profound forces of progress elsewhere over the whole world. In the main even in these areas of uncertainty the difficulties are to a large degree fiscal and political rather than commercial and industrial.

During the year the world generally has gained in social stability: Bolshevism has greatly diminished and even in Russia has been replaced by a mixture of socialism and individualism; at least active war has ceased for the first time since 1914; famine and distress have diminished to much less numbers this winter than at any time since the great war began; production has increased greatly during the past year; unemployment is less in world totals than at any time since the armistice; international commerce is increasing; the world is now pretty generally purchasing its commodities by the normal exchange of services and goods, a fact which in itself marks an enormous step in recovery from the strained movements of credit and gold which followed the war.

In our country unemployment has ceased to be a problem and we are indeed upon an economic level of comparatively great comfort in every direction except for the lag of recovery in some branches of agriculture. Even in this field there has been a distinct improvement in prices in the past twelve

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Labor Rates and Conditions Throughout the Country

A shortage of freight cars proves to be the most serious of the several impediments, now confronting the industries of the country. Production records, with an adequate supply of freight cars, would soon approach the peak levels of 1919-1920, despite seasonal declines. The car situation, however, is due to a combination of circumstances, involving the following factors: (1) Coal miners' strike during the summer; (2) Tremendous volume of freight piled up; (3) Lack of cars to haul materials to build new cars or repair old ones; (4) Claim on the part of railroads that their industry is unprofitable, also that insufficient capital is being attracted to permit of investments in unusual expansion of freight equipment.

Labor shortage has handicapped some industries and that, combined with restricted immigration, has seriously hampered industrial activities, causing wages to trend upward.

Construction activities have only slackened to a degree consistent with normal seasonal slow-down. The building season, however, in the face of an unsatisfied housing demand, has been extended much further into the winter months than was expected; and promises to continue in this direction, weather permitting.

Local industrial conditions as reported by *Engineering News-Record* correspondents are as follows:

Atlanta—Weather mild; building continues active with many new projects under way.

Boston—Plenty of building trades mechanics. Common labor rate 50@60c. as against 50@55c. per hr. one month ago.

Cincinnati — Carpenters on strike. Brick layers reduced to $1.25, from $1.35 per hr. All classes of building labor plentiful.

Dallas—Enough hodcarriers and common laborers; limited supply of other crafts.

Denver—Building trades 100 per cent employed. Construction work continuing without interruption.

Detroit—Seasonal slackening of building construction causing larger supply of workmen in all trades. No great surplus evident yet.

Kansas City—Few carpenters available; other trades plentiful. Better grade of common laborers scarce; wage scale reduced from 40@50c. to the present rate of 30@50c. per hr.

Montreal—Labor, all classes, plentiful. Common laborers receive 30c. as compared with 30@35c. per hr., one month ago.

New York—Conditions point to the continuance of the 1921 wage scale. Scarcity of skilled building trades mechanics; plenty of common laborers. Wage rate for pick and shovel men, 45@50c. per hr., at excavating work; 60c. per hr. on buildings.

Pittsburgh—No labor shortage in construction industry. Range of common labor rates, 40@60c. per hr.

St. Louis—Bricklayers rate, $1.25; being paid $1.37½ per hr. because of extreme shortage. Carpenters rate, $1.10; plan to demand $1.25 per hr. after May 1, 1923. Few being paid above scale at the present time. Hoisting engineers will ask increase of 12½c. per hr. on May 1; similar demand to be put forward by structural iron workers, March 1. Plasterers granted increase of 12½c., effective Dec. 1, 1922; helpers receive same wage advance Jan. 1, 1923. General move for higher wage rates in spring, anticipated.

San Francisco—Bricklayers awarded advance of 12½c.; hodcarriers, 6¼c. and common laborers, 2½@6¼c. per hr., effective Jan. 2, 1923. Plenty of work for all trades.

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90	$0.70	$0.70	$0.30	.....	$0.65	$0.30@.35
Baltimore	1.25	.80	.87½@.90	.60@.75	$0.75	1.00	.35@.40
Birmingham	1.00	.75	.50@1.00	.15@.25	......	1.00	.20@.25
Boston	1.25	1.00	90@1.00	.75@.80	1.00	1.00	+.50@.60
Cincinnati	—1.25	.95	.95	.72½	.....	.95	.35@.40
Chicago	1.10	1.00	1.10	......	1.10	1.05	.72½
Cleveland	1.25	1.10	1.10	.75	.91	1.10	.75
Dallas	1.37½	1.00	1.00	.40	.87½	1.00	.30@.50
Denver	1.25	1.00	1.00	.75@.81¼	1.00	1.03⅛	.35@.50
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.12½	1.00	+1.00@1.25	.80	1.00	—1.00	.30@.50
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.56¼@.62½
Minneapolis	1.00	.80	.80	.65	......	.80	.35@.50
Montreal	.90	.65	.50	.35	.50	.65	.30
New Orleans	1.00	.85	.90	.65	.80	1.00	.35@.40
New York	1.25	1.12½	1.25	.87½	1.00	1.12½	.45@.60
Pittsburgh	1.30	1.12½	1.00	.90	1.00	1.00	.40@60
St. Louis	1.25	1.10	1.12½	.85	1.12	1.12½	.30@.45
San Francisco	+1.25	1.00	1.00	+.81¼	1.00	1.12½	+.50@.56¼
Seattle	1.00	.80	.90	.70	1.00	.80@.90	.50@.60
Philadelphia	1.25	.90@1.00	.90@1.00	.75@.90	1.00	.90@1.00	.35@.45

months and its troubles are mostly due to over production in some lines. Our manufacturing industries are engaged well up to the available labor; industrial production has enormously increased over last year; real wages and savings are at a high level. Our transportation and housing show great gains in construction, though we are yet behind in these equipments. Both our exports and our imports are again increasing after the great depression and are today far above prewar levels.

Outside of Europe the whole world has shaken itself free from the great afterwar slump. The economic wounds of Asia, Africa, Latin America, and Australia from the war were more the sympathetic reaction from slump in the combatant states than direct injury. Their production and commerce has recovered to levels above prewar. The enforced isolation of many areas in Latin America and Asia during the war has strengthened their economic fibre by increased variety of production and has contributed vitally to their effective recovery.

In Europe, England together with the old neutral nations are making steady progress in production and diminishing unemployment. Their trade and commerce are improving; their governmental finances are growing stronger; their currencies that are not already on a gold basis are steadily approaching par; and their exchanges are more stable. The combatant states on the Continent are slower in recovery. Even these nations, including Russia, have shown progress all along the line in commercial, industrial, and agricultural fields although the harvests suffered in some spots. Some of these nations such as Italy, Belgium, the Baltic States, Poland, Czechoslovakia, and Hungary show increasing political and social stability and improvement in their Governmental finances. In Germany and some minor states in southeastern Europe governmental finance and political difficulties threaten to overwhelm the commercial and industrial recuperation already made.

The continued maintenance of armies on a greater than pre-war basis in the old Allied states maintains political uncertainty, lowers productivity, and retards the balancing of budgets with consequent cessation of direct or indirect inflation. Disarmament and the constructive settlement of German reparations and the economic relations of states in southeastern Europe are the outstanding problems of Europe, and their adjustment to some degree will affect the progress of the rest of the world. The more general realization during the past year of the growing menace of these situations and the fundamentals that underlie their solution is in itself some step toward progress. Their solution would mark the end of the most acutely destructive forces in the economic life of the world which still survive the war.

Economic forecast cannot amount to more than a review of tendencies and a hazard in the future. The odds are favorable for 1923; the world begins the year with greater economic strength than a year ago; production and trade are upon a larger and more substantial basis, with the single exception of the sore spot in Central Europe.

The healing force of business and commerce has gained substantial ascendency over destructive political and social forces. There is ample reason why there should be continued progress during the next twelve months.

Tax-Exempt Securities Amendment Opposed

Washington Correspondence

Such opposition was developed in the House of Representatives against the proposed constitutional amendment aimed at tax-exempt securities that the consideration of the bill has been put over until late in January. Many are of the opinion that no further effort will be made to call it up. Even if it is brought to a vote later in the session, it is very doubtful if the proponents of the measure can muster the necessary two-thirds majority required to adopt a constitutional amendment.

The principal arguments advanced for the amendment are that tax-free securities shift taxation from the rich to the poor; that they divert capital from productive enterprises; create unrest because of the avenue afforded certain citizens to escape taxation, and that they encourage extravagance in municipal expenditures.

Opponents of the measure contended that the national government should not have the power of imposing taxes upon the bond issues of the cities, towns and counties. To do so, they believe, simply would transfer the burden to the people who issue the bonds and who in the course of time, must redeem them. It was contended that it would paralyze the farm loan system an the great program of internal development, including highways, reclamation projects and the building of schools. Much of the influence behind the amendment, it was stated on the floor of the House, comes from those who already own large blocks of tax-exempt bonds, since the ratification of the amendment would increase enormously the market value of the tax-exempt securities already issued.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig-Iron—Market quiet following recent wave of buying; prices show average decline of $2 per ton since last month. Higher quotations, however, considered unavoidable owing to recent stiffening of fuel costs.

Railway Supplies—Minimum on light rails $40@$42 per ton at mill; $10 higher than year ago. Slight rise in red oak ties in Middle West. Track bolts, 10c. per 100 lb. cheaper at mill.

Pipe—Cast-iron pipe, 6-in., $43 as against $43@$43.50 per ton, last month, at Birmingham mill. Decline of $2 reported in San Francisco. Prices lower on 4 and 6-in. in Chicago and on 4-in. in New York. Sharp drop on clay-drain tile in St. Louis. Slight declines in sewer pipe in St. Louis and Boston. Wrought steel and iron pipe prices firm.

Road and Paving Materials—Road oil prices unchanged; demand light. Asphalt up 50c. per ton in Boston; declined sharply in Seattle during month. Granite paving blocks advanced $2 per M. in Philadelphia. General tendency of flagging and curbing prices upward, in New York and Middle West. Wood blocks, 3½ in., $2.26 as against $2.32 in Boston and $2.46, compared with $2.48 per sq.yd. in Philadelphia.

Sand, Gravel and Crushed Stone—Sand-prices firm throughout country. Gravel, at minimum of $2.25 per cu.yd. in Detroit as against $2@$2.25, one month ago; due to increased handling costs in cold weather and also higher labor. Crushed stone up 5c. per cu.yd. in Boston; declines reported in Atlanta, Cincinnati and St. Louis.

Lime—Hydrated finishing, down $10; common hydrated, $1 per ton in St. Louis, during month. Minneapolis also reports drop of $1 per ton in common hydrated. Boston quotes advance of $1.50 in hydrated finishing; $1 per ton in hydrated common and 15c. per bbl. in lump finishing.

Cement—Reduction of 15c. per bbl. at Buffington, Ind., mills; 10c., at Universal, Pa. and Steelton, Minn. Mill reduction reflected in similar drop in quotations, f.o.b., fourteen Middle Western cities.

Structural Steel—Tendency higher in finished steel, following advances in coke and scrap prices. Plates, shapes and bars firm at $2 per 100 lb., Pittsburgh, with few attempts at price shading. Heavy buying of ship and tank plates and car materials. Wire products up $1@$2 per ton at mill.

Brick and Hollow Tile—Common brick, $20 as against $15@$15.50 per M., alongside dock, New York, one month ago. No shortage; demand unusual for this season of the year. Dallas also reports advance of $1 per M. Brick down, $2 in Boston; $1.50, in Atlanta and 50c. per M. in Detroit. Few changes in hollow tile. Slight advances in Atlanta and Montreal; decline in Boston.

Lumber—Car shortage main factor in holding prices up; scarcity, however, being slowly relieved. With better deliveries, prices are expected to lower. Yellow pine structural timbers, base sizes, up $10 in Boston and $2 per M. ft. b.m. in Detroit; down, $1.50 in St. Louis, $2 in Minneapolis and $7.50 in Cincinnati, during month. Fir high along Atlantic Seaboard and in Middle West. Hemlock down; spruce advanced.

Scrap—Market stronger; demand for first quarter improved. Prices firm in New York, Chicago and St. Louis.

Explosives—Price tendency upward; 40@60 per cent gelatin dynamite, higher in Cincinnati, 40 per cent, up in Philadelphia.

Linseed Oil—Raw oil 93c. as against 90c. per gal., one month ago, in New York; Chicago, 98c., compared with 95c. Dallas advanced 2c. and Atlanta dropped 3c. per gal. in week.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$27.55	$22.50
Northern Basic	*28.27*	22.02
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	*29.27*	23.52
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	*33.44*	28.50
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	*23.00*	18.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@ 2.75 sil.)	*28.76*	22.26
Virginia No. 2 (silicon 2.25 @ 2.75)	*33.17*	28.74
Basic	27.50	20.75
Gray Forge	*28.14*	22.50
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	*28.00*	21.70
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	*28.51*	24.66
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	*25.00*	22.46
Basic	*24.25*	20.96
Bessemer	*27.50*	21.96

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43 00	$40 00		$43 00	43.00
Standard openhearth rails	43 00	40 00	$43 00	43 00	43.00
Light rails, 8 to 10 lb.	40.00	31@32	2 00*	43.00	43.00
Light rails, 12 to 14 lb.	42.00	31@32	2.00*	43.00	43.00
Light rails, 25 to 45 lb.	42.00	31@32	2.00*	43.00	43.00
Rerolled Rails	28@30	....	.....	......	....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.40	$1.55
Chicago, Hardwood and Red Oak	1.25	1.40
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco...... Green Douglas Fir	.84	1 17
San Francisco, Empty Cell Creosoted, Douglas Fir	1.60	2.25
St. Louis, White Oak	1 30	1.55
St. Louis (creosoted) (zinc treated)	1.70	2.05
St. Louis, Red Oak, plain	1 15	1.40
St. Louis, Sap pine-cypress	1.05	1.30

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, 9/16-in. and larger	$2.75	$2.25	$2.55	*$3.60*	$4.45	$3.29
Track bolts	3 75@4 50	3.25@3 50	3 65	*4 70*	5 45	4 29
Standard section angle bars	2 75	2.40	2 40	*3 45*	4 10	2 94

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	66	54½	¾ to 1½	34	19

LAP WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
2	59	47½	2	29	15
2½ to 6	63	51½	2½ to 4	32½	19
7 to 8	60	47½	4½ to 6	32½	19
9 to 12	59	46½	7 to 12	30	17

BUTT WELD, EXTRA STRONG, PLAIN ENDS

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 1½	64	53½	¾ to 1½	34	20
2 to 3	65	54½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
2	57	46½	2	30	17
2½ to 4	61	50½	2½ to 4	33	21
4½ to 6	60	49½	4½ to 6	32	20
7 to 8	56	43½	7 to 8	25	13
9 to 12	50	37½	9 to 12	20	8

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	57%	62½%	**57%**
2½ to 6 in. lap welded	54%	59½%	**54%**

	Galvanized New York	Galvanized Chicago	Galvanized St. Louis
1 to 3 in. butt welded	44%	48½%	44%
2½ to 6 in. lap welded	41%	45½%	**41%**

Malleable fittings, Class B and C, from New York stock sell at list less 10% Cast iron, standard sizes, *32-5%* off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York Current	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	*$47.00*	*$54 50*	$50.30	*$55.20*	$53.10	*$56.00*
6 in. and over	*43.00*	**59 00**	47.30@48.30	*51.20*	49.10	*52.00*

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45 00	$40 00	*$40 00*	$50.00	....	$55.00
4	55.00	50.00	*40 00*	60.00	$76.50	65 00
5	80.00	80.00	*75.00*	80.00	97.75	84 00
6	105 00	105.00	*75.00*	100.00	127.50	110 00
8	170.00	175.00	*165.00*	150.00	212.50	181.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0 14	$0 105	.	.	$0 12	$0 12	......
4	14	105	$0 10	$0 0875	.12	.15	$.175
5	.20	.1575	.125		.18	.18	.20
6	.20	1575	150	*1225*	18	21	.2625
8	.34	245	.225	.2000	28	30	.435
10	.51	3675	.2925	.2800	42	42	64
12	.65	.4725	.3825	.36	.54	.54	82
15	1.03†	.63	.5625	.52	.72	.90	1 18
18	1.50†	875	.765	.68	1.00	1.32	1 65
20	1.80†	1 05	1.0125	.92	1.20	......	.....
22	2.40†	1 40	1 2375	. .	1 60	.....	2 10
24	2.70†	1 575	1.4625	1.20	1 80	2 16	2.73
27	4.50†	2 795	....	2.45†	3.75†	3 00	.. ..
30	5.00†	3.096	.	3.00†	4.75†	3.60	.....
33	6.50†	4.14	....	3.55†	5.50†	. ...	....
36	7.50†	4.715	. .	3.96†	6.00†	......	.....
	3	5	8	12	24	36	
Boston	*$0 12*	*$0 185*	$0 29	*$0 75*	*$1 545†*	*$5.535†*	
Minneapolis	......	.. . .	40	72	2 55	5.66†	
Denver	.135*	18*	27	47	1 70	....	
Seattle	13	. .	325	.65†	2 34	.....	
Los Angeles	. .	..				....	
New Orleans	.1120*	168*	28	.476	1 82†	....	
Cincinnati	.111*	1665	259	.4995	1 665	**4 407†**	
Atlanta	.108*	162*	.27	.459	1 75	. ..	
Montreal, *delivered*	68‡	45†	70	1.35	4 50†		
Detroit	.102	153	238	.459	1 98†	6 15†	
Baltimore	....					.	
Kansas City, Mo.	135	19	30	54	2 16		
Philadelphia	12	18	28	54	1 80†	4 10†	

*4-in., 6-in., 9-in., respectively †Double Strength. ‡3-[illegible] period

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named

	Current	One Year Ago
New York, 45% asphalt (at terminal)	$0.06	$0.0[illegible]
New York, 65% asphalt (at terminal)	.06	.05½
New York, binder (at terminal)	.06½	.07½
New York, flux (at terminal)	[illegible]	.06
New York, liquid asphalt (at terminal)	.07	.06½
St. Louis, 50@60% asphalt	[illegible]	.0[illegible]*
Chicago, 40-50% asphalt	[illegible]	.05
Chicago, 60-70% asphalt	.05	.05½
Dallas, 45% asphalt	.040	.10
Dallas, 55% asphalt	.048	.13
Dallas, binder	.053	.15
San Francisco, binder, per ton	9.50†	15.00†

* Freight $21.75 per ton [illegible]

† F.o.b. Oleum, Cal. Freight to San Francisco 80c. per ton

ASPHALT—Price per ton in packages (350-lb. bbl. or 425-lb drums) and in bulk in carload lots, f.o.b. points listed

	Package	Bulk
New York (*Mexican*)	$20 00	$16.00
Boston (*Mexican*)	**19 50**	**16 00**
Chicago (*Stanolind*)	26 00	22 00
San Francisco, *f.o.b. refinery*, Oleum, Cal	17.00*	11 00*
Dallas, (*Texas*)	*26 00*	*18 00*
Seattle "*D*" *grade* (*California*)	23 75	13 00†
Denver (*California*)	40 00	
Minneapolis *f.o.b. Twin Cities* (*Stanolind*)	*28 25*	*21 90*
St. Louis (*Mexican*)	25 00	21 00
Baltimore (*Mexican*)	.	.
Los Angeles, *at factory, Bakersfield* (*California*)		
Montreal (*Mexican*)	28.00	21.00
Atlanta (*Mexican*)	22 00	16 50
Detroit (*Mexican*)	23 68	18 95
Cincinnati (*Mexican*)	22.50	19 50
Maurer, N. J. (*Trinidad and Bermudez*)	28.00	26 00
Maurer, N. J. (*Mexican*)	18.00	15 50
Philadelphia (*Mexican*)	20 00	16.00
Kansas City, *petroleum*	28.83	22.83

*Freight to San Francisco, 80c. per ton.

†F.o.b. Richmond, Cal.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums, 200 to 300 gal. to the ton.

PAVING STONE—

New York	5-in. granite, 30 blocks per sq.yd.	$4.45 per sq.yd.
Chicago	About 4x8x4 dressed About 4x8x4 common	3.35 sq.yd. 3.10 sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M
Boston	5-in. granite	2.00 per sq.yd.
Atlanta	Granite	2.10 sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	100.00 per M
Baltimore	Granite	
Montreal	Granite	100.00 per M
New Orleans	Granite, 4 x 8 x 4	3.25 sq.yd.
Cincinnati	Granite	1.35 per M.
St. Louis	4x8x4 dressed 4x8x4 common	3.10 sq.yd. 2 90 sq.yd.
Kansas City	Granite	3.95 sq.yd.
Philadelphia	Granite	**130 00** per M.

FLAGGING—

New York	Bronx, 5 ft Manhattan, 4 ft Queens, 5 ft 6x20-in. cross-walk	**$0.50** sq.ft .**35**@ .**40** sq.ft. .**35**@ **40** sq.ft. 1.00 lin.ft.
Chicago	18 in. wide	.99 lin.ft.

CURBING—Bluestone per lineal foot, delivered in New York, costs **$2.40@2.75** for 5x16 in.; **$3.50@4.00** for 5x18 in. 5x18 in., *$1.40* per lin.ft. delivered in St. Louis. 6x18 in., Chicago, $2 per lin.ft.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2 21
New York (*delivered*)	3½	16	2 30
New York (*delivered*)	4	16	2 77
Boston	3½	16	*2 26*
Chicago	4	16	3.00@3 25
Chicago	3½	16	2.50
St. Louis	3½	16	2.00
St. Louis	4	16	2.00
Seattle	4	16	Off market
Minneapolis	3½	16	2 09
Atlanta	3½	16	2.30
New Orleans	3	16	*1.75*
New Orleans	3½	16	1.95
New Orleans	4	16	2.25
Dallas	4	18	3.90
Baltimore	3½	16	..
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	2.35
Kansas City	4	16	3.25
Philadelphia	3½	16	*2 46*

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel				Sand	
	1½ In.		¾ In.			
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
New York	$2 00	$1.75	$2.00	$1.75	$1.00	$1.00
Denver	1 90	2 50	1 90	2.50	1.30	1.10
Chicago	2.25	2.00	2.25	2.00	2.25	2.00
St. Louis, *per ton*	1 45	1 25	1 50	1 30	1 45	1 20
Seattle	1 00	1 50	1 00	1.50	1 00	1 50
Dallas	*2 25*	2 00	*2 25*	2 00	*1 87½*	2 00
Minneapolis	1.75*	1.50	1.75*	1.50	1.00	0.50*
Cincinnati	*1 25*	1 00	1 25	1 50	1 15	1.50
San Francisco	2.15	2.25	2.15	2.25	1.50	1.50
Boston	1 40	2 65	1 40	2 65	1.10	2.00
New Orleans	2.85	2.08½	2.85	2.08½	1.35	1.35
Los Angeles, per ton	....	1.35	....	1.35	....	1.20
Atlanta, per ton	1 75	1 85	1 75	1 85	1 32	1.25
Detroit	2.25	2.00	2.25	2.00	2.00	2.00
Baltimore, per ton	....	1 40	....	1.60	....	2.00
Montreal, per ton	1.25	1.25	1.50	1.50	1.25	1.25
Birmingham, per ton (Crushed slag used instead of gravel)					1.25	1.28
Philadelphia	1 70	1 50	1 75	1.57	1.65	1 80
Kansas City, per ton	2.00†	....	2.00†	....	0.66*	

New York—Grit, $1.75 per cu. yd.

Los Angeles—Freight from quarry, 70c. per ton, and is included in above price

* At pit.

† Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In.		¾ In.	
	Current	One Year Ago	Current	One Year Ago
New York	$1.65	$1.80@1.90	$1.75	$1.80@1.90
Chicago	2 25	1.60	2 25	1.60
St. Louis *delivered*	*2.00*	1.65*	*2.10*	1.65*
Dallas	1.65	2.93	1.65	2.93
San Francisco	2.15	2.25	2.15	2.25
Boston, *delivered*	**1.70**	3.00*	**1.70**	3.00*
Minneapolis, *at plant*	2 00	2.00	2.25	2.25
Kansas City	2.40	2.75	2.40	2.75
Denver	3.50	3.50	3.50	3.50
Seattle *delivered*	3.00	3.00	3.00	3.00
Atlanta	2.00*	2.00*	2 00*	2.00*
Cincinnati *delivered*	*1.80**	2.37½	*1.80**	2.08
Los Angeles	.....	1.60*	.....	1.70*
Detroit	1.90@2*	1.90*	1.90@2*	1.90*
Baltimore	....	1.75*	....	1.65*
Montreal	1.80*	2.00*	1.90*	2.10*
Birmingham *delivered*	3.20	3.20	3.10	3.10
Phildelphia	1.75*	1.70	1.60*	1.55
Pittsburgh	2.85	..	2.85	....
Cleveland	3.00*	....	3.00*	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1 30	$1 30	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
East Canaan, Conn.	1.25	1.35	4 00	1.00
Easton, Catasaqua, Pa	1.00	1.00	2.00	0.90
Birmingham, Ala	*1.00*	*1.00*	*1.00*	*1.00*
Buffalo, N. Y., and Erie, Pa	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.20	1.20	...	1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2.00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$16.80@*$17.10*	$13.10	$3.63½*	$2.75@$3.13½*
Chicago	18.00	18 00	1.50†	1.40†
St. Louis	*22 20*	*19.00*	18.75‡	18.00‡
Boston	**18 50**	**14.00**	**3.90***	**3.00***
Dallas	22 50	.		2.50†
Cincinnati	15.80	13 30	....	10.75‡
San Francisco	22 00	16.00	....	1.75†
Minneapolis	25.50	*21.00* (white)	*1.55*†	1.40†
Denver	24.00	.	....	2.70†
Detroit	19.50	17.50	...	18.25‡
Seattle *paper sacks*	24.00	.....	2.80†	.....
Los Angeles	. .	....	....	.....
Baltimore	.....	....	....	.....
Montreal	21.00	21 00	15.00‡	11.00‡
Atlanta	23.00	13.00	2.25†	1.85†
New Orleans	. .	17.25	2.40†	..
Philadelphia	15.50	14.50	13.00‡	12.00‡
Kansas City	25.60	24.00	2.40†	2.40†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.55, Sheboygan $1.45. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	*1.50*	1.60
Atlanta (Magnolia)	11.00 ton	11.00
Cincinnati (Utica)	1.72	1.93
Boston (Rosendale) per bag	...	0.85@0.95
St. Louis (Carney)	*1.75*	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Dec. 7	One Month Ago	One Year Ago
New York, del. by truck	$2.60@2.70	$2.60	$2.20@2.30
New York, alongside dock to dealers	2 30	2.30	2.00
Jersey City	2 48	2.48	2.12
Boston	2.85	2.85	2.52
Chicago	*2.05*	2.20	1.97
Pittsburgh	*2 14*	2.24	2.02
Cleveland	*2.36*	2.46	2.26
Detroit	*2.33*	2.47	2.17
Indianapolis	*2.26*	2.41	2.21
Toledo	*2.33*	2.48	2.20
Milwaukee	*2.22*	2.37	2.18
Duluth	*2.04*	2.14	1.95
Peoria	*2.26*	2.39	2.13
Cedar Rapids	*2.33*	2.45	2.26
Davenport	*2.28*	2.43	2.21
St. Louis	2.35	2 35	2 20
San Francisco	2.71	2.71	2 84
New Orleans	3.30	3.30	3.20
Minneapolis	*2.29*	2.39	2.24
Denver	2.85	2 85	3.10
Seattle	2.90	2.90	3.10
Dallas	2.25	2 25	2.55
Atlanta	2 54	2.54	2.55
Cincinnati	*2.39*	2 51	2.35
Los Angeles	...		3.31
Baltimore	.	2.90	2.50
Birmingham	2.40	2.40	2.27
Kansas City	2.45	2.45	2.45
Montreal	2 88	2.88	3.10
Philadelphia	2.51	2.51	2.23
St. Paul	2.29	2.39	2.24

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags; to contractors:

Buffington, Ind	*$1.80*	Mason City, Ia	$2 05
Universal, Pa.	*1 [illegible]*	La Salle, Ill	2.05
Steelton, Minn.	*1 85*	Hudson, N. Y	2.20
Fordwick, Va	2 20	Leeds, Ala	2.20
Mitchell, Ind	2 05	Hannibal, Mo	2.10
Iola, Kan	2.10	Lehigh Valley District	2.10

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style number	Weight in Pounds per 100 sq.ft.	Pittsburgh, Mill	Warehouse New York	Chicago	Dallas	San Francisco
032	22	$0 85	$0 95	$0 92	$1 172	$1 03
049	28	1 08	1.23	1 18	1 488	1 34
068	35	1 31	1 48	1 43	1 835	1 64
093	45	1 69	1 91	1 84	2 345	2 10
126	57	2 08	2.35	2 27	2 917	2 60
153	68	2 48	2 81	2 71	3 468	....
180	78	2 85	3.22	3.12	4 08	.....
245	103	3 76	4.25	4 11	5 253	.....
287	119	4 34	4.90	4 74	6 079	5 43
336	138	5 04	5.69	5 51	6.458	.....
395	160	5.84	6.60	6.38	8 16	.....
PAVING						
036P	17	$0.65	$0.72	$0 71	$0 897	.....
053P	24	.91	1.02	99	1 284	.....
072P	31	1.15	1 29	1 26	1.601	.....
097P	40	1.48	1.67	1.62	2 06	.....
049R	24	.91	1 02	.99	1.264	.....
067R	31	1 15	1 29	1.26	1 601	.....
089R	40	1.48	1.67	1.62	2 06	.....

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27Dia.	2.3	$22 00	$20 39	$20 22	$20 78	$25 50
26 "	2.5	22.00	21 93	21 64	21 43	27 58
25 "	3.0	22 00	24 45	24 28	.....	30 71
24 "	3.4	24 00	26 33	26 10	24 28	33 16
22 "	4.33	27 00	31 06	30 77	......	35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut New York	Chicago	St. Louis	Dallas	San Francisco
¾ and larger....	$2 00	$2 35	$3 04	$2 92	2 75	$3 15	$3 35
⅝............	2 05	2 45	3 09	2 97	2 80	3 20	3 40
½............	2 10	2 55	3 14	3 02	2 85	3 25	3 45
⅜............	2 25	2 60	3 19	3 17	2 95	3 40	3 60
¼............	2 50	2 65	3 54	3 42	3 20	3 65	1.85

Includes 15c charge for cutting to lengths of 2 ft. and over.

Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¾ and larger	$2 10	$2.45	$3 50	⅜........	$2 35	$2 75	$3.95
⅝ in........	2.15	2.50	3 75	¼........	2 60	3 00	4 20
½..........	2.20	2.55	3.80	....	.....	.. ..	....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common Current	One Month Ago	One Year Ago	Paving Block 3-inch*	4-inch*
New York (del.)......	$23 50	$18.00@18.55	$17.40@18.40	$42 00†	$50 00†
New York (at dock)...	20.00	15@15.50	14@15	......	..
Chicago	11 00	11 00	11.00	34 00	42 00
St. Louis, salmon......	15.00	15.00	16 00	35.50	40.00
Denver, salmon......	12 00	12.00	14.00	......	......
Dallas..............	10 90	9.90	12 65	no market	
San Francisco	15 50	15.50	15.50	......	....
Los Angeles (del.)......	.. ..	..	15 50	(not used)	
Boston (del.)	20 00	22 00	17.00	70.00	70 00
Minneapolis (del.).....	18@19	18@19	15.00	.....	43 00
Kansas City.......	14 50	14 50	14 50	....	......
Seattle............	14 00	14 00	14 00	44 00	.....
Cincinnati	17 00	17.00	19.00	42 00	42.00
Montreal	16 00	16 00	16 00	70.00	75 00
Detroit (del.)........	16.50@17.00	17 00	15 00	36.50	39.50@41
Baltimore (del.).......	....	20 00	20.00		.. ..
Atlanta	10 00	10 00	9 00	39.00	......
New Orleans..........	15 75	15 75	14 00	......	......
Birmingham	12 50	12.50	11.50	......	......
Philadelphia..........	20@28	20@28	16.00	40.00	48.00
Pittsburgh (del.)	16.00	16 00	......	.	.. .
Cleveland	16 00	16.00	......		....

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York Current on Trucks*	New York One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12...	$0.123	$0.1112	$0 0674	$0 12	$0 088	$0 108	. .
6x12x12...	.1844	1667	0926		114	156	
8x12x12...	.2305	.2084	1263	1875	16	244	$0.2147
10x12x12...	....	. .	1621	......	.18	......	2653
12x12x12...	....	. ...	1853	....	22	......	3448

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston	$0.1015	$0 1904	
Minneapolis (f.o.b. cars).....	0 0696	.115	$0 204
Minneapolis (delivered).......	0796	13065	.229
Cincinnati	0859	.1611	....
Kansas City..............	083	105	..
Denver	.065	123	.188
Seattle (delivered)	11	25	.36
Los Angeles factory	.....	...	.. .
New Orleans	.12	23	.36
Detroit (delivered)..............	.09	175	.26
Montreal	.115	225	.30
Baltimore..............	. .		..
Atlanta..............	.0859	1615	......
Dallas..............	.115	...	......
Birmingham	.11	18	......
Pittsburgh (delivered) .	.068	.128	.179
Cleveland	.08	164	

San Francisco, Philadelphia, Atlanta, New York and Chicago quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburg and Birmingham together with quotations per 100 lb. from warehouses at place named:

	Pittsburgh, Mill	Birmingham Mill	Warehouse New York	Dallas	St. Louis	Chicago	San Franciso
Beams, 3 to 15 in. ..	$2.00	$2 40	$3.14	$4 40	$3.00	$3 02½	$3.25
Channel, 3 to 15 in...	2 00	2.40	3.14	4 40	3.00	3 02½	3 25
Angles, 3 to 6 in., ¼ in. thick..............	2 00	2.40	3.14	4 40	3 00	3 02½	3 25
Tees, 3 in. and larger...	2.00	2.40	3 14	4.40	3.05	3.02½	3.25
Plates..............	2.00	2.40	3 14	4.50	3.00	3.02½	3.35

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	Warehouse New York Current	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
¾ in. and larger	$3.00	$3.85	$3.50	$3.75	$3.85	$4 75	$5 25
CONE HEAD BOILER							
¾ in. and larger.	$3.10	3.95	3.60	3.85	3.95	4.85	5.40
⅝ and 11/16........	3.25	4.11	3 76	4 00	3.95	5.00	5 55
½ and 9/16.... ...	3.50	4.35	4 00	4 25	3 95	5 25	5.80

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.........	$2.80	$3.45	$4.00	$4 40	$3.11	$4 95
Cut...........	3.35	5.50	5.65	6.90	3.26	5 00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square, f.o.b., as follows:

	New York 1-Ply l.c.l.	New York 2-Ply l.c.l.	New York 3-Ply l.c.l.	Philadelphia 1-Ply l.c.l.	Philadelphia 2-Ply l.c.l.	Philadelphia 3-Ply l.c.l.
No. 1 grade....	$2 10	$2 55	$3.00	$1 90	$2 35	$2 80
No. 2 grade....	1.85	2 15	2 55	1.70	2 00	2 40

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.95 per roll in carload lots and $2.20 for smaller quantities f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.50 per package (sufficient to cover 50 sq.ft.) in carloads; $5.75 in smaller quantities, in Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia. l.c.l., $5.90

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft...........	$2.00
Tar pitch (in 400-lb. bbl.), per 100 lb	1 65
Asphalt roofing (in barrels), per ton, f.o.b. plant*......................	40.50
Asphalt felt (light), per ton, f.o.b. plant*...........................	64.50
Asphalt felt (heavy), per ton, f.o.b. plant*...........................	68.50

* Delivered in Metropolitan Dist., $3,00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10................	$2 50	4.10	$4.00	$4 35	$4 19
No. 12................	2.60	4.15	4.05	4 40	4 24
No. 14................	2.70	4.20	4.10	4 45	4 29
No. 16................	2.90	4.30	4.20	4.55	4 39
Black					
*Nos. 18 and 20.......	3.20	4.65	4.70	5.70	4.30
*Nos. 22 and 24.. ...	3 25	4 70	4 70	5 75	[illegible]
*No. 26..............	3.30	4.75	4.75	5.80	4 40
*No. 28..............	3.35	4.80	4.85	5.90	4 50
Galvanized					
No. 10................	3.35	4.85	4.85	...	4.60
No. 12................	3.45	4.95	4.95	5.85	4 60
No. 14	3.45	4 95	4 95	5 85	[illegible]
Nos. 17 to 21 .	3 75	5 10		6 15	[illegible]
Nos. 22 and 24	3 90	5 40	5 40	6 30	[illegible]
*Nos. 25 and 26.......	4.05	5.55	5 55	6 45	5.20
*No. 28..............	4.35	5.85	5.90	6.75	5.50

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York Current	New York One Year Ago	Chicago Current	Chicago One Year Ago
Raw in barrels (5 bbl. lots)	$0 93	$0 72	$0 98	$0 74

WHITE AND RED LEAD—Base price in cents per pound

	Red				White	
	Current		1 Year Ago		Current Dry or In Oil	Yr Ago Dry or In Oil
	Dry	In Oil	Dry	In Oil		
100-lb. keg	**13 50**	**15 00**	12.25	13.75	**13 50**	12 25
25 and 50-lb. keg	**13 75**	**15 25**	12 50	14 00	**13 75**	12 50
12½-lb. keg	**14 00**	**15 50**	12.75	14 25	**14 00**	12.75
5-lb. cans	**16 50**	**18 00**	15.25	16 75	**16 50**	15 25
1-lb. cans	**18 50**	**20 00**	17.25	18.75	**18 50**	17 25

LUMBER

Price, wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional

	6, 8 and 12 Ft.	10, 16, 18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$30.00	$33 00	$33.00	$35 00
3x6 and 8	30 00	33 00	33 00	36 00
4x4-6 and 8	30 00	33 00	34 00	37 00
3x10 and 12	30 00	35 00	34 00	38 00
3x14	34 00	35.00	36.00	38 00
4x10 and 12	30 00	33 00	34 00	37 00
4x14	34.00	35.00	36.00	38.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$32 00	$35.00	$37 00
6x14	34 00	37 00	39 00
8x10	32.00	35 00	37 00
8x14	34 00	37 00	39 00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine

	New York*		Chicago	
	20 Ft. and Under	22–24 Ft.	20 Ft. and Under	22-24 Ft.
3x 4 to 8x8	$47 00	$48 00	$46.00	$48 00
3x10 to 10x10	50 00	51.00	49 00	51 00
3x12 to 12x12	54 00	55 00	52 00	54 00
3x14 to 14x14	60 00	61 00	57.00	59 00
3x16 to 16x16	67 00	68 00	61 00	63 00
3x18 to 18x18	80 00	81 00	68.00	70 00
4x20 to 20x20	90.00	91.00	78.00	80 00

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under				12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	**$58 00**	**$110 00**		**$60 00**	**$75 00**	**$120 00**
Seattle		22 00	.	...	...	23 50
New Orleans	**33 00**	.	......	35.00	35 00	.
Baltimore	..	......	......	....		.
Cincinnati	**45 00**	48 00	$48 00	......	50 00	[illegible]
Montreal	50.00	50 00	40 00	38 00	78 00	**90 00**
Los Angeles	....			......	......	
Denver	....	39 75	38 75	38.75	.	39 75
Minneapolis	45 50	**42 75**	41 00	.....	48 00	**43 75**
Atlanta	35 00	...	....	.....	36 00	.
Dallas	45.00	....	....	....	48 00	
Kansas City	38 75	47 00	47 00	49.50	52 75	
Birmingham	32 00	.	..	....	40.00	
Philadelphia	**45 00**	**39 00**	40.00	44.00	55 00	**39 00**
Detroit	**46 75**	**48 25**	.	.....	**55 75**	**48 25**
St. Louis	**44 50**		.		49 50	

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	**$48 00**		**$48 00**	**52 00**	
Seattle	......	$14 50			$15 50
New Orleans, at mill	70.00		.	23 00	
Baltimore	..	..			
Cincinnati	47 50	[illegible]	**68 50**	**40 00**	**80 25**
Montreal	*60.00*	**50 00**	**37 00**	45 00	45 00
Los Angeles	.....			..	
Denver	.....	30 25	30 25		33 25
Minneapolis	48 50	**40 25**	**38 50**	43 75	38 25
Atlanta	18 50	...	.	28.00	..
Dallas	45 00	36 00		48 60	..
Kansas City	77.00	38 50	38 50	74 00	40 00
Birmingham	28 00			30 00	
Philadelphia	**34 50**	**41 00**	40 00	**44 50**	**39 00**
Detroit	**48 75**	**40 00**		**47 00**	**42 25**
St. Louis	[illegible]			[illegible]	

Montreal—Up to 32 ft.; over which, $3.00 per M. ft. increase up to 30 ft.

Birmingham—Quotes carload lots, f.o.b. sidings. $1 50 additional per M. ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractors on large projects.

St. Louis—Wholesale price to contractors, $7@$11 per M. ft. additional.

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M. ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except plate-body), chain, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.

Baltimore	$0.315	Detroit	$.295
Birmingham	.69	Kansas City	.735
Boston	.365	New Orleans	.515
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	[illegible]†
Cincinnati	.295	Philadelphia	.325
Cleveland	.215	St. Louis	.43
Denver	1.275*	St. Paul	[illegible]

* Minimum carload, 40,000 lb.

† Minimum carload, 50,000 lb., structural steel only, 80,000 lb. for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago

Current	One Month Ago	One Year Ago
$2.00@2.05	$2 50	$1 80

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	25%
Patent flattened strand, special and cast steel	25%
Patent flattened strand, iron rope	10%
Plow steel round strand rope	40%
Special steel round strand rope	35%
Cast steel round strand rope	27½%
Round strand iron and iron tiller	10%
Galvanized steel rigging and guy rope	12½%
Galvanized iron rigging and guy rope	+7½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ⅝-in., 8 ft., ¾-in., 6; ⅞-in., 4½; 1-in., 3½; 1½-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	*$0.16¼*	New Orleans	**$0.17¼**
New York	.17	Los Angeles	....
Chicago	.18	Seattle	.18
Minneapolis	.18	St. Louis	**.17½**
San Francisco	.16	Montreal	.30
Atlanta	*.19*	Detroit	.19
Denver	.20	Baltimore	....
Cincinnati	*.17½*	Kansas City	.19½
Dallas	.22	Birmingham	**.20½**
Philadelphia	*.18*		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin	
	40%	60%
New York	$0 27	$0.30
Boston	.22	.24
Kansas City	.2125	.2325
Seattle	.165	.195
Chicago	.22	.25
Minneapolis	.189	.2094
St. Louis	.22	.25
Denver	.2025	.2325
Dallas	.23	.25
Los Angeles	.....	.....
Atlanta	.23	.26
Baltimore	....	....
Cincinnati	**.22**	**.25**
Montreal	.195	.235
Birmingham, *delivered*	.20	.22
New Orleans	.235	.265
San Francisco	.1625	.1925
Philadelphia	**.25**	.28

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.13	$0.17½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.17½	0.22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.19½	0.24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.25	0.34
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$14 50	$11.50	**$14 75@15**
Stove plate	13 50	12.00	13.50@**15.50**
No. 1 machinery cast	18 00	16 50	17@**21**
Machine shop turnings	9 00	4.00	**10.00**
Cast borings	12.00	5.50	10 50@**11**
Railroad malleable cast	15 00	12 50	**18@19**
Re-rolling rails	16 00	13 00	15.50
Relaying rails	28.50	30.00	25@30

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco		Seattle
	Galv.	Black	Black
¼	$6 75	$5.50	$8 00
⅜	6.30	5.05	7.75
½	6.15	4.90	7.70

Pittsburgh base in lots of 200 kegs or more $3.50.

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AND CONTRACTING

E. J. Mehren
Editor

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A Charge Not Proved

THE criminal indictment brought by the federal grand jury at Washington against the seven men associated with the Emergency Construction Committee of the Council of National Defense comprises 63 pages of closewritten typed manuscript. It is not a document lightly to be discussed or considered—for on its proof depends the reputation of men of hitherto unimpeached integrity, but pending a more complete analysis of the charges the following extract, which embodies the gist of the indictment, should be read by the construction industry:

> The defendants, each well knowing the stress under which the United States would be operating because of the sudden necessities arising on account of war conceived the fraudulent scheme and plan of getting control, for their own gain, profit and benefit, and for the gain, profit and benefit of their past and future clients, employers and their friends, of the administration of the immense emergency construction program of the United States during the war, including the determination of the policy to be followed, the form of contract grossly, unconscionably and fraudulently favorable to the contractors and in a like manner and to the same extent unfavorable to the United States, the selection of contractors, the letting of contracts thereunder and the supervision and administration of all emergency construction work of the United States during the war, and to that end did unlawfully and feloniously conspire, combine, confederate and agree together and with divers other persons to the said grand jurors unknown, to defraud the United States by unlawfully and corruptly delaying, impeding, obstructing, perverting, prejudicing, contravening and defeating the administration of its laws and lawful regulations.

Whatever technicalities of the law were violated in those early driving days of the war—and we have no doubt that the necessary cutting of red tape did involve some violations—we refuse to believe that the men back of the construction program were conspirators and traitors. The characters denounced in the intemperate language quoted are so different from those which the accused have been known to possess that every friend, not only of the men indicted but of the whole body of engineers and contractors who were a part of the war building program, will pray for the early trial of the case. A government department which will formulate such an attack and not hasten in every way to attempt to prove its justice is itself a travesty on justice.

The Engineer and the Small Detail

BUSY executives are often pictured as those men devoted only to broad problems of planning and direction. Small details are considered beneath their notice. Yet quite often the small detail, if wrongly handled, will wreck an entire program. Therefore does it happen that details often command executive attention. Particularly does it behoove the engineer and contractor to "cut the corners." *Engineering News-Record* has been publishing for a year a section wherein short cuts in field and office work have been described. More frequently than not contributions to this section have been from men who actually devised the thing described. For this special issue however, a request was sent to a number of executive engineers to supply the "From Job and Office" material. The material herein is an acknowledgement that no matter how busy engineers may be they have time in which to take intimate notice of the outstanding details of original work.

Still Room for More Light

THE consent decree handed down by Federal Judge Knox in dissolving the Gypsum Industries Association is of general interest chiefly as a judicial confirmation of some of the distinctions drawn nearly a year ago by the attorney general between the lawful and the unlawful activities of trade associations. It sheds no new light on the shadowy middle-ground that lies between what is generally accepted as being within the law and what is clearly under its ban. Among the most important of the border-line activities is the collection and compilation of statistics as to capacities, production, stocks and distribution and of the prices involved in completed sales. These were held by the attorney general to be within the law, but Judge Knox's decree falls short of a clear-cut confirmation of his ruling in these particulars. The distinctions that have been drawn are so generally accepted and the debatable ground has been so little narrowed by the decree that it is not easy to understand why it should have aroused so general a stir outside the gypsum industry itself.

Improved Road Building Equipment

ROAD-BUILDING equipment features this week's installment of *Engineering News-Record's* review of developments during 1922 in the construction equipment and materials field, begun last week. Roads of the higher type, as now built, while lacking in the spectacular features of a great bridge or skyscraper, are nevertheless large and complicated structures demanding, on the part of contractors, a great variety of heavy equipment. It has already been stated that the year just passed brought out nothing which could be classified as new in road-building plants, but scores of detailed improvements in standard types of equipment were made by manufacturers. Highway engineers and contractors realize fully that results now attained in road building have been made possible, in large part, by the manufacturers of construction equipment and materials. It is just as important to keep informed regarding improvements in machinery as to follow progress in design and the results of highway research.

International Road Congress

REPRESENTATION by the United States in the Permanent Association of International Road Congresses calls for immediate action by highway officials and the industries interested in highway development. The association is a technical body, composed of delegates from independent countries whose purpose it is to assemble and co-ordinate knowledge on highway engineering and highway transport. Leading all nations in highway construction, the United States certainly should not lack a place in an organization from which it may gain much and to which it should be able to contribute abundantly. To participate, however, an act of Congress is required. The act does not involve an appropriation but merely an authorization to make the expenditure and take the action necessary to membership. The authorization is what the Department of Agriculture now asks for its Bureau of Public Roads. The request is approved by the State Department and by President Harding. Indeed all is accomplished except getting congressional action and this, at a "short session" crowded with bills of larger public concern, requires immediate effort. State and county road officials and everyone in the highway industry should write their congressmen and senators to pass the act of authorization. The action required is hardly more than mere formality, but it will not be taken unless it is urged emphatically.

The Lesson of Low Road Bids

LOW bids characterized highway contracting in 1922. This was particularly true of the early-season contracts. In Wisconsin, which is logically a low-cost state in road construction and where practically 90 per cent of the year's mileage was put under contract prior to May 15 there was a drop of about 30 per cent below 1921 bidding prices. In other states a similar if not an equal decline was exhibited by the bids submitted at the beginning of the year. As the season advanced and bad weather, poor railway service, higher prices and increased wages came along, bidding prices soared to a height not so far below those of 1921. Probably not all the low-price work was completed at a loss but it is certain that not much of it paid a reasonable profit.

Why did prices for road construction take such an extraordinary drop a year ago? We have the best explanation perhaps in a statement by H. J. Kuelling, highway construction engineer, that an influential reason for the low prices in Wisconsin was that "news of profits made in 1921 became noised about with the result that many new contracting firms sprang into being over night." The competition of these newcomers confident in their estimates predicated on the weather, wage, price and transportation conditions in 1921—one year in a decade in its conjunction of conditions favorable to construction operations—stampeded road contractors into a slaughter of prices which astounded the engineers who were taking the bids. Fear of being without a contract again demonstrated its power to fix the charge for doing work. Other influences contributed but they were largely fugitive.

The lesson is plain. In a stabilized industry the conditions indicated could not exist. Highway contracting is not stabilized. It lacks definitive knowledge of equipment performance, relative efficiency of methods and reasonable costs. It has not evaluated the influences that control progress. It has accumulated no general fund of quantitative information which indicates the boundaries of prices and profits. It has no established business policy. Its practices are individualistic and erratic. What happened early in 1922 is a natural consequence. It will happen again and again until contractors organize to stabilize their business policies and to determine the efficiency factors of their tasks.

The last year has seen progress in the organization of highway contractors. In only a few instances, however, have these organizations become awake to the fact that their greatest opportunity for power and influence lies in perfecting their own practices and not in wringing concessions from state highway engineers. The few who have taken the wiser course are getting returns in co-operation by highway departments and, incidentally, the concessions desired are being received as a matter of course. There is hardly a leading road-building state which does not now have its association of road contractors. The supreme task of each of these associations in 1923 should be to organize their skill and efficiency as road builders. It will be their greatest defense against irresponsible influences in their own business and their greatest power of attack against abuses in highway engineering practices.

Structural Progress in a New Phase

IN STRUCTURAL engineering the past year has developed something that gives promise of being most important: a new movement toward efficiency, based on thinking and motives different from those that controlled heretofore. A deliberate seeking for economy of material has developed, which is concerned with the elimination of useless safety allowances—the reduction of over-cautious margins of ignorance handed down as traditions from the early days.

It appears in many scattered items of activity, of which the better known ones may be called to mind. The demand for higher working stresses for structural steel, which has now given rise to a well directed engineering study of the subject; the advocacy and discussion of lighter brick-wall construction; restudy of frame-house specifications to promote economy by reducing unnecessary requirements, in conjunction with a progressive raising of timber stresses extending back over a number of years; the general movement to revise and, if possible, make uniform the building codes of various cities; the attempt to arrive at a more precise statement of fireproofing requirements, with the ultimate object of classifying fire hazards so as to permit each type of protective material to be used to its full scope, with due regard to light and cheap forms, such as fireproof lath and plaster construction; and the revision of reinforced-concrete specifications, now nearly completed. These separate enterprises and investigations, originating independently and at different times, are in fact all of them expressions of a broad general attitude of mind on the part of structural engineers that seeks to establish a new, higher-efficiency, basis of practice.

For a generation or two the art has developed by improving the calculation of stresses and making designs more rational. The results of steadily advancing engineering method, however, still had to be applied to practical service by way of basic standards (such as working stresses) that had come into existence by rather arbitrary judgment at an early period. The nature of these standards did not permit of their being changed from year to year, since they were built integrally into the whole structure of practice. Now, after years of concern with methods of calculation, details of design and processes of execution, engineers are turning back to scrutinize these standards as to their fitness.

To consider a specific case: wood construction, the oldest branch of the art, continued for long years on the basis of limiting stresses not far from one thousand pounds per square inch. Strength tests indicated that these stresses would yield a factor of safety of about five; and, while no entire structure would probably ever have shown a ratio of more than two or three between working load and failure load, such conceptions as the "factor of five" held a commanding position, virtually until today. In recent years, however, several influences, most powerful of them the competition of other building materials, brought higher working stresses into use, as 1,400, 1,600, and finally 1,800 for the stronger woods, with no indication as yet that there is any lack of adequate safety so long as the detail design is good—and, in fact, no indication that working stresses have yet been raised as high as safety warrants. Large masses of test figures showing consistently high strength values give occasion for questioning the former low stresses, and invite study of how a safe and economical stress limit may be fixed.

Precisely this same development, leading to the same questions, is observable in the field of other materials. An advance to new standards may be looked for in each, and ultimately, no doubt, the traditional limits for all the widely used materials of construction will be subjected to searching inquiry. It is the general initiation of this movement of inquiry that marks the present time as the beginning of a new stage in structural progress, containing the possibility of far-reaching change in engineering practice.

Why—so runs the thought back of the new movement of inquiry—why should the engineer make great efforts in calculation and design to realize a possible saving of a few per cent, if twenty or thirty times as much material is consumed by a blanket allowance to cover the designer's mistrust in his own foresight and knowledge? How can so large an allowance be justified? A safe margin is needed, but not an unreasonable one; what this margin should be is the question to be answered.

Competitive pressure was the principal stimulus in raising questions of this kind, though not the only one. Wood becoming scarcer and dearer, found steel and concrete taking its place, and habit carried this substitution even beyond the cost balance, as is evident from the recent return to wood framing and roof-truss construction for many kinds of industrial buildings. Steel lost ground in the expansion of concrete construction, especially because concrete design was conducted on a fairly modern working-stress basis, while steel continued on the footing of a quarter century ago. The field of rolled steel was invaded by light pressed-steel construction. Brick similarly suffered through the competition of concrete, and in a measure also through the effect of bad industrial conditions of production and marketing. Competition between various fireproofing materials affected these as well as the system of construction to which they are practically adapted.

But in a sense the desire for modernizing traditional standards is the direct outgrowth of the wartime shortages in materials and the disturbed conditions of the reconstruction period. Emergency building for plant construction and housing during the war stamped insistent question marks on many accepted dogmas, and the topsy-turvy price relations of the years following the war emphasized them. The study of minimum dwelling-house design and other building code matters now going on under the direction of the Department of Commerce is an immediate consequence of reconstruction problems, as are also, though in a different way, the studies of timber design and brick-wall practices being conducted by commercial organizations of the industries. Incidentally, the fact that the building-code work has already extended to a radical restudy of house plumbing requirements—also suggested by reconstruction needs—gives an instructive illustration of how the movement for more economical use of material leads abroad into other investigations.

The relation of the new movement to past practice is perhaps best seen in the case of working stresses for steel in general building service. For many years all designing has been conducted on the basic standard of 16,000 pounds per square inch maximum stress in bending and tension, a figure whose origin is more or less lost in antiquity. Even the pressure of war demands did not weaken the sway of this standard much. But the war did teach that many things could be built of wood or concrete that had generally been built of steel, and in the restored free conditions of business after the war there soon arose strong demand by various commercial interests of the steel industry for an increase in working stresses, which would obviously give steel a new competitive advantage. Simultaneously, engineers also began to doubt whether the old figure was not unduly conservative. Discussion and agitation proceeded, until within the past year a technical committee to study the question was organized and began work.

Structural steel engineers, when they contemplate the $2\frac{1}{2}$ to 3 ratio of ultimate strength to working strength used in concrete design, are naturally dissatisfied with the much larger ratio demanded in steel. But should they attempt to compare safety relations in structures of different materials and radically different character, they are confronted by a very complex problem. Further, they face the fact that, if the safety margin is to represent best economy of material, a degree of uniformity of material is required which, many protestations to the contrary, is not now satisfactorily assured. Still further, they are at a disadvantage in rational stress fixing because the much younger art of concrete construction can refer to tests of complete structures to verify its choice of stresses and its designing practice, while steel construction can not. And finally the use of steel involves fixed units of size and form in its rolled shapes, and it may be that the most efficient use of higher stresses would require a revision of these standards. Thus, a discussion of whether the old 16,000 figure should be changed leads of necessity to an intricate series of other questions, involving elaborate research, and bearing also on the correlation between engineering and its underlying industries. In the same way each single material that is made the subject of inquiry will bring about (if the inquiry is carried to its fullest extent) far-reaching study of engineering facts and principles, possible revision of industrial practice, and in any event much research.

We have spoken throughout of a new movement, a broad movement of general importance. That such a movement exists at the moment is certain; the fact is easily verified. Whether the movement really will prove to be broad and general more than temporarily, or whether it will survive for long, it would be mere speculation to predict. But if all members of the profession come to a full realization of the present situation, and appreciate the possibilities of the movement actively enough to give it their support and aid, they will place its successful progress beyond any doubt.

Progress Made in Highway Engineering

Administration a Pressing Problem—Research Leads All Activities—New Pavements Have Thickened Edges—Construction Exhibits Improved Efficiency

An Editorial Review

CONTRACTS for highway construction in 1922, measured either by the mileage of road or by the cost, exceeded those of 1921. Using the same measures, the volume of construction actually performed in 1922 was somewhat smaller. Reports available from about half of all states and including most of the states notably active in road building, promise a volume of construction in 1923 fully equal to that of 1922. The Federal aid system provided by law (7 per cent of the total road mileage of each state) aggregates 187,406 miles. At the rate of Federal aid construction in 1922, about 10,000 miles, this mileage will require from 15 to 20 years to complete.

There is, then, a reasonably sound basis for asserting that we may expect yearly, for a decade or more, a volume of highway construction perhaps not as great as that of any of the last three years but certainly of comparable magnitude.

The preceding statement demonstrates that highway construction in America is established as a continuing business of great magnitude. It is important that engineers and contractors should fix their attention on this fact. They have to prepare to administer a permanent construction business not merely to carry out a big construction job. All collateral industries—equipment manufacturers, materials producers, purveyors of transportation—have to organize for a continuing market. The problem and the opportunity are similar, with essential differences, to those of our period of intensive railway construction. They have to be approached and grasped with the certainty of clear engineering knowledge and business intelligence which distinguish the best examples of railway administration.

Growing consciousness of highway development as a permanent institution ranks high among the accomplishments of the year. It brings problems of highway administration to the front, where their place is, just as in railway direction principles of administration take precedence of research, design, construction or maintenance.

Research Activities — Research outstripped every other highway engineering activity in 1922. More progress was made investigating road design and structure and determining the traffic demands on modern roads than during all previous time. This does not indicate that design, construction and maintenance have lagged, but that research has accelerated its advance.

By a careful census undertaken by the Advisory Board on Highway Research of the National Research Council, it was disclosed that there were in progress in the United States, as of December, 1922, 486 research projects in highway engineering and highway transport. Naturally most (267 of 486) of these projects are investigations of materials, but there were listed 58 studies on economics, 18 on operation, 119 on road design, 7 on vehicle design and 17 on construction.

Possibly traffic tests deserve to lead in any consideration of highway research in 1922. At all events their spectacular nature has made them better known than other investigations. Leading these traffic, or service tests, of course, is the Bates Road test in Illinois, the essential results of which are published on p. 57 of this issue. Second in magnitude to the Illinois tests come those on the Pittsburg Road in California which were outlined in our issues of June 29, 1922, p. 1066, and Nov. 23, 1922, p. 893. Supplementing these service tests, with standard trucks and full-size road sections, are the tests at Arlington, Va., by the Bureau of Public Roads where loading machines are traveling on circular tracks to determine wear and other surface action of traffic.

With the new series of truck impact tests of the Bureau of Public Roads, the three investigations mentioned are notable achievements in which technical knowledge and highly advanced technique are combined. Outstanding as practical results are the conclusions that if existing paved roads are to endure there must be strict load regulation and that balanced strength calls for a pavement having edges thicker than the center. Here then is a lesson from research that possesses the utmost practical economic value.

As great practical value is contained in the supplementary fatigue tests of concrete which have been under way at the University of Maryland, at Purdue University and at the laboratory of the Illinois Division of Highways. These tests have gone so far as to make reasonably certain the conclusion that concrete pavements will endure indefinitely under repeated loads not exceeding half the modulus of rupture of the concrete. With greater loads the pavement fails by fatigue. With this knowledge and knowledge of the strength of the concrete, safe truck loads can be determined with some accuracy. It is even predicted that, using the new strain gage designed by the Bureau of Public Roads, it will be possible to determine the bearing capacity of old pavements of unknown original strength so that load limits may be named.

While pavement investigations have been most emphasized in the year's research, unpaved roads and particularly gravel roads have been intensively studied The studies on dust preventives by the Michigan State Highway Department and on rhythmic corrugation by the Bureau of Public Roads, give highway engineers a substantial start toward correcting two of the most annoying faults of gravel surfaced roads. Scarcely less important are the studies in North Carolina and Georgia of sand-clay and top-soil roads. In this research work three facts (1) the combination of clay and sand most stable under traffic, (2) the limit of traffic under which maintenance is practicable and (3) means of strengthening and toughening the surface layer, are approaching tentative determination. It appears quite certain that means may be at hand in the near future of extending considerably the durability of artificial and natural sand-clay roads.

Studies of tractive resistance have been notable. Two of these conducted at the Iowa State College are outlined in *Engineering News-Record*, Dec. 7, 1922, p.

982 and on p. 76 of this issue, and they reach noteworthy practical conclusions. With the equally comprehensive investigations of the University of Michigan, the studies of Major Mark L. Ireland, Q.M.C., and the tests at Yale University, results have been made available which give the highway engineer a good start in the economics of road surfaces, grades and alignment.

A traffic census remarkable for its magnitude and detail is under way in Connecticut in conjunction with the Bureau of Public Roads. With the records of this census analyzed, a task now in progress, engineers will have data and conclusions on commodity and passenger movement which will furnish a real basis for rational selection of road types. Incidentally Connecticut has conducted a census of highway accidents which is equally unusual in its scope and detail.

Only the high points of highway research have been touched. Significant as are their results they are less significant and inspiring than is the fact noted at the outset that nearly 500 research studies on highway engineering and highway transport are in actual progress in the United States in engineering schools, in state highway laboratories, in city and county laboratories, by state geologists and by industrial organizations. With the co-ordinating possibilities of the Advisory Board on Highway Research, which should function positively during the coming year, these many individual studies promise real usefulness.

Incidental to this highway research work there has been invention and adaptation of instruments and devices for conducting and recording tests. Individual mention of even the more unique of these apparatus is impracticable but the general statement can be made that highway research engineers have had virtually to create scores of instruments and testing apparatus of all kinds with which to work, before they could conduct the research studies which they have undertaken.

Development in Design—Advance in road design has been largely confined to the pavement slab. In all states there seems to be general satisfaction with the present grade cross-sections and finish. Use of standards is the prevailing custom. Very few states as general practice design roadbed for the specific project in hand or to meet the local variations in soil, drainage and location. To repeat, highway engineers appear to be satisfied with their present standard roadbed designs.

In pavement design a similar contentedness of mind does not prevail and there is development. Growing out of the service tests on the Bates road and the Pittsburg road there is a strong inclination to change pavement cross-section from a slab thick at the middle and thinner at the edges to one as thick at the edges as at the center or to one with edges much thicker than the center depth. The new concrete pavement section adopted in Illinois is the outstanding example of the change to strengthened slab edges. The technical significance of the new Illinois design deserves some consideration.

Test roads have seldom given results so positive that a radical change in pavement design has followed. The fact then that, following the Bates Road tests, Illinois will hereafter build its concrete road slabs with thick edges and a thin crown, is worthy of note as a variation from the normal. This change in practice is, however, significant in a broader way. The idea of a road pavement with thickened edges is not unique. Virtually the same design as has been adopted in Illinois was selected for the Maricopa County road system in Arizona as described in *Engineering News-Record,* May 26, 1921, p. 882. Also road slabs with their edges thickened have frequently been built in California and in other places. These designs have generally been regarded by engineers as erratic practice or as resorts to satisfy peculiar local conditions. The standard concrete pavement has invariably been conceived as a slab thick at the center and thinner at the edges. The new Illinois design for concrete pavement and pavement base is, therefore, a move toward a radical revision of a standard. Its second significant feature is that it is a design based on tests and mathematical analysis. It is an interesting effort toward the rational design of paved roads.

Mention that the new Illinois section for concrete road and concrete base is not entirely novel invites a few words of the history of paved road slabs strengthened by thickening at the edges. When Woodward Ave., one of the early Wayne County, Michigan, concrete roads, was paved in 1910, it was designed with inverted curbs or edge girders, in one piece with the slab. The design was never repeated in Wayne County and indeed was regarded as bad, so that when California in 1912 specified a slab with thicknened edges as an alternate design to be used when ordered and in 1914 constructed 7,000 ft. of road with thickened edges it was virtually the pioneer in employing this section for concrete roads. Maricopa County, Arizona, with its 300-mile concrete road system, all of substantially the same section as that just adopted in Illinois, was the pioneer user in quantity of thickened-edge concrete road.

A second design development worthy of note is the extension during the year of the use of longitudinal joints and doweled joints. Several states have come out with new designs differing in detail but alike in general character and dedicated to the same purposes: (1) reduction of longitudinal cracking, (2) reduction of traffic interruption during construction and (3) increased ease of construction. Concrete road with a center joint may be considered to have developed in 1922 into generally accepted good practice.

It has been noted that the development of thickened edges applies also to concrete base for brick or asphalt pavement. In other respects neither type exhibits any notable alterations purely in design. Perfection of material and progress in their simplification and standardization are to be observed. These are problems for the users of asphalt and brick roads to investigate this year. With the experiments now being concluded by the Bureau of Public Roads the engineer is promised means of improvement in bituminous surfaces.

Primarily, however, the pavement design advance of the year has been the possibility created by research of employing rational methods.

Construction Management Improved—Road builders accomplished no material advances in machines or in construction methods. There has been, however, a notable extension of machine operations particularly in grading. Tractor grading is coming to be common practice. Mixing and finishing machines show mechanical improvement but in general no material departure from precedent. Another year, however, is likely to tell a different story if devices now being perfected do what they promise. On the whole, the outstanding developments of 1922 in construction are broader in scope than improvement in detail of machines and methods.

An obvious conclusion from the year's construction is that road builders are becoming more competent in construction. In a season curtailed by bad weather they have accomplished nearly as many units of work as in the remarkably fair season of 1921. Other factors of course may have had influence but one does not presume too much perhaps in assuming that four years of intensive road building have created a corps of highway contractors of relatively high skill. The states are getting through their yearly programs more easily.

Two conditions curtailed the construction season. One was rain and the other was inadequate railway transportation. All the spring and through May and June and in some states well into July there was continued rain. Later good weather prevailed but in August operations began to be hampered by the coal strike and the shopmen's strike and then by the withdrawal of cars for handling coal and, later, the crops. Estimates based on general observation are uncertain but it is reasonably safe to say that the road building season of 1922 was only about 70 per cent that of 1921. In the last calendar year, however, the amount of work done was only slightly less than in 1921.

Growing out of inadequate transportation service last year and in several previous years except 1921, is the utilization of local materials which in 1922 reached perhaps its maximum development to date. Wisconsin, Pennsylvania and North Carolina have played leading parts in developing road-side gravel pits and stone quarries, but other states have not lagged in inaugurating the practice. It has become established during the last twelve months as a well-proved means both of reducing cost and of striking off the shackles of undependable railway service.

General improvement was recorded in contract practice. In general (1) the practice increased of letting contracts all the year round instead of largely in two months of the early spring; (2) risks and elimination of variables, such as variations in freight rates and changes in cement prices, were more generally undertaken by the states; (3) states more generally adopted the practice of paying estimates on materials in stockpile and warehouse on the job; (4) a step was made toward liberalizing contracts in the respects outlined in *Engineering News-Record*, Nov. 2, 1922, p. 749.

With all this progress and other effective movements to stabilize road contracting, contractors in general in 1922 miscalculated the conditions and undertook work at prices which gave little if any profit and often involved a loss. Some of the conditions which appear to account for this situation are reviewed editorially in this issue.

Maintenance Extended—Progress in highway maintenance in 1922 was expressed in four principal ways: (1) general extension through the adoption of systematic maintenance by more states; (2) increased practice of extending maintenance to entire main road system prior to constructing permanent grade and surfacing; (3) increased adoption of patrol maintenance with floating gangs for special tasks such as painting, installing signs, and bridge repairs; (4) general acceptance of the principle that financing for construction of improved roads premises financing and organization for the maintenance of such roads after construction.

Administration has been a matter for consideration by a number of states just entering into active improvement programs. Considering primary road systems, virtually the present state road systems, administration of maintenance is state, county, or state and county combined, with pronounced advocates of each but very few comparative facts to show which is preferable and under what conditions. Organization for maintenance makes it (1) a branch of the construction division or (2) a separate division. Again each has its advocates with pronounced views and no comparable evidence. All the forms of administration and organization which have been named are operating successfully in practice but again there are no facts by which comparative success is demonstrated. In brief, the whole problem of road maintenance administration has approached a phase this year where it requires elucidation.

As another phase of maintenance, the control of vehicle loads and speeds has inspired more activity in the last twelve months than ever before. As already stated, research in 1922 has demonstrated beyond question that without load regulation maintenance becomes nugatory for a road has no established life.

Again a new thought is presented by the action of certain states newly launched into the flood of intensive road improvement in establishing full primary highway maintenance before undertaking construction of the system. This procedure enables improved service over the whole system in the intervals between laying out the system and completing its improvement by permanent grade and surface. It is highly successful as a means of clinching the favor of the public.

The Task Ahead—Looking forward to the coming year, with the record of the past year in mind, certain lines of necessary activity appear to be indicated as follows:

1. Administration: Studies to fix general principles and policies relating to (a) the problem of securing efficient, well-paid, non-political highway organizations; (b) the problem of adequately and fairly financing the programs of construction and maintenance made necessary by the present and expected traffic; (3) the problem of co-ordinating highway transportation with railway transportation for the highest economic benefit of industry.

2. Organization: Perfection on the theory of highway improvement as a continuing business involving consideration of the problems of (a) advisory control, (b) executive direction and (c) personnel as influenced by adequate compensation, permanency of employment, opportunity for promotion.

3. Research: Extension along all of the lines followed in 1922 with particular attention to (1) traffic studies to determine economic types, (2) tractive studies to determine the economic theory of alignment, grade and surface, and (3) studies of gravel and earth road surfaces to determine limits of traffic and means of increasing durability.

4. Standardization: Extension of the standardization studies now in progress (1) on design of roadway and pavement, (2) on materials, and (3) on construction plant.

5. Simplification: Extension of the work of reducing the variety of materials now specified. The reduction of paving brick sizes from 66 to 11 is an example. Asphalt varieties require a similar reduction.

Practical Lessons from the Bates Road Tests

Paved Roads Will Fail Prematurely Unless Loads Are Controlled—Balanced Strength Requires Pavement Edges to Be Strengthened — Fatigue Failures Possible

COMPLETION of the traffic tests on the Bates test road in Illinois permit certain tentative conclusions which can be put to immediate use in designing paved roads. In general the tests have shown first that there must be strict truck-load regulation if paved roads are to endure, and second that greatest pavement endurance is secured by a slab which is considerably thickened at the edges. Both of these practices have been laid down as requisites for the future highway operations of the state of Illinois.

Beginning with the completion of the Bates Test Road in 1920 and continuing through the traffic tests of 1921, frequent progress reports and discussions have been published by the Division of Highways of the Illinois Department of Public Works. The final report has not been completed. The conclusions and discussion in this article have been assembled from the progress reports, and all have the authority of the department officials, Clifford Older, state highway engineer, and Frank T. Sheets, superintendent of highways.

A description of the Bates test road and details of the construction of each section were published in *Engineering News-Record* of Aug. 18, 1921, p. 274. In the issue of Aug. 10, 1922, p. 236, the results of the traffic tests up to and including the fifth increment of loading were published. Briefly, the plan of the traffic test was to impose on the two-mile road consisting of 63 different sections of pavement, a loading shown in the table on Page 60. Eighteen 3-ton trucks were used for applying the loads. The accompanying sketches of the layout of the sections give an idea of the present condition of the road. Views of all sections are also shown. These pictures were taken after the completion of all of the traffic runs.

Tentative Conclusions—With the completion of the tests the greatest traffic imposed upon any section was 377,460 tons. Of this 198,000 tons were imposed by trucks loaded to the legal limit of 8,000 lb. on each rear wheel. Only nine of the original 63 sections came through without a break. Since four of the sections had breaks which were obviously caused by abnormal conditions, thirteen sections may be considered as having satisfactorily sustained the traffic test. The final records are not yet fully analyzed, but certain general comparisons and tentative conclusions are possible.

1. A difference in the thickness of base, thickness of brick or type of brick, apparently had no consistent effect upon the load-supporting capacity of bituminous filled brick on macadam base. All five sections failed at approximately the same time and to the same extent. This does not seem logical and studies will be made in an effort to fix the cause of the apparent inconsistency.

2. No consistent ratio of strength to thickness of base appears in sections of asphaltic concrete on macadam base. Apparently traffic-supporting capacity increases with an increase in thickness of asphaltic concrete top.

3. The assumption made at the beginning of construction that an asphaltic concrete wearing surface on a concrete base would have a traffic supporting capacity equal to that of a concrete pavement having a thickness equal to that of the base plus 1-in. seems to have been a fair guess. Additional thickness of top apparently adds strength to the pavement. It is further evident that increased base thickness is accompanied by increased strength.

4. Wide variation is noticed in comparing sections having the same base and top thickness, but having lean and rich base mixes.

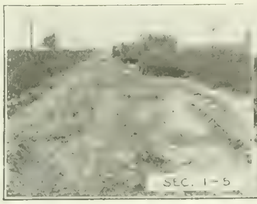
5. The original assumption that a bituminous-filled brick wearing surface on a concrete base has a strength equal to that of a concrete slab having a thickness equivalent to that of the base plus one-half the thickness of the brick surface was apparently incorrect. In practically every instance the concrete sections proved of greater strength than their supposed equivalent in bituminous filled brick.

6. There appears to be no obvious difference in the resulting strength of the two kinds of brick (lug and lugless), the bases being the same. In each case the artificially-cut joint was inadvertently made in the part of the sections laid with lug brick; and to this fact is attributed the greater number of breaks occurring in the sections of this type. Had these joints been cut in both the lug and lugless sections, it is believed the breaks would have been equal in number in both types of brick sections.

7. Although no direct comparisons can be made between 3-in. and 4-in. brick, the bases being the same, the indications are that the added inch of brick is probably effective in producing greater strength. In comparing sections where the total thickness of the pavement is about the same, but variations are present in the thicknesses of the base and brick surface, a great inconsistency is noticed. The comparative effect of rich and lean base mixes seems also to be inconsistent.

8. In comparing the various cushions which were used under the surfaces, it seems to appear that the mastic cushion (in this case 10 per cent Tarvia B mixed with sand) is superior to the sand and sand-cement cushion. In regard to the use of sand and mastic cushions, it can be said that previous to the application of traffic on the road, a difference was noted in the surface of the brick in these sections. In the sand-cushioned sections it was noted that an occasional row of brick across the entire width of pavement had settled immediately over a crack in the base. It is thought that this settlement was due to the sifting of the sand from the section through the crack. Although cracks were present in the base of the mastic-cushioned section the cohesiveness of the cushion prevented any sifting

BATES ROAD TEST TOLD IN PICTURES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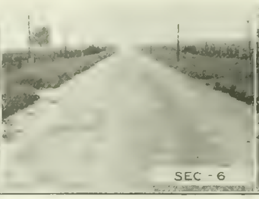
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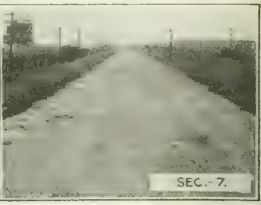
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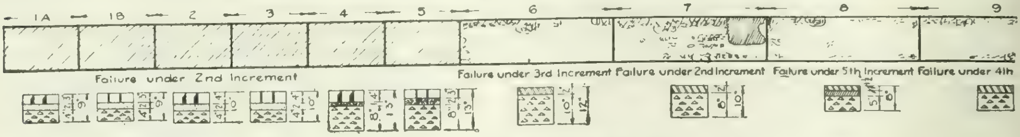
1A
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Failure under 2nd Increment
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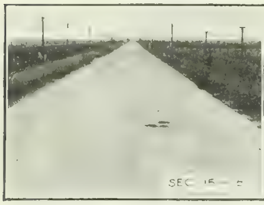
Failure under 4th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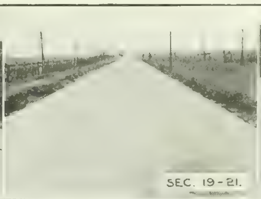
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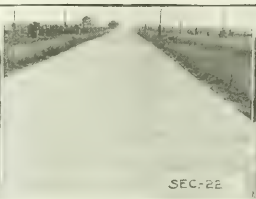
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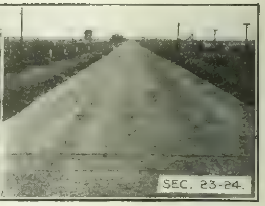
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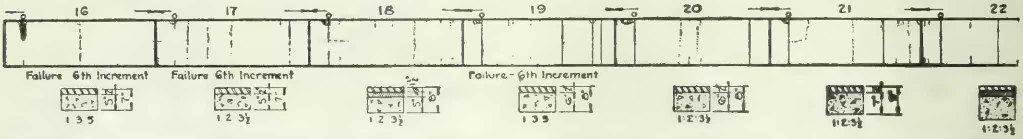

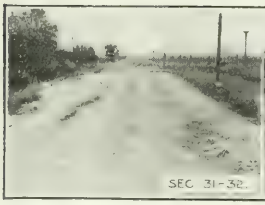
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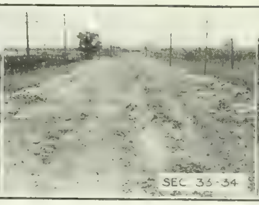
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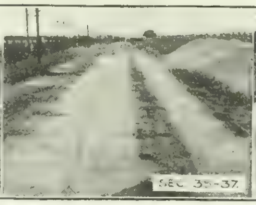
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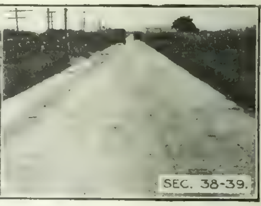
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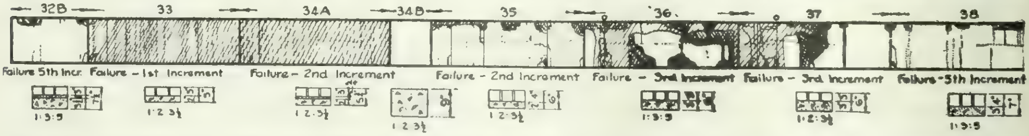
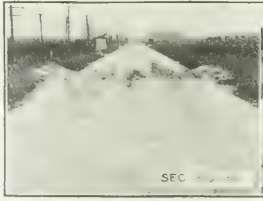


LEGEND OF BREAKS
- - - - NATURE BREAKS
——— BREAKS DEVELOPED UNDER PREVIOUS LOADINGS
——— " " " 8000 LBS WHEEL LOAD (NIGHT RUN)
▨ AREAS FAILING UNDER PREVIOUS LOADINGS
■ " " " 8000 LBS. WHEEL LOAD (NIGHT RUN)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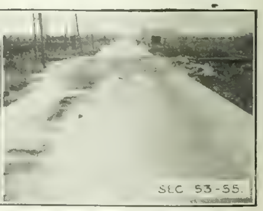
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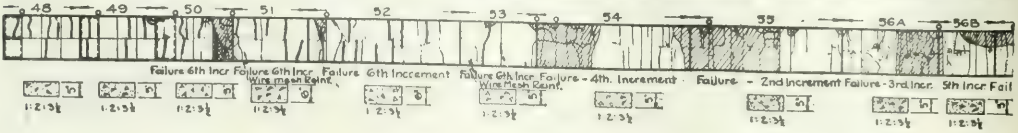

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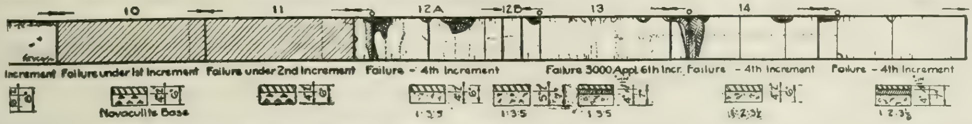

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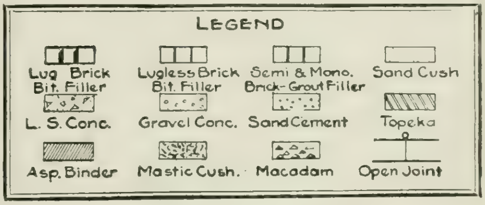

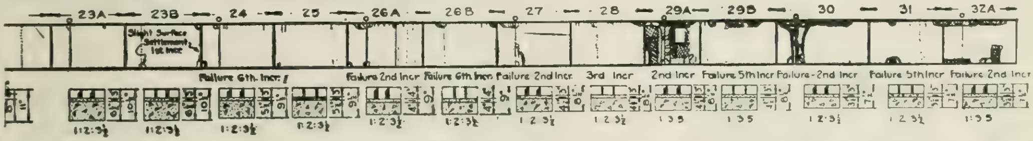

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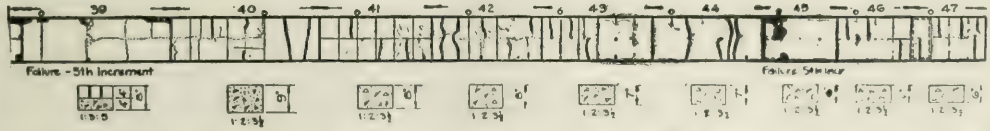

SEC 56-57

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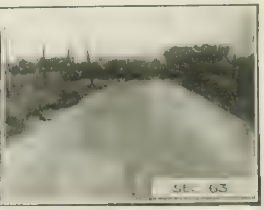
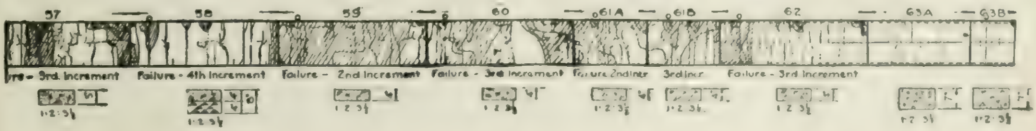
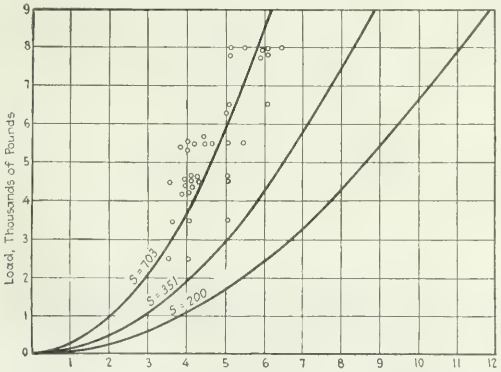

SEC 63



of the material, with the result that no settlement in the brick took place.

9. The original assumption that the brick surface in monolithic pavement acts as a unit with the concrete of the base, thus forming a truly monolithic slab having the same carrying capacity as an equal thickness of concrete, was disproved early in the traffic tests. Before the truck traffic was started, a number of areas were recorded where the bond between the grout-filled brick surface and the base was distinctly broken. Additional areas of this character continued to develop during the test. Under the trucks, the brick surface and the base in these areas acted as independent superimposed units in supporting the loads. The brick surface usually failed first by a shattering of the bond between the individual bricks, the base then being called upon to support a much greater proportion of the total load. Usually base failure soon followed. It was clearly evident that the strength of a so-called monolithic section was less than that of a concrete section of the same thickness.



LOCATION OF ACTUAL BREAKS WITH RESPECT TO THEORETICAL BREAKING LOAD CURVES

Points related in same position relative to average modulus of rupture of all sections as they occur relative to the average modulus of rupture of the particular type they represent.

10. In comparing the value of an added inch of brick with an added inch of concrete base, the total thickness remaining the same, it was noticed that the thicker base section has the advantage.

11. An increase of total thickness appears to add strength. That is, a 4-in. brick on a 2-in. base shows greater strength than a 3-in. brick on a 2-in. base.

12. Indications are that a richer mix of concrete in the base is better than a lean one.

13. Soon after starting traffic, it developed that the sections containing special cements or other chemicals showed less strength than the plain concrete sections of the same thicknesses.

14. Sections containing certain special features of design, consisting of transverse and longitudinal joints with marginal steel, showed greater strength than the plain concrete sections of the same thicknesses.

15. A comparison between the sections having imbedded steel gives the impression that the sections containing wire mesh showed the least strength for their thicknesses.

16. Sections containing wire mesh seemed to show some indications of greater strength than plain concrete having the same thickness.

TABLE I. LOAD INCREMENTS AND THE NUMBER OF APPLICATIONS OF EACH

Increment No.	Load Lb. on Each Rear Wheel	Load Lb. on Each Front Wheel	Gross Load	Net or Live Load in Lb.	Number of Round Trips Day	Number of Round Trips Night
1	2,500	2,250	9,500	. . .	1,000	. . .
2	3,500	2,150	11,300	.	2.167	1,033
3	4.500	2,000	13,000	1,700	2,000	1,000
4	5.500	1,900	14,800	3,500	2,000	1,000
5	6,500	1,800	16,600	5,300	2 000	1,000
6	8,000	1.930	19.860	8,560	5,000	5,000

17. A comparison of sections containing longitudinal control joints and those in which no joint was placed appears to give the former the advantage of strength.

18. In the plain concrete sections the thicknesses of the slabs were a measure of their strengths.

19. *The behavior of all of the 63 sections demonstrates the fact that if traffic can be kept away from the edge of the pavement, fewer failures will result.* Under every increment of load, except the first, the number of failures occurring on the south side exceeded to a very great extent those on the north side. The line of traffic in all runs except the first, was such that the outer rear wheels of the trucks traveled 2½ ft. from the edge of the pavement on the north side and directly on the edge of the south side.

Strength Theory of Rigid Pavements—In *Engineering News-Record* of Feb. 3, 1921, p. 210, Clifford Older, State Highway Engineer of Illinois, called attention to the apparent weaknesses of rigid pavements at corners formed by the intersection of transverse cracks or joints with the edges of the pavements. A tentative formula for pavement design was suggested which was based on the assumption that such corners should be designed as unsupported cantilevers. This formula for slabs of ordinary design without special provisions for strengthening the edges was as follows:

Stress equals three times the load divided by the square of the depth of the slab:

$$S = \frac{3W}{d^2}$$

Transposing this formula,

$$W = \frac{Sd^2}{3}$$

If, then, the assumption upon which this formula is based is true, by substituting for S the modulus of rupture of the load-carrying element of the slab design, the breaking load for any thickness may be determined.

It is interesting to compare the behavior of the rigid sections of the Bates road with this formula.

In the figure the theoretical breaking load curve is plotted on the basis of the average modulus of rupture of the test pieces of all concrete sections and all others having concrete bases. The breaking load points in this diagram are plotted in the same horizontal position relative to this breaking load curve as they hold to the average modulus of rupture curve of their respective series. It is noticeable that even as so plotted, the points fall in rather a wide band. Such an occurrence is inevitable considering the fact that even in carefully controlled operations, accidents of construction may influence the strength of the pavement slab. Further, the temperature conditions affecting the closing of transverse joints and cracks, therefore greatly affecting the carrying capacity of the weak corners, tend to produce erratic results. Again, the load increments vary one from the other by rather wide stages, which might easily mean that the critical load for a given thickness was less than the one recorded. No attempt was made to take this factor into account in evaluating the critical load breaks, as previously described. The figure shows also a curve in which the load causing fiber stress equal to that of one-half of the average modulus of rupture is plotted against the thickness.

The fatigue tests which have been carried on by the Illinois Division of Highways for about 18 months indicate conclusively that concrete may resist bending loads indefinitely if such loads do not cause fiber stresses in excess of one-half of the modulus of rupture of the concrete. Inasmuch as it was impossible to operate the trucks a sufficient number of trips for each increment to cause fatigue, the plotted points in all diagrams without doubt are but little effected by fatigue breakage. The laboratory tests show that where the loads applied produced a fiber stress of from 5 to 10 per cent in excess of one-half of the modulus of rupture, fatigue may not follow for from 5,000 to 40,000 repetitions. Loads which produce fiber stresses in excess of 60 per cent of the modulus of rupture are usually followed by breakage after a comparatively few repetitions.

It seems safe therefore to conclude that had the number of applications of each increment been much greater—say 30,000 to 40,000—the breaking load points would have fallen in the main between the curve passing through points representing a fiber stress of 703 and that representing a fiber stress of 351.

In the figure is also plotted a curve representing a fiber stress of 200 lb. per square inch which was proposed as a working formula in 1920. Had the various sections of the Bates Road been designed in accordance therewith, no breakage of any kind would have appeared under increments equal to the designed load. In none of the sections of the Bates Road, except 63A and 63B, which represent the Illinois 1921 sandard, was provision made for strengthening corners by doweling.

While the theory on which this formula is based is perhaps not yet fully established, nevertheless the empirical data furnished by the traffic tests seem to be sufficiently confirmatory to justify its use at least until something better is found.

By means of one or more continuous dowel bars along the edge, it is believed that adjacent corners may be made to act together and thus the breaking and working loads may be increased materially, or perhaps even doubled. Further, it is easily conceivable that if in addition to dowel bars the edges are thickened, they may be made stronger than other portions of the slab. It is, then, important to determine where next to look for trouble; and eventually determine how the slab should be designed for balanced strength throughout.

Safeguards for Existing Pavements—Many miles of pavement now in service are directly comparable with the Bates Road sections plotted in the figure. It is therefore not unreasonable to expect such pavements to show corner breakage when the load-thickness relationship here shown prevails. Further, the behavior of the test sections shows that loads much in excess of the critical load, as determined by the theoretical curve, are almost sure quickly to cause serious progressive destruction.

It would seem difficult to eliminate the danger entirely. It is suggested that shoulders of gravel, macadam, concrete or other material which could be constantly maintained, preferably slightly higher than the permanent edge, would help. Such shoulders would ordinarily prevent wheel loads from being applied to the extreme edges of the slab and thus tend to reduce bending stresses. Center traffic lines also help because where such lines exist drivers concern themselves only with keeping their vehicles on the proper side of the line. Without such lines they crowd to the outer edge of the pavement to make sure to clear passing vehicles.

Heavy triangular corner repairs of rigid material will also help, as the obtuse-angled corners of the adjacent old slab will carry greater loads than right-angled corners.

Limiting the loads to the strength of the slab would of course solve the problem for old pavements.

Suggestions for Improved Designs—Designs for new pavements should provide for strengthened edges.

This may be accomplished by providing integral curbs which would not only strengthen the edge but largely prevent wheel loads from being applied to the extreme edge. It is believed that wider pavements, with integral or inverted curbs, using no more or even less material than is now used in many designs, would afford equal or possibly greater load-carrying capacity.

Merely increasing the width would undoubtedly prolong the life by reducing the frequency of the passing of heavy wheel loads off and on, and along the edges.

Longitudinal joints in concrete pavements reduce the warping due to changes of temperature, thus increasing the possibility of subgrade support along the edges under night traffic. Such joints should be provided with tie bars to prevent spreading, and a corrugated or tongue-and-groove effect so that the adjacent slabs would afford mutual support.

Illinois New Design—The terms of the Illinois Bond Issue Act prevent general construction of pavements wider than 18 ft. Integral curbs on pavements of this width would probably inconvenience traffic and for this and other reasons are not generally used. To increase the edge strength, the new Illinois design provides for a 9-in. edge thickness, tapering to 6-in., at 2 ft. from the edge. The edge is also strengthened by a continuous ¾-in. round smooth bar. The rest of the slab is uniformly 6 in. thick. A tongue-and-groove longitudinal joint is provided across which deformed tie bars are placed.

Four sections of this type have been added to the Bates Road, and will be tested by truck traffic early next spring. It is confidently believed that the results will show this design to have an ample factor of safety for the Illinois legal limit loads.

Rapid Progress in Selecting Federal-Aid Roads

The selection of the roads to compose the system of Federal-aid highways which will reach into practically every county of the United States is progressing rapidly. The system will comprise approximately 187,000 miles, and consist of not more than 7 per cent of the total road mileage in any one state. Not more than three-sevenths will be primary or interstate highways, and the remainder secondary or inter-county highways. This program of road construction will cover a period of from 15 to 20 years, though many states will complete their mileage in a much shorter time as they have included in the system a considerable mileage of improved road. They will then enlarge the Federal-aid system by including additional mileage.

The Labor Shortage—Its Volume and Means of Relief

How the Wastes of Seasonal Employment Are Being Studied and How Apprentices Are Being Procured for the Building Trades

In the issue of January 4, the first section of this series contained two articles; the first, "How Great Is the Shortage of Building Trades Workers," and the second, "Immigration as Affecting the Labor Situation." The two articles herewith complete the series.—EDITOR.

How Are the Building Trades Training Apprentices?

BY FRANK L. GLYNN
Managing Director, New York Building Congress

THE fact that Europe has ceased to be the training school for the United States has brought about an acute situation in the building industry which is being reflected in all the basic industries contributing to a finished structure from the mining of the coal to the manufacture of hardware, tile, glass, electric fixtures, heating apparatus and the hundred and one necessities upon which a contractor is dependent.

This situation is due to the neglect on the part of the building industry to perpetuate itself by providing means for training skilled labor. It is particularly unfortunate that this neglect has only begun to be realized at a time when the demand for building is at its highest peak, with indications that this peak will be maintained for some time to come provided there is enough labor to do the building. Nor has the responsibility for the discouragement of building trade apprentices rested all with the unions. Employers in the past have put obstacles in the way of apprentices getting ahead. As long as young men were apprentices they got apprentice wages. The more they learned the more would be the wages and it was not to the interest of the employer to enlarge his payroll.

The Wisconsin Law—The only apprenticeship law now in force in the United States is in Wisconsin, which, for more than six years, has provided for apprenticeship contracts under the administration of the State Industrial Commission. These contracts embody the signatures of the parties to the contract, the date of beginning apprenticeship, the period of its duration, the processes or particulars of the trades to be taught and practiced, the wages to be paid and any other special arrangements customary in the trade.

The law requires, furthermore, that the apprentice shall attend an apprenticeship school for supplementary trade instruction five hours per week on the employer's time where such schools are established. It is required by law that such schools shall be established in all cities of more than 5,000 and may be established in smaller cities. These schools are supported entirely by public funds. They are designed to give academic trade instruction to the boy as well as to afford him trade experience in the shop.

Penalties are provided for violation of the contract which will involve a fine of from $1 to $100 for either party; in addition, the regular penalties follow for the violation of the orders of the Industrial Commission which have the same standing as any other orders of that commission.

But despite the slowness of the building industry throughout the country to arise to the needs of this situation, it has now come to realize the necessity for far reaching and fundamental changes. The need of more apprentices in the building trades has become so obvious that, in many cities throughout the country, there are being worked out definite programs for the training of mechanics. This plan is well under way in New York, Boston, Chicago, San Francisco, Philadelphia, Cleveland and Portland, Ore., and is in process of development in Detroit and St. Louis.

The New York Plan—In New York, to take a specific case, the administration of the plan is in the hands of the Apprenticeship Commission of the New York Building Congress and already it has been applied to two of the trades. The program is outlined as follows by Stephen F. Voorhees, president of the congress:

> We have been giving our attention to the shortage of skilled labor in the building industry for the past year, and have worked out a plan in entire co-operation with all the elements of the industry including architects, realtors, engineers, contractors, material manufacturers, bankers, and organized labor. We have worked together until now we have a going commission in charge of providing opportunity for the young men of this locality to learn the skill required by mechanics in the building business. Formerly we were able to draw on Europe for our skilled workers. This has now stopped and we must make them. The basic idea is close co-ordination with the public school system both in offering an opportunity for graduate students to enter the industry and to provide the necessary technical instruction that goes with our development and is a vital part of it.

The plan in force in New York provides for a four-year apprenticeship during which practical daily work is supplemented by evening instruction under the supervision of the public school administration. The training comprises five and one half 8-hr. working days per week continuously and four hours evening instruction weekly for a period of 38 to 40 weeks per year. The New York City Board of Education has made a specific appropriation of $20,000 for this work during the fiscal year 1922-1923. The Apprenticeship Commission places the apprentices through co-operation with the placement department of the public schools and with the employers, and exercises a continuing supervision in order to insure that the boy keeps up with his studies and that the employer gives him the graded work necessary for his training.

How Agreements Are Made—The apprenticeship agreements are negotiated by conferences between the commission and joint trade committees composed of representatives of the trades unions and the employers. The commission itself consists of five representatives of the building trades unions, five employers, and three neutrals who are interested in building construction but who are non-partisan as between the unions and the employers. In all the conferences with the various trades, this commission represents the congress, but each of the trades has its own joint trade committee. When satisfactory standards of apprenticeship have been drawn up, they are ratified by the joint trade committees and incorporated in the trade agreements.

The ratio of apprentices in each trade is determined as a result of an exhaustive study of seasonal employees in the building industry in the metropolitan district, in the course of which 93,000 cases were studied for each year of a ten-year period. This is a matter of the utmost importance, for an essential feature of the apprenticeship plan is continuity of employment, which could not be realized if the number of apprentices were excessive. This difficulty is accentuated in the building trades because of its seasonal nature. Although it is planned to allow four years in which to bring the plan into full operation, the ratios in each case have been based upon 50 per cent of the lowest rate of employment, thereby allowing for a falling out of about half of those that start.

A Specific Case—As an example of how this plan works out in a specific case, the apprentice ratio for the painting and decorating trades for the first year has been placed at 140 apprentices to a total of 8,000 journeymen. The apprentices must be between 16 and 21 years of age and are required to put in a probationary period embodying the first two weeks of employment. Advanced credit is allowed to apprentices for previous trade experience or for work in an approved school subject to rating by the joint apprenticeship committee of the trade.

The wages of an apprentice are for his first year $33\frac{1}{3}$ per cent of the beginning journeymen's wage, for the second year $44\frac{4}{9}$ per cent, for the third year $55\frac{5}{9}$ per cent, and for the fourth year $72\frac{2}{9}$ per cent. For the time spent in the school the employer allows the apprentice one-half the regular hourly wage rate. Apprentices who do not keep up their school work are subject to discharge by their employers and to exclusion from membership in the unions.

The subjects taught in the schools include related mathematics, trade sketching and drawing, shop practice, related science and general information. In his work, the apprentice is taught the processes and the care and use of the tools used in the painting and decorating trade.

The Industry Supports the Plan—Both employers and trades unions are loyally supporting this plan, as they have been brought face to face with the necessity for bringing young men into the trade and for giving them a thorough training in order to maintain the high degree of skill established by the industry, which heretofore has depended more or less upon skilled workers coming from European countries and has neglected the training of the younger workers.

In the last few years intensive training, vestibule schools, etc., have been turning out specialized workers who are able to do some particular jobs, but these workers do not know the relation of their work to the finished product. Experience has proved that these so-called quick methods of training workers have failed to produce trained mechanics.

A trained mechanic is a man who has had practice, experience and instruction in the various processes of the trade. He knows the various processes of the trade, the relation of one process to another and to the finished product. He can perform his work with an economy of material, a high degree of accuracy and in a minimum period of time. These factors of experience are accomplished by the co-ordination of the hand, the eye and the brain, and the proper functioning of these factors is only brought about by well directed apprentice training.

Employers are in favor of apprentice training as they know a trained mechanic is an asset to the industry. He earns the wages he receives, he goes about his work in a business-like way without the necessity of a highly paid foreman telling him every few minutes what to do and how to do it. He can stand on his own feet. Organized labor is in favor of a well-directed apprenticeship plan as well-trained workers can maintain wages commensurate with the quality and quantity of work performed. Such workers take a pride in their work and raise the standard of their trade to a higher plane whereby the craft has the respect of the community. The public favors well-trained workers because it knows that when work is performed by trained journeymen, it receives full value for money expended.

This is essentially the apprentice problem in one of the great building trades. As the workers go up the ladder a round a year and leave the ladder altogether after the thirtieth round, new men should be mounting behind them. But at the present rate of apprenticeship replacement those lower rounds are soon going to be empty, and before very many years have passed only a few of the upper rounds will be occupied.

* * *

Seasonal Employment in Building Construction

By D. Knickerbacker Boyd
Architect and Structural Standardist, President,
Philadelphia Building Congress

MORE possible working days are lost by workers in the building "trades" than by those in almost any other industry. The year's work is literally "shot to pieces" by intermittency due to unemployment, not only from seasonal causes, which for the most part could be overcome, but from other causes many of which are related. Among them is (1) indoor work so often unnecessarily required to be done in warm weather and in a crowded construction period when it could be deferred till colder weather and a lowered employment period; (2) demolition not being started until the time of the year that the new construction which replaces the old should itself be under way; (3) lack of foresight in ordering or assembling materials or fabricated products in advance of construction needs; (4) delays in closing contracts with sub-contractors (sometimes unfortunately due to the other unfair practice of "shopping" for lower estimates).

Two of the most potent causes for lack of employment in localities subject to varying degrees of cold and possible inclemencies of the weather, say in December, January, February and March, are: (1) the psychological attitude of the building public towards starting anything in advance of this period of the year due to lack of concerted effort on the part of the contractors in each locality to convince themselves and the public through foresight and practical demonstration that construction can be advantageously carried forward by overcoming climatic handicaps; (2) the failure of employers, workers and others interested, to settle defi nitely, not later than say October 1, the scale of wages which will prevail for all the building trades in that locality on and after the beginning of the next calendar year and throughout the year.

And while we are speaking of scales it would be interesting to see if all manufacturers and dealers in each locality would settle upon prices at which deliveries would be made throughout the year instead of by the operation. With the knowledge of all costs fixed in the minds of investors and building owners in October for the next fifteen months, winter construction would become very popular with all those desiring to avoid the "spring rush." Thus would year-round construction become an economic accomplishment.

There are several things which must be done toward eliminating the great unemployment waste in the building and construction industry. Let us consider three of them in the following order:

TABLE I—DISTRIBUTION OF TIME FOR 1920 IN PHILADELPHIA BUILDING TRADES

Trade	Full Saturdays off	Half Saturdays off	Recognized Holidays	Possible Effective Working Days	Aver. days Worked Per Year	Total days Lost
Asbestos workers	0	52	6	281	185	96
Bricklayers	10	42	7	275	182	93
Stonemasons	10	42	7	275	185	90
Electrical workers	0	52	6	281	216	65
Elevator constructors	0	52	6	281	216	65
Engineers	0	52	6	281	200	81
Firemen	0	52	6	281	200	81
Granite Cutters	0	52	6	281	180	101
Lathers, wood, wire and metal	0	52	7	280	190	90
Plasterers	52	0	6	255	170	85
Plasterers Helpers	0	52	6	281	180	101
Cement Finishers	0	52	6	281	176	105
Painters	52	0	6	255	182	73
Paper Hangers	52	0	6	255	182	73
Plumbers	16	36	5	273	200	73
Riggers	0	52	6	281	176	106
Composition Roofers	0	52	7	280	182	98
Slate and Tile Roofers	0	52	7	280	170	110
Sheet-metal Workers	0	52	7	280	185	95
Steam Fitters	0	52	6	281	180	101
Iron Workers	12	40	6	275	152	123
Stone Cutters	0	52	7	280	180	100
Upholsterers	0	52	6	281	225	56
Tile Setters	0	52	5	282	200	82
Tile Setters' Helpers	0	52	5	282	200	82
Building Laborers	0	52	6	281	217	64

Note: Plasterers, painters and paper hangers have a 40-hour week the year round; no Saturday work. Stonemasons, bricklayers and carpenters have a full day off on Saturdays in July and August and Saturday before Labor Day. Plumbers have a full day off on Saturdays of June, July, August and September; half-days on Saturdays the balance of the year. Iron workers have full days off on Saturdays of June, July and August. All other trades work 44-hour week, 8-hour day, 4 hours on Saturday the year round, except building laborers, who work 50-hour week, 9-hour days and 5 hours on Saturday. On some work the building laborers do not have Saturday half-days off. The 52 Sundays have been eliminated Recognized holidays are considered as falling on other than Saturdays.

1. Secure results through studies as to the effect of weather conditions on various kinds of buildings under construction so that intermittency of employment due to the interference of the elements could be promptly and co-operatively prevented by the promotion of better methods and management to decrease all such as could properly be overcome by the reasonable use of commercially possible precautions.

2. Secure the co-operation of building owners, managers, and tenants in bringing about a more equitable distribution of requirements in maintenance, alterations and equipment in existing buildings as distinguished from new construction so that the wasteful effects of intermittent employment could be greatly reduced as a corollary of seasonal occupation.

3. Inform the public in no uncertain way as to the nature, extent and costliness of the unemployment waste. Through this means and demonstrations as above to secure the co-operation of public, corporate and private ownerships in a sensible distribution of their new construction requirements in each region.

Individual contractors, aside from large regionally distributed construction concerns which are already realizing some of the possibilities, cannot without public appreciation and support cope with the first of these alone and building owners should not be greatly criticized for failure to co-ordinate their maintenance work with low employment periods because the building construction industry as a whole has until very recently been sadly neglected by those constituting its component groups. The "readiness to serve" burden of expense, due to waiting for public recognition of construction needs, has been allowed to grow to present bounds with little or no check. At last the public has become aroused to the high cost of construction for which it, in itself, is in a large measure responsible.

The existing pronounced shortage of building workers has at last caused recognition of the fact that their ranks have been decreasing for years past to an alarming extent. This in the face of increasing demands for their services and constantly rising wages has brought with it a realization that something is wrong, and that steps must be taken to recruit the ranks.

The usual procedure has been to establish courses for training apprentices which while apparently a wise move has not succeeded as it should. There are several reasons for this, the most potent being that present mechanics discourage young men from entering the crafts, as I prefer to call them rather than trades, because of the lost time which apparently accentuates the hazards and hardships.

Many young men, none too anxious to take up manual labor, especially outdoors, heed such advice without seeking inspiration for entering a calling in which they do not appreciate the possibilities for individual expression through real craftsmanship, nor comprehend the joy of achievement in what can be, and should be, an art and not a mere job.

The "job" of the building "craftsman" must, then, be made more attractive. One sure way to help in doing it is to eliminate as much lost time and idleness as possible. The industry must come to its own rescue and the public which has a vital stake in the enterprise must co-operate in the industry's program. The Building Congress movement shows the way out locally, regionally and inter-regionally, and if encouraged and co-ordinated by the American Construction Council will nationalize it and the industry. First in Philadelphia, then in Boston and finally on a more comprehensive scale by the New York Building Congress data on lost time have been assembled in all the building trades and the peaks and depressions in each charted.

It is high time that through such agencies, with the full co-operation of employees—familiar with the turnover and other special problems of the building industry—and skilled workers in the industry in each locality the U. S. Department of Labor, Bureau of Statistics, and the American Construction Council when functioning, be provided with accurate data for informing the public as well as all other trades that the basic wage paid skilled building mechanics is not so much higher than that paid other workers who have steady employment and receive 52 envelopes each year without loss of pay for holidays. Those who receive regular pay regardless of holidays or illness would not relish being docked for Christmas and other important days as are workers in the building trades and in such other trades as are paid only by the hours actually worked, rain or shine, ill or well.

Regular workers also usually receive each year one, or two weeks vacation with pay. But how different it is with the oft none-too-easy job of the construction worker. Instead of a reasonable annual rest period with pay, he gets an enforced leave of absence eight to ten times as long as the usual vacation period and without pay.

Because of the fact that wages actually received are only on the basis of hours actually worked (subject to the whims of some foreman, the caprice of the elements, or to transportation delays) there is insufficient incentive on the part of some employers to eliminate unemployment or on the part of some of those employed efficiently to complete one job and take chances on promptly securing another, especially in seasons or localities where it is known that intelligent foresight is not being exercised to avoid intermittency.

Several leaders of labor in the building construction industry have made the positive assertion to the writer that if they and their workers were convinced that other groups were sincerely co-operating with them to afford them more days in which to work and fewer in which to be idle, they would welcome the opportunity to maintain their efficiency—and would do more!

They have made the candid and almost obvious statement that if they had an actual demonstration over a period of two average years that the unfortunate, unpleasant and expensive circumstances attendant upon idleness would disappear except on holidays for which they lose wages they would voluntarily reduce their hourly wage rate as a compensation for the relief from "fear of unemployment" and be better off each year in spirits as well as in finances.

In addition to the satisfaction to be derived through such a use of time formerly lost—one thing which when gone can never be replaced—the saving to the building public would be enormous.

If figured at an average of 20 per cent on construction labor, this one item alone would take approximately 10 per cent off the cost of any home or building and leave each worker better off physically, mentally and financially at the end of every normal year of construction.

In 1920 and 1921 with the co-operation of the Philadelphia building trades and W. S. Hays, later secretary of the National Federation of the Construction Industries, there was made the first study of lost time in the building industry in any given locality. The figures have recently been brought up to date preparatory to another survey and it is expected that contractors and sub-contractors as well as labor will co-operate.

An advance copy of the preliminary report of a Committee to the Philadelphia Building Congress is here abstracted for the benefit of readers of the *Engineering News-Record* in the hope that the data may prove of value in other localities also and will afford a stimulus for similar studies elsewhere.

In making these calculations, there were first deducted from the 365 days of the year all Sundays, all holidays observed in the trade under consideration, and the number of full days lost through the custom of trade in regard to work on Saturday. What remained was called the number of possible effective working days. From this was then deducted the time lost through unemployment, the time lost—and unpaid for—on the job through delay in the delivery of materials or through other causes for which the worker is not responsible, the average time during which weather conditions prevent work, and the average time lost through illness and absenteeism. The remainder was taken as the average time worked during the year. No deduction was made for the time lost through labor troubles; the "average days worked per year" represent what a man might expect if he took no part in strikes or lockouts, worked whenever weather permitted and he could get work to do, and had average success in securing employment. The results thus arrived at for the various trades are as given in Table I.

On the basis of these preliminary figures, the average annual income of the building trade workers in Philadelphia can be calculated. Taking the hourly rates paid in the various building trades, as compiled by the National Association of Builders' Exchanges and as representing conditions prevailing Sept. 30, 1922, and applying them to the data concerning average number of days worked in a year, Table II is obtained, in which the theoretic annual earnings represent what the worker would receive if he were employed for the full number of possible effective working days, and the average annual earnings show what he would receive if employed for the average number of days worked per year in his trade.

TABLE II—WAGE RATES AND ANNUAL EARNINGS IN BUILDING TRADES OF PHILADELPHIA

Trade	Hourly Rate	Daily Rate	Theoretic Annual Earnings	Average Annual Earnings
Bricklayers	$1 25	$10 00	$2,750 00	$1,820 00
Stone Masons	1 10	8 80	2,360.00	1,628 00
Electrical Workers	90	7 20	2,023 20	1,555 20
Elevator Constructors	1 06	8 48	2,372 88	1,831.68
Engineers	90	7 20	2,023.20	1,440 00
Lathers	96	7 68	2,150 40	1,459.20
Plasterers	1 77	14 00	3,570.00	2,380 00
Cement Finishers	.80	6 40	1,798 40	1,126.40
Painters	80	6 40	1,632.00	1,164.80
Plumbers	.90	7 20	1,965 60	1,440.00
Roofers	65	5 20	1,461 00	884 00
Sheet-metal Workers	90	7 20	2,016 00	1,332.00
Steam Fitters	90	7 20	2,023 20	1,296.00
Stone Cutters	1 00	8 00	2,240 00	1,440 00
Tile Setters	1 00	8 00	2,256 00	1,660 00

The table is based on the average number of days worked during the year 1920 but this average will be probably somewhat higher during 1922 due to the abnormal amount of building being done and the favorable weather to date (Dec. 26). The hourly rate is that of union men; in cases where non-union men are employed the hourly rate may run higher or lower than the figures here given. These figures do not include any bonus which if given varies with each employer.

In only 4 out of the 15 trades considered do the theoretic annual earnings fall below $2,000 and in only one do they fall below $1,600. On the other hand the average annual earnings in only one trade rise to $2,000; and in only two other instances do they reach $1,800; in nine trades they are below $1,500.

As stated in the *Monthly Labor Review* in its conclusion, "The difference between the theoretic and the average annual earnings lends force to Secretary Hoover's statement that in the building trades 'one of the reasons for the constant drive for higher hourly wages is to maintain an adequate annual income and to offset the loss due to intermittent occupation.'" Probably also, it throws some light on the reasons for the fact, deplored by Senator Calder, that "American-born young men are no longer entering apprenticeships and learning construction trades from the bottom up, with a view to spending their lives in such work."

Storm King—A Modern Road Built Under Pioneer Conditions

Four-Mile Stretch Along Hudson Combines Scenic Beauty With Extreme Importance as Link on a Heavily Traveled State Route—Construction Difficulties Tax Contractors' Resource

LOCATION and construction difficulties which are to be expected in mountainous country in the West, when lack of transportation facilities combine with natural topographic obstacles to make new highway locations more or less inaccessible, appear entirely out of place in New York State where dense population, a network of improved highways and railways, and river transportation would seem to make a myth of inaccessibility. Yet, in the construction of the Storm King Highway, a route opened to the traveling public last November, were found all those natural difficulties which taxed the ingenuity and resource of the engineers who surveyed and designed, and of the contractor who figured and executed. The Storm King Highway job, therefore, may be characterized as a Rocky Mountain pioneer road project executed within 50 miles of the country's largest city.

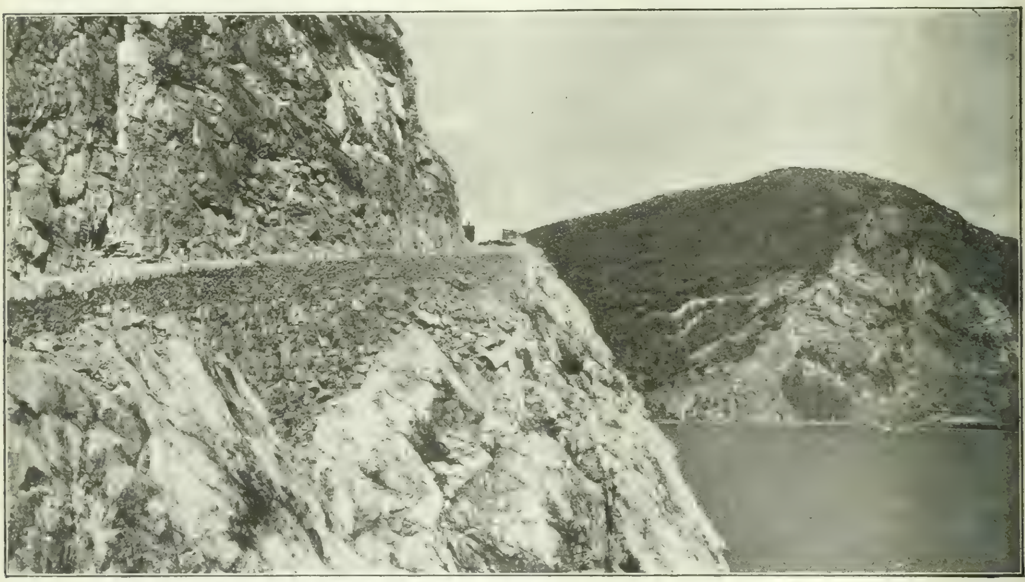


FIG. 1—ROAD SKIRTING STORM KING FACE 400 FT. ABOVE THE HUDSON RIVER

Breakneck Mountain is seen on the opposite side of the river. The road at this point is almost directly over West Shore R.R.

Two features of the project are outstanding: The importance of the 4-mile link as part of a great transportation system; and the extreme difficulties met in locating and building the highway. The scenic beauties opened by the road are many, but to the technician acquainted with the history of the route's design and construction, even these are obscured.

History of Highway—Active effort to secure the construction of what is now designated as State Route 3 dates back almost 20 years. It was in 1903 that the first appropriation was made and preliminary surveys were begun. The original design called for a limiting 5 per cent grade and some tunneling. Upon this location designs were made and a bid taken and an actual contract was let for the work at a cost of $187,000, but before work had started a group of men got hold of land which was to be used as right-of-way and successfully held up the job by holding out for high prices.

Pending a final decision of right-of-way matters, temporary adjustments were made and a new survey taken. This time the design called for a maximum 7 per cent grade and the elimination of tunneling. This threw the location farther away from the river and about 400 ft. above it. When bids were again opened the lowest was $197,000 for building only 1.27 miles. In order to bring the cost within the appropriations a redesign was made in which considerable expense was eliminated by substituting a fill for a steel viaduct across the Big Gully. On July 26, 1915, the contract was awarded to the John L. Hayes Co., Yonkers, for $273,736.70.

By the time the war stopped construction a good deal of the road had been built, $264,000 having been expended. However, costs had mounted so high that it was necessary for a separate contract to be made, though, however, with the same contractor who began the work. Final estimates show that the cost of the completed highway is between two and three times the original engineers' estimate, though the discrepancy is easily accounted for when it is considered the estimate was made with pre-war construction costs existing and with no exact knowledge of terrain to be encountered possible.

Physical Features—The highway itself, 4.03 miles in length, starts at Bayview Ave., Cornwall, climbing gradually along the side of Storm King mountain at about a 5 per cent grade until it is almost 400 ft. above the Hudson at the nose of the mountain. Then there is a descent of about 200 ft. on a 7 per cent grade back into the cove, across the Big Gully, and on around Crows Nest mountain to the West Point Reservation line. Thence it follows the base of the mountain, partly on new location and partly along the old Washington Valley road to its intersection with the state highway two miles west of Highland Falls.

The finished road is 24 ft. wide with 18 ft. of metaling for the greater part of its length, the highway having a bituminous penetration surface. In general the cross-section is a sidehill section partly cut in solid rock and partly held in retaining wall construction. The heaviest depth of rock cut is over 130 ft. and the highest section of retaining wall 38 ft. The wall is surmounted by a rough stone parapet. Walls are dry masonry walls whose footings at least to the ground line rest either on solid rock or firm ground, and are set with masonry. In most cases beyond the ground line or above the wall footing the walls are of dry rubble.

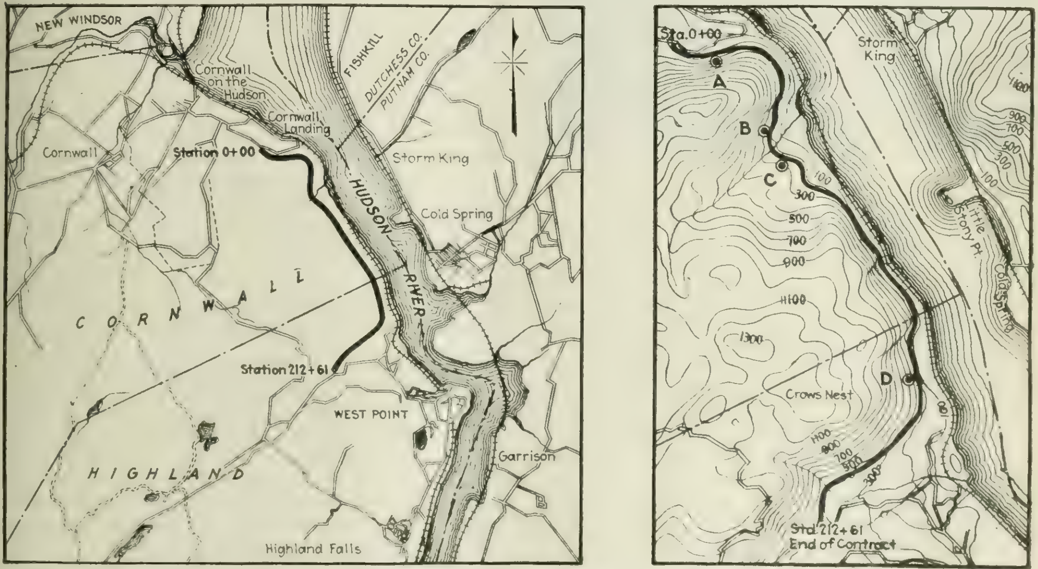


FIG. 2—GEOGRAPHICAL LOCATION OF ROAD AND TOPOGRAPHIC CHARACTER OF ROUTE TRAVERSED

A, B, C, D indicate points at which construction began. Manner in which material was got to these points is explained in text

One heavy fill was encountered at about Sta. 63+40 to 65+60 (the zero end of the contract was at the Cornwall end). This fill has an average width at the top of 26 ft., an average width at the bottom of 150 ft., and an average height of 90 ft. and crosses what is known as the Big Gully. Altogether, about 46,000 cu.yd. of material were placed in this fill.

The total rock excavation for the whole road amounted to 112,082 cu.yd., and the total earth excavation, 149,363 cu.yd. There are 25,746 cu.yd. of stone in masonry walls.

Before going into any of the design or construction features it may be well to explain the importance of the highway as a link in a north-and-south state route.

Importance as Traffic Link—There is a great deal of truck traffic which originates in the Newburgh territory and this, added to trucking and passenger traffic coming from points farther north, makes the traffic over a north-and-south route considerable. Until the completion of the Storm King road most of this traffic had to take a route traveled by vehicles coming from Binghamton over the state route which may be described as an east-and-west line. All the traffic, therefore, of the Binghamton and Newburgh territories came together at Harriman, Suffern, or Highland Falls, congesting the main route leading from those points to points in New Jersey and to New York City.

The use of Storm King, therefore, will divert the heavy truck traffic originating around Newburgh from this main east-and-west state route, relieving the congestion greatly. It will also make inter-communication between Orange County points, such as Monroe, Harriman, Highland Falls, and West Point, much easier and will enable traffic going from Cornwall to West Point, or vice versa, to cut off about 15 miles. The distance between Highland Falls, West Point, and Newburgh will be shortened about 18 miles and that between Newburgh and New York City about 15 miles.

Location—The final location was not possible because of unforeseen difficulties encountered in the construction work. However, the almost exact location was made, though around the nose of Storm King and at one or two other short points the location of the road in the field was impossible because of the precipitous slopes and the impossibility of doing any instrumental work. At such points the stationing was figured and topography taken by triangulating from the West Shore R.R. tracks below

Manner of Construction Attack—In attacking the construction work the contractor was practically con-

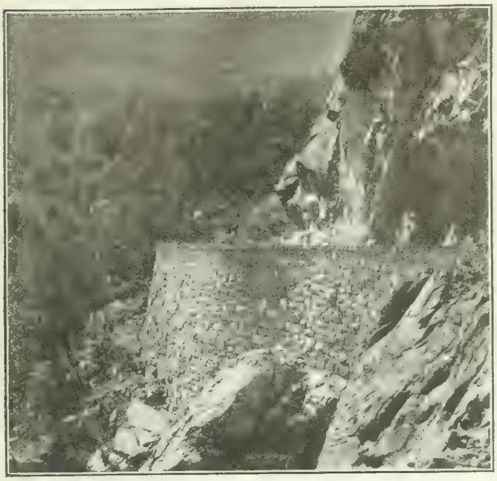


FIG. 3—SOME OF THE DRY MASONRY RETAINING WALL

fronted with a pioneer job. The zero end was accessible from an existing road, so that it was possible to start excavation work at about Sta. 19 with a full revolving crane which was utilized primarily for mucking and for laying masonry wall. This first point of attack is designated Point A in Fig. 2. An old wood road which had been used to get timber down from the height above West Point was utilized for hauling equipment to Point B. A revolving crane was sent in over this wood road and the haul was about 12 miles, the last several miles of which were such difficult going that blocks and tackles had to be utilized in pulling the crane upgrade and letting it down.

Point B was on the northern side of the Big Gully and the third point of attack, Point C, on the opposite side. It was impossible to cross the gully with equipment, so Point C was reached from below. An old road led from the river up the side of the mountain for several hundred feet and over this were taken small pieces of equipment, the steel parts of a traveling derrick, and finally a steam shovel. These were hauled from a spur track of the West Shore R.R. and block and tackle was also utilized, particularly when the steam shovel practically pulled itself up the mountainside. Mules also were used in getting equipment up the mountainside.

At Point D practically the same method was used in getting equipment up from the West Shore tracks as was used at Point C, though the haul was considerably less. At Point D was installed a bull-wheel derrick, the framing timbers of which were cut from trees on the job. Blacksmith shops were installed at all four construction points.

Construction Procedure—The usual procedure in construction work was to locate footing foundations for masonry walls first. When the footing excavation had been done, if any was necessary, and the wall carried up a sufficient height, blasting was done along the inside of the cut. It was often necessary to fire at least three lifts of holes before anywhere near approximate finish grade was reached. In many instances it was necessary to lash both drillers and drills to the rock in order to save either should the other slip.

Other pioneer features of the road construction work included methods used in getting the first bags of cement to various points on the job for laying masonry wall footings. At the beginning of the work cement had to be packed by hand in half-bag lots.

Compressed air for the entire job except the operation of one steam shovel was supplied from a line extending from near Cornwall through about 27,000 lin.ft. of 4-in. pipe. The impossibility of getting fuel to the site and the danger from using steam equipment on such a job made the use of compressed air a necessity.

One of the features of the job which indicated the finesse possible under such adverse circumstances was the facility with which rock shooting was accomplished. Particularly at the nose of Storm King and at Crows Nest, where the road almost hung above the West Shore R.R. tracks, it was necessary to avoid, in so far as possible, rock being hurled to the tracks below. Therefore, the contractor conceived the idea of drilling a line of holes fairly close together on the inside of the cut, then a second line a little farther out on the face, though considerably farther apart. At times a third line of holes, though widely separated, was drilled for the same lift. With these lines of holes drilled there was usually an undrilled ledge on the outside of the cut. When these holes were fired the resistance to the blast was in such a direction that the blasted material

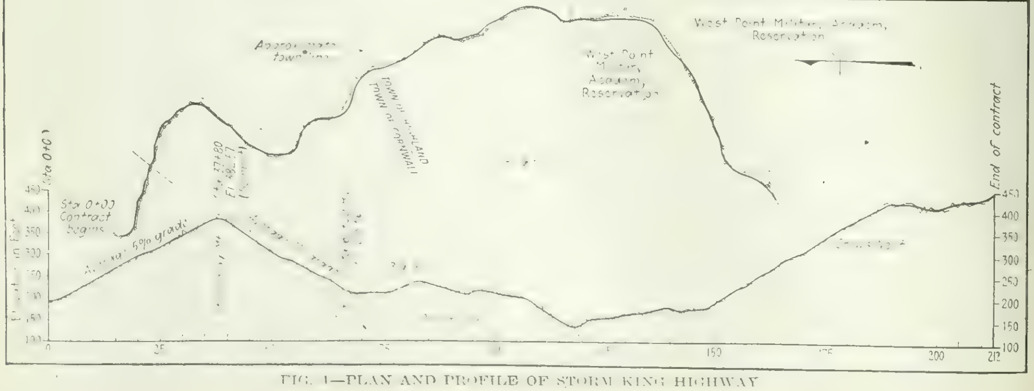


FIG. 1—PLAN AND PROFILE OF STORM KING HIGHWAY

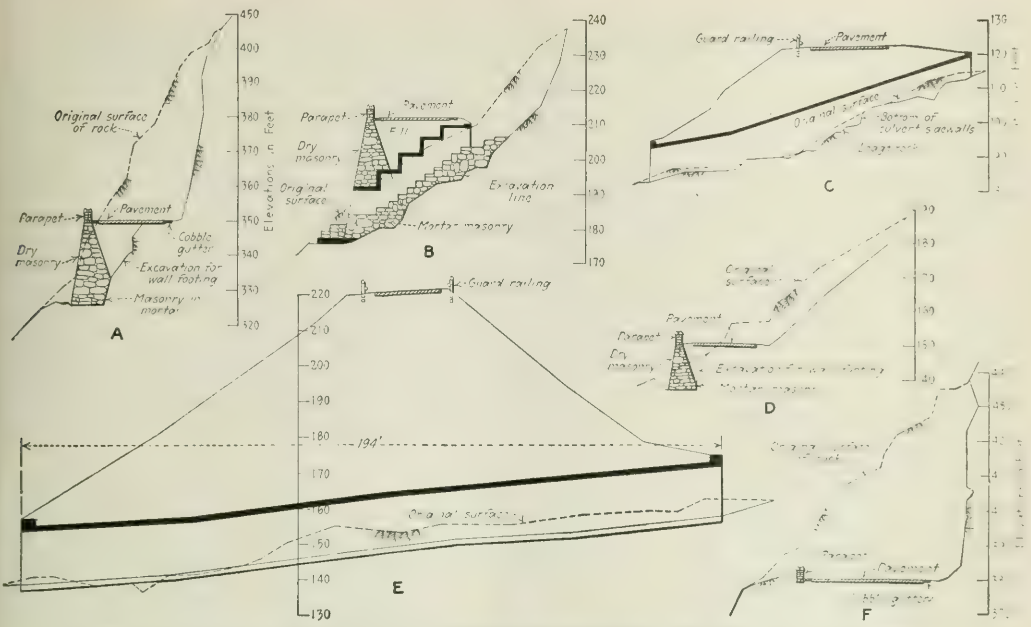


FIG. 5—TYPICAL CONSTRUCTION SECTION DETAILS

A—Section as constructed in ledge rock, typical for about 800 ft.
B—Culvert section through retaining wall on steep slope.
C—Culvert section as constructed on Storm King Mountain.
D—Section as constructed in earth and loose rock.
E—Section of the fill at Big Gully.
F—Section as constructed in ledge rock at the summit of roadway on nose of Storm King Mountain.

was thrown not directly toward the tracks, but in a line parallel with the axis of the highway. It was impossible, of course, to keep some rock from going over, but after this system had been followed and experience had taught them what could be done the powder men could throw the spoil in a place where it would do the least damage to the railroad tracks.

Another interesting feature in the work was the care with which the work was prosecuted to avoid any great amount of damage to railroad tracks or to rolling stock. When blasting along the nose of Storm King, operations were practically controlled by the dispatcher at Jersey City. It was he who, through telegraphic communication to the contractor's representative at Storm King, let it be known when trains were to pass, after which blasting could be done and the tracks cleared immediately for succeeding trains. The efficiency of such a system is easily seen when it is known that not a single train was damaged.

A special clause in the contract gave the contractor a higher classification for rock blasted where there was direct danger of injuring railroad tracks or equipment. There were two such areas—known as crane areas—below the nose of Storm King and at Crows Nest. Within these crane areas it was necessary to keep gangs of men and equipment to clear tracks after blasts. A lump sum was also included in the contract to cover such overhead. At Storm King, where the highway is about 400 ft. above the railroad and almost directly over it railroad ground wires were protected by a boxing of 3-in. plank. Ground wires were further protected by being inclosed in a heavy cable, but even with such heavy protection frequently boulders would fall smashing the boxing and at times cutting the cable. The highway is only about 200 ft. above the railroad at Crows Nest so the danger of injury to railroad structures was minimized at that point.

Though a final paper location of the road was made prior to beginning construction work, when construction work was actually carried out it was necessary to revise the location according to terrain conditions encountered. For instance, it was necessary quite frequently to drop masonry wall footings several feet lower or pull them in considerably toward the cliff from positions noted on the paper location, making additional cut and therefore additional cost necessary. In other words, the job was one in which final design and construction were carried on simultaneously. In excavating for masonry wall footings it was usually necessary to take out several feet of ledge rock because of seams, disintegrated pockets and sloping faces. Only occasionally did anchor bolts have to be used between foundation and bottom course stones.

About a dozen water courses were encountered along the four-mile section and culverts for these had to be designed so that water would be delivered at the outside of the road in such a fashion as not to endanger wall footings. The bottom and sides of such culverts usually were made of mortar masonry and set to follow practically the original ground line. The tops of culverts were usually of concrete. A typical section is shown in Fig. 6.

The first construction work was begun in 1915 when Edwin A. Duffy was state highway commissioner, and under the direct supervision of Bert Wait, then division engineer, Division No. 1. It was completed under James H. Sturdevant, divison engineer of Division 1, with E. J. Howe, resident engineer in charge of construction. Herbert S. Sisson is state highway commissioner.

Does Highway Engineering Call for Locating Skill?

A Sheaf of Answers to the Questions Raised in *Engineering News-Record* of Nov. 9 by R. S. Blinn, Who Charges Much Poor Highway Location to a Lack of Railroad Training

IN THE issue of Engineering News-Record *for Nov. 9, 1922, p. 808, R. S. Blinn raised two questions: Is railroad locating a lost art? Does highway engineering suffer from the lack of engineers trained in railroad location? On page 775 of the same issue we commented editorially on these and suggested that some of the older locating engineers and the younger highway engineers might be able to shed more light upon the subject. The following extracts are from letters that have since reached us.*—EDITOR.

F. M. Hill

State Highway Department of Georgia

IN THE MORE SETTLED communities the location of highways often requires more of diplomatic than of engineering technique, a quality in which the "old timers" were not always proficient. There remains, however, a vast amount of highway work to be done in the broken and undeveloped regions, where locations can still be made along strictly engineering lines, and it is here that the question raised by Mr. Blinn becomes of outstanding importance.

Answering the question raised in your editorial "Just how great is the need, in highway engineering, for locating skill?" I have no hesitancy in saying that in mountain work at least, it is fully as great as in railroad work. It is well to remember that many highways now being constructed, and many more which will be undertaken within the next few years, involve an expense for grading and drainage structures greater than that of many railroads; and justice to the taxpayers who are furnishing the funds for this construction demands that we spare no pains to secure the best "locating skill" available.

There is unfortunately a large share of highway construction in every state which cannot be located on a strictly engineering basis—where we must stick to the old road or not build. But even here a thorough knowledge of location is not out of place.

One difficulty in securing the best talent for location arises from the fact that we are obliged to make these locations piecemeal, locating just enough of the road to use up the appropriation that is available, and for this work it often happens that the only man available is one who has not had the training or experience that the job really requires. Yet we must use him because the job will be of such short duration that we cannot make it attractive to a man of real locating ability.

If a state having much of this work in prospect could so arrange its budget as to enable it to keep a locating party continuously in the field until all the surveys have been made, more attention could be paid to securing the proper man, and he in turn would have more time to develop his location.

* * *

R. Z. Myers

Assistant Division Engineer, State of Ohio, Division of Highways, Chillicothe, Ohio

GENERALLY SPEAKING, railroad location and highway location as sciences cannot be compared, from the mere fact that most of the factors involved in the former cannot be considered in the latter, and vice versa. For example, in locating a highway line the locator is not restricted in the matter of maximum grades and curvature to the extent that he would be if he were locating a railroad. The problems of the highway locator involving curvature and grade are a series of local problems each of which may be solved on the spot separately as the location progresses, whereas the railroad locator may have the problem of locating a line with two or more controlling points such as a mountain pass, a desirable river crossing, a town or city, or an existing main line of the railroad company, all of which may be far apart and all of which are to be connected with the most economical line possible within the limits of grade and curvature.

On the other hand, the highway locator is limited in many instances to the simple problem of laying his line over an old traveled road or conforming to certain well defined property lines in which case his "located line" is nothing more than a base line upon which the actual construction of the road is referred. The writer does not desire to leave the impression that highway location is unimportant from an engineering and economic standpoint but rather to call attention to the more flexible nature of the factors that enter into highway location as compared with those of the railroad.

Our old-time railroad locator usually was sent out by the railroad company to locate a line, which he did to the best of his ability and engineering judgment, being responsible only to the company employing him. If he met with any opposition from a property owner or otherwise, the company fought this battle itself by condemning the right-of-way over the disputed land. The highway locator, however, is confronted with a different problem; he is serving the public and trying to please not one party but many individuals, automobile clubs and other organizations all of whom may be vitally interested in the project financially or otherwise. Our highway locator here has a problem with which he must use much diplomacy and in some instances, it is regretted to say, he must subordinate his engineering judgment to stronger influences not in any way connected with the science of engineering.

W. G. Caldwell

County Highway Engineer, Waukesha Co., Wis.

THE PURPOSE of the railroad is to furnish transportation between two points. The purpose of the highway is to furnish the means for transportation between two points and between all intermediate points.

The determining points for the location of a line of railroad are cities five, ten or twenty miles apart or more. The determining points for a highway are generally: farm buildings, orchards, existing roads, cross roads, and section lines—a quarter of a mile apart or less.

The construction of a railroad is financed by men directly interested in the cost of operation. The construction of a highway is financed by men vitally interested in the cost of construction but only remotely interested in operation.

The differences in these three points alone show why a knowledge of railroad location might be handy but is not necessary to the average highway engineer.

* * *

Fred Lavis

Consulting Engineer, New York

THE TECHNIQUE of surveys for highway location and the actual layout of the location, can undoubtedly be benefited by a study of the methods of railroad location. The fundamental principles underlying highway location are, however, different from those governing the location of railways, even if the highways are to be built through virgin territory unhampered by the need of following an existing road.

These principles are, however, different only in detail. There is a different minimum radius of curvature, the rates of gradient may be as high as 10 or 12 per cent, instead of 2 or 3 per cent, rise and fall may not have the same value, and the operating economics of horse-drawn vehicles and motor trucks are not well understood, but these are only matters of detail. A man accustomed to railroad location will, I am sure, be a better man to locate a highway, provided, of course, he has sense enough to realize the differences and their significance.

Mr. Blinn need not worry much, because highway engineers rediscover old methods, this is not uncommon and does no harm; there always must be a certain amount of lost motion. Neither is there cause to worry about the locating engineers dying off; there are still quite a few left and as the world gets straightened out and recovers from the effects of the war, there will be many, many more miles of railroad built in South America, Asia and Africa, which are as yet almost untouched.

The one thing that may militate against the further development of good locating engineers for railroads is the fact that much of the railroad construction of the future is almost sure to be under government auspices, thus minimizing the impelling need of "making a dollar earn the most interest." This is also the case with highways. Without doubt a knowledge of the principles of railroad location will help in the proper location of highways, but also without a doubt many highways and railways will be located and built without regard to true economic principles.

* * *

F. R. Quackenbush

Formerly Highway Engineer, U. S. Bureau of Public Roads,
Washington, D. C.

JUST HOW GREAT is the need in highway engineering for locating skill? In thickly populated districts practically all road improvement follows the old roads. Therefore, locating skill is of minor importance. In sparsely settled territory where new roads are to be constructed locating skill is of prime importance. The first-class highway engineer must know what curves and rates of grade are permissible, what relation the road to be located bears to connecting highways, what type of road is to be constructed, approximately how much money will be available for construction, the source of materials for construction, the kind of soil conditions that are most favorable, what rock is to be encountered. These and various other factors control the locating of a new highway and it is my candid opinion that unless a man has been through the mill as a highway designer and highway builder he may fall down on the job regardless of other experience. I will grant, however, that a railroad locator who takes all necessary points into consideration will be likely to do a better job than a man who has not had such experience.

What share of our highways can be located as a railroad would be, and what share must stick closely to existing roads? The U. S. Bureau of Public Roads should be able to give a fairly definite answer to this question. I would risk a guess that less than 5 per cent of the mileage of hard surface roads in the United States could have been located in the same manner that a railroad would be at the time they were surfaced. Most new roads follow some old trail at least and there are so many influencing conditions, that railroad practice can seldom be followed.

To what extent is the location, even of new highways, controlled by conditions outside the domain of engineering science? This query is not intended as a joke, but I am tempted to give the answer in three words, *mostly by politicians!* Seriously, there are many things outside the engineering domain which belong inside. this is one of them.

And even though there may be room for a science or an art of highway location, to what extent would this agree with railroad practice and to what extent must wholly new or modified principles be developed? The old railroad lines were nearly all built as large units for certain definite purposes and could be located to make other things conform to them. Highways are coming long after railroads and many other improvements. They are built in small sections and must conform to what has preceded them. To my mind, here is one fundamental reason at least why railroad practice and highway practice must necessarily differ. Railroads carry heavy loads in large units and must have easy curves and slight grades. Roads carry quite heavy loads to be sure, but in small units and the vehicles can make quite sharp curves and steep grades, it necessary. In railroad work exact balancing of quantities of cut and fill is not necessary. In highway work, as a general rule, earthwork quantities should be more carefully balanced. If this is not done the reason should always be stated in the plans. The principal drainage problems of railroad men, because of heavy work, is to build waterways. The principal drainage problem of highway engineers is properly to drain the subsoil under and near the road. I could go on and name several other items that vary between the two fields, all of which have a direct bearing on location. My answer to this question is that it is necessary to have almost an entirely different set of principles.

* * *

H. J. Tinsley

Bent, N. M.

R. S. BLINN states a truth, applicable to at least a portion of the states, when he speaks of too little money being spent on location and too much on office calculations. He makes some other statements, however, that are misleading and wide of the point. He says, "all the methods of locating railroads are applicable at the outset in locating highways."

The transitman, levelman and topographer on highway location each may employ the methods of his railroad brother in instrument work for they are the same. The problems of topography, as they confront the locator, are the same but he is working in a much more flexible field than the railroad locator and has a greater latitude in which to satisfy alignment and profile.

Mr. Blinn is of the opinion that a man must be practiced in railroad location before he is qualified to locate highways. From a study of my own work and from inspection of the work of other railroad locators, working in the highway field, I am convinced that a good railroad locator starts as a poor highway locator and he will continue to be a poor highway locator just so long as he attempts to use railroad methods in his work. For the railroad man, accustomed to picking a line meeting the narrow limitations imposed by heavy engines and long trains running on steel rails, it requires a sharp revision of methods to get him away from the long tangents, flat curves and smooth profile so essential to the railroad but of minor importance to the highway. A grade line carrying adjoining summit and sag verticals makes an easy riding profile for an automobile and goes a long way in reducing excavation quantities, but it could not be used on a railroad.

And again, about 75 per cent of the highway locator's work is confined to following old alignment of present roads where about all that he can do is to "shoot her up the center" with an occasional curve or grade improvement.

Far be it from me to belittle the province of the highway locator. I contend that he should be the most experienced man in a state's highway organization, and that he should have charge and supervision of all location work in the state, for is not the *location* the one and only permanent feature that an engineer can bequeath to any structure?

* * *

R. D. Rader

District Engineer, Montana Highway Commission

AS ONE of the "newly-born highway engineers" who has been locating highways for ten years in mountain country—and this without first locating a railroad—I wish to take issue with Mr. Blinn on his statement that "unless the highway locator assimilates these principles through actual practice in railroad locating, we will continue to have poor highway locations." An excellent highway location may be very poor railroad location, and vice versa. A railroad locator is prone to long line and grade tangents which are expensive and useless on mountain highways. He is apt to forget that a rolling grade with a 5 per cent or 6 per cent maximum is just as satisfactory and much more economical than long sustained grades. Many of our highway engineers were previously railroad location and construction engineers, but these men all have had to modify the principles and methods learned in railroad work very considerably in order to fit them to highway conditions.

I agree heartily with Mr. Blinn in the importance of careful location of mountain highways. The cost of a careful location by an experienced man will be saved many times over, not only in construction costs, but in maintenance cost and the cost of operating vehicles. No highway should be constructed until all possible routes have been investigated, and it is certain that the best location has been secured. And the securing of the "best location" involves so complicated adjustment of the usually conflicting demands of alignment, grade, first cost, probable maintenance cost, local traffic needs, long distance or through traffic requirements, freedom from snowdrifts, drainage necessities, scenic values, and many other considerations; that often "old time locators" do not agree on details.

* * *

M. J. Patterson

Denver, Colo

We are building many fine earth and gravel roads in our mountains, which I would only criticize as following too closely the railway engineers' ideas, without due regard to the differing requirements of the automobile tourist. The roads are mainly through national forests, where the location is unrestricted, and are largely intended to make such forests accessible to automobile tourists and campers.

I can explain my criticism most clearly by use of special examples. Last year I came East on the fine road over Monarch Pass connecting the Gunnison and Arkansas valleys. I desired to camp before reaching any great altitude, but the road is as shown in cross section by full line in Fig. 1. I passed many attractive spots which I could not utilize, as there was no way to get off the road and back on again. A few "runoffs" as indicated by dotted line in the figure would remedy this.

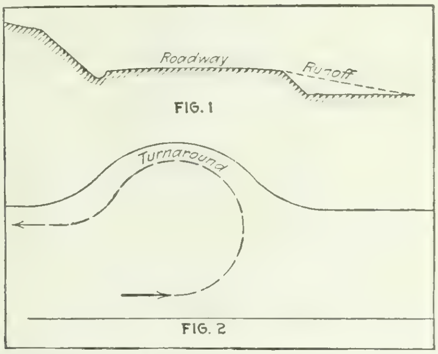


FIG. 1

FIG. 2

RUNOFFS AND TURNAROUNDS FOR HIGHWAYS

A second illustration is afforded by the fine road up Bear Creek Canyon. The need here is for convenient places to turn or to get out of the traffic while making adjustments. I have often run several miles further than I desired on this road for lack of a convenient place to turn, especially when the road is muddy and the few flat spots beside the road are too slippery for traction. A few "runoffs" as shown in Fig. 1 or "turnarounds as indicated in Fig. 2 would remedy this. A railway train runs from town to town, but an automobilist often desires to turn back between towns.

Another regrettable tendency shown is that of making too long continuous grades. On some of the more popular mountain roads thousands of cars pass in a day. A considerable number of them need to stop for minor repairs or adjustments. Some adjustments can not be made with locked brakes and resort is had to blocking the wheels with stones while the adjustment is made. It is of course reprehensible to go off and leave the stones there, but it is often difficult to start and hold the car on the grade, while getting out and removing the stone. Preferably there should be level spots every half mile or so and a widened roadway at such spots when practicable. Such criticism as is implied in the above, is that the highways are too often designed for through continuous travel.

Another kind of problem occurs in many cases, of which our Berthoud Pass road affords a typical example. Here the road follows a rather easy grade up Clear Creek and North Clear Creek, then makes an abrupt climb to the top of Berthoud Pass and an equally abrupt descent to the Fraser River. On the original road the final climb and the descent were each about four miles long. I judge the average grade was about 15 per cent with some steep pitches running up to probably 25 per cent. This road was also very narrow and the surface rough. Automobiles of fair power climbed it readily but many cars in poor condition failed on the steep pitches.

On the relocated road the grade is reduced to 6 per cent and the climb is lengthened from four miles to about ten miles, with much increase in curvature.

I doubt the desirability of so great a change. The road would suit me better if it had been widened, surfaced, and evened out to a 15 per cent maximum grade without increase in length. On mountain roads the speed attainable is usually limited by the visibility of the road ahead, and owing to obstruction of view by curves one cannot safely make much more speed on a 6 per cent grade than upon a 15 per cent. Probably truck owners will prefer the lighter grade. And perhaps mile for mile the 6 per cent grade is easier to maintain.

But all of our mountain roads have to be resurfaced after a rain, particularly if traversed by trucks while wet, and it would seem probably cheaper to drag four miles of road than ten. Also it seems undesirable to encourage by easy grades the use of trucks on roads so readily destroyed.

The question of the best grade to use in getting from one point to another near by, but much above, will probably remain a matter of personal opinion. A pedestrian usually takes the short but steep path. His method of locomotion is adapted to climbing. A locomotive goes the long way around. It is not adapted for steep climbing, but with a reasonable certainty of a clear track, it can make up by speed for a considerable increase in distance. An automobile is rather intermediate between the two. It cannot climb precipices, but by reason of its change gear it can readily climb considerable grades. It also is never sure of a clear track around curves. Personally I believe that 15 per cent grades are preferable to 6 per cent in many cases where the distance is necessarily inversely as the grade.

I might say that the old grade over Berthoud carried all the traffic (by teams) from Denver into Middle Park for many years before the railroad was built, and I doubt whether even the old teamsters would prefer the new grade with a distance increased from eight miles to twenty. Outside of the mountain district there are some cases where I think highways would have been improved by following railroad practice. I refer particularly to concrete main roads where I think the curves should have been banked and perhaps spiralized.

* * *

Edward Gillette

Sheridan, Wyo.

Minimum grades and the elimination of grades or hills seem to be as important on highways as on railroads, for the lifting of loads requires corresponding power, and as the speed is not so different a little extra distance is nothing compared to lifting a load over a hill. Highways are blocked by snow in shallow cuts just as the railroads are. It is painful to see a well-built concrete road following curves for which there is no excuse, or to see a road forced to follow the bluffs on the side of a valley when a line through the middle of the valley would enhance the value of the good land two or threefold and at the same time make a road cheaper to construct and maintain, effect a saving in transportation of all kinds and insure greater safety in travel. In our headlong rush to spend money on highways this question of proper location seems to have been pushed one side and no doubt considerable of our highway location ultimately will have to be abandoned. The cost to increased traffic in the future will be too great.

Continuous Frame Design Used for Concrete Highway Bridges

Flat-Arch Types Over Bronx Parkway Roads Have Reinforced-Concrete Frame With Cut Stone Facing—Save Money

By Arthur G. Hayden
Senior Assistant Engineer in Charge of Design, Bronx Parkway Commission, Bronxville, N. Y.

CLEARANCE conditions and architectural demands in the roadway crossings of the new Bronx River Parkway north of New York City have led to the adoption of a special type of continuous-frame reinforced-concrete bridge which presents some novelty in design and economy in construction. One of these structures carries Swain St. over the Parkway Drive and accommodates a roadway 32 ft. wide and two sidewalks each 10 ft. wide. The other carries Palmer Ave. over the drive and accommodates a roadway 30 ft. wide and two sidewalks each 8½ ft. wide. The clear span of both structures over the drive is about 42 ft.; overhead clearances at the center of drive 15 ft. and at the curbs 11 feet.

The grades of the streets and of the Parkway Drive and desired clearances together with architectural requirements precluded beam construction and limited the design to an arch-like structure with but 12 in. crown thickness. On account of the relatively great height over the curbs at the sides of the driveway, a true arch design would have involved abutments with excavation and compacting of roadway fill whose cost would have been disproportionate to the function performed by the arch proper. This consideration led to studies of the type of structure shown in the accompanying figures which is nothing more than a reinforced-concrete frame to sustain lateral earth pressures as well as the vertical loads which it is designed to carry. The economy in concrete, excavation and compacting of roadway fill permitted by this type of design is considerable—the estimated saving in cost over a true arch design being about $5,000 for each structure.

The first studies were made for a structure with a permanent hinge at the crown, the hinge consisting of a vertical joint through the concrete for the full width of the bridge, the steel in the upper face running through (Fig. 3). The steel acting alone was sufficient to carry the thrust and the shear from unbalanced live-load but relatively very small bending moment. The bending action of the rods due to the passage of heavy live-loads was negligible. The appearance of a joint in the soffit was considered to be objectionable architecturally, however, and the design was discarded.

The design adopted is for a structure continuous at the crown as shown in Fig. 4. In such a structure, the bending moment at the crown (or any other section for that matter) is affected by the elastic properties of all other sections as well as by the magnitude of the vertical and lateral forces. Increasing the strength at the knees for example decreases the bending moment at the crown for any system of loads and vice versa. Increasing the strength at the crown increases the bending moment at the crown for any system of loads and vice versa.

Alternate Designs—Since there will be several other structures of this type built on the Parkway, most of them of about the same span length, two complete designs were made for the same loadings, to study the effect of varying the proportions at the knee. Design A (so called) had 4 ft. thickness across the knee and 12 in. crown thickness; Design B had 3 ft. thickness across the knee and 12 in. crown thickness. In Design A the maximum positive bending moment at the crown is 10,400 ft.-lb. per ft. width of structure. In Design B the bending moment at the crown *for the same loading* is 15,500 ft.-lb. or 50 per cent more. The corresponding negative bending moments at the knee are: Design A, 86,400 ft.-lb. per ft. width of structure and Design B, 74,400 foot-pounds.

Design B is the more economical and was adopted for Palmer Ave. and all future structures of the same span. Plans for the Swain St. structure were made before comparative designs, to determine economical proportions, but agree quite closely with Design A.

Design Conditions—The amount of passive earth pressure which will be developed as a result of compacting the roadway fill and by flexure of the frame under load is an undeterminable quantity and must be assumed. The following conditions were investigated:

(a) Dead-load, and balanced active earth pressure, with or without live-load.
(b) Dead-load, and balanced earth pressure equal to three times the active earth pressure, with and without live-load.
(c) Dead-load with lateral earth pressure on one side only.
(d) Dead-load without lateral earth pressure.
(e) Earth pressure alone equal to three times active earth pressure, representing conditions before removal of falsework and the action of dead-loads.

The live-loads assumed in design were a uniform load of 100 lb. per sq.ft. on any part of the roadway and sidewalks, or, three 20-ton motor trucks on 30 ft. width of roadway in addition to sidewalk loads.

Conditions (c) and (d) presumed that earth pressure might be removed from one side or both by future excavation for some purpose or other. Such conditions will never be realized, however, for provision has been made for carrying telephone ducts and gas and water pipes up to 8 in. diameter over the structures in the sidewalks, and future excavation back of the vertical wall-abutments will not be necessary. A calculated unit stress of 20,000 lb. per sq.in. in the steel at the top of the footing with unbalanced earth pressure (earth pressure on one side only) was therefore permitted. All other conditions were met without exceeding 16,000 lb. per sq.in. in the steel or 650 lb. per sq.in. in the concrete in any part of the structure.

This type of structure may be used for much greater span lengths than the Swain St. or Palmer Ave. structures and the crown-bending moments kept within proper limits by giving sufficient flexibility to the crown sections and sufficient rigidity to the knee sections. Calculations are being made for a span length of 55 ft. for another structure on the Parkway.

If the intrados is of sharp curvature, stirrups near the crown, where heavy bending moments exist, will constitute an important detail, although in a true arch they are more or less redundant. The crown section acts like a curved beam between points of contraflexure, and the curved lower tension rods will tend to straighten out and spall out the thin layer of concrete between the rods and the soffit. Stirrups will be required to secure these rods to the upper rods and pre-

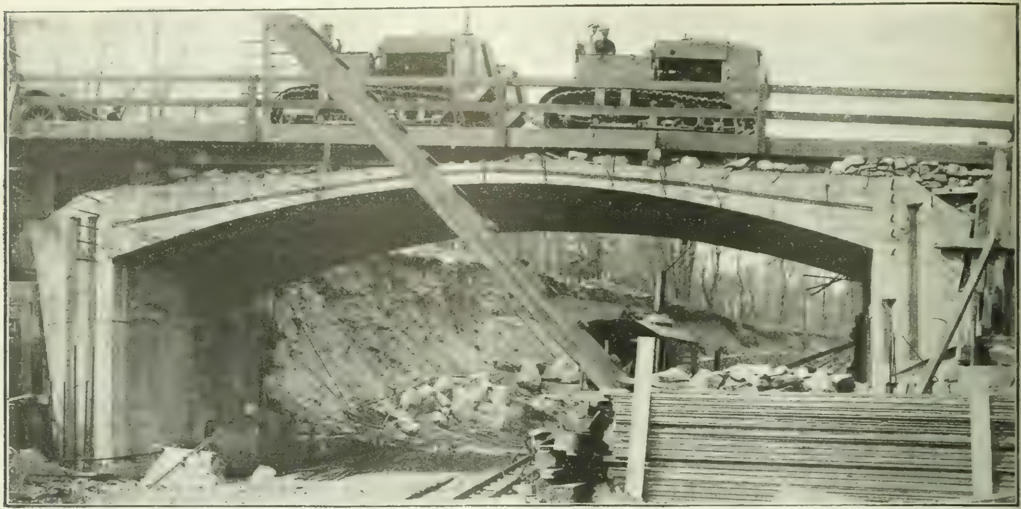


FIG. 1—SWAIN ST. BRIDGE IN BRONX PARKWAY NEAR NEW YORK CITY

A continuous-frame concrete structure, here shown before final stone facing and carrying 10-ton test load near the crown of first section (22 ft. wide) built. This bridge is much thicker in section than later ones of same type.

vent such action. They will furnish the required vertical components to the increments of direct stress.

Construction Details—One-half of the width of the Swain St. structure was built at a time. Traffic was maintained on the north side of Swain St. while the south side of the street was excavated, and the south half of the bridge built. Traffic was then diverted over the south half while the north half was built.

Each half of the structure was built in vertical sections, small enough to make a day's work of concreting for a small plant. The footings were first laid, with dowels projecting therefrom to which the main reinforcing rods in the vertical wall-abutments were to be spliced. All the remainder of the steel reinforcement was then placed on the forms. The excavation was made to lines sufficiently accurate to deposit concrete directly against the earth and dispense with the back forms. The second lift carried the concrete up to the bend of the knees and the third lift completed the top of the frame. Construction joints between the footings and the vertical walls and between the vertical walls and the top of the frame were made approximately normal to the line of direct stress and furnished with keys.

When the first half of the structure had been completed, the falsework was removed, although instruc-

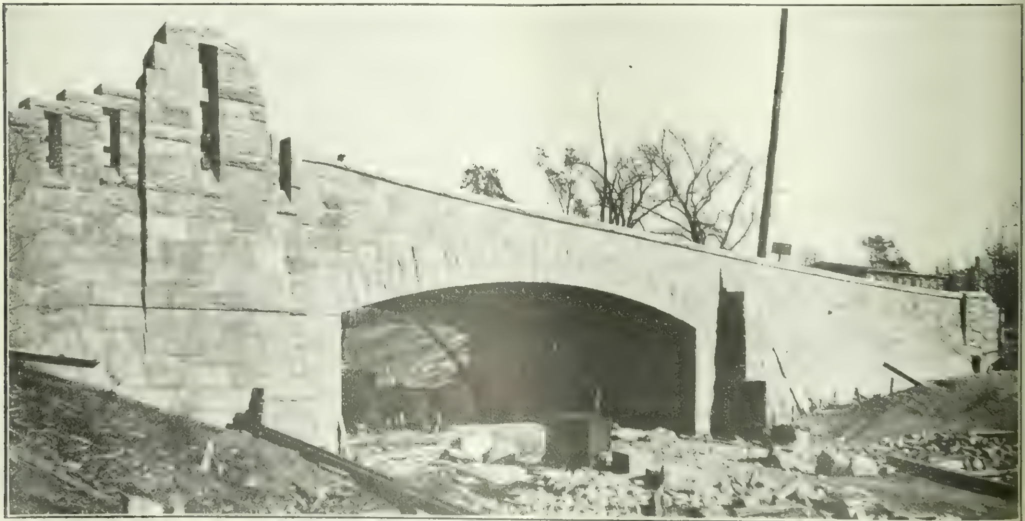


FIG. 2—SWAIN ST. BRIDGE AFTER STONE FACING HAD BEEN PLACED

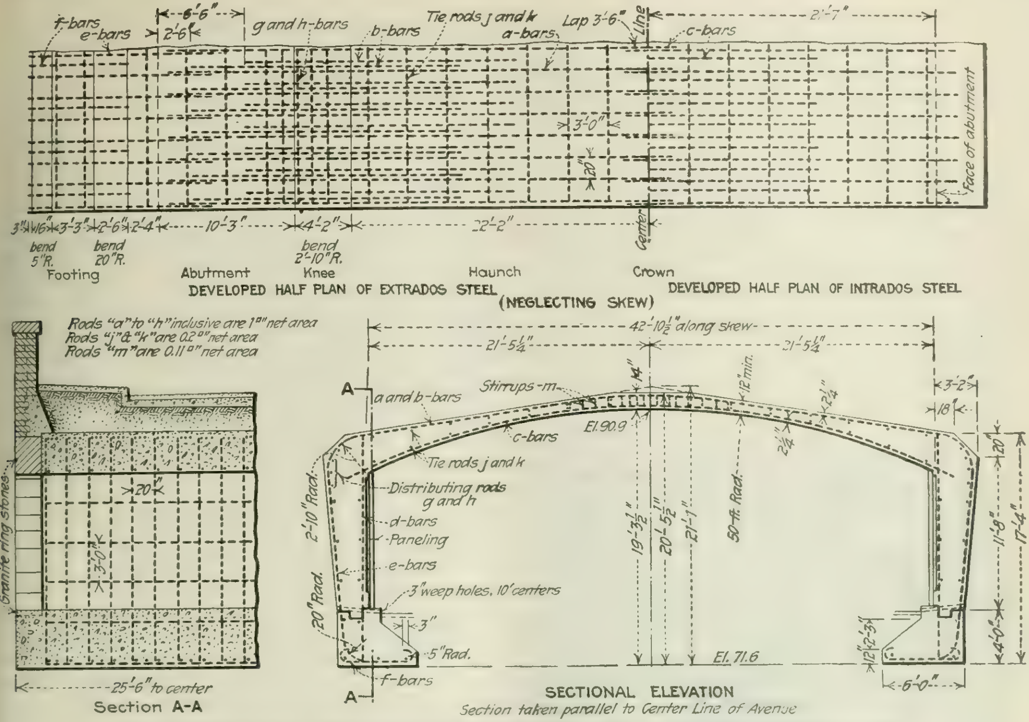


FIG. 4—DETAILS OF CONTINUOUS-FRAME CONCRETE BRIDGE OF BRONX PARKWAY TYPE

tions had been issued to the construction forces to leave it in place until the second half of the bridge had been completed and lower the falsework for the entire structure at once; the transverse reinforcement being designed as continuous for the full width of the bridge and no permanent joint between the two halves of the structure being provided, so that the differential deflection between the two halves could not be equalized. However, the dead load deflection of the first half was too small to be measured without delicate instruments and no trouble developed when the falsework for the second half was lowered.

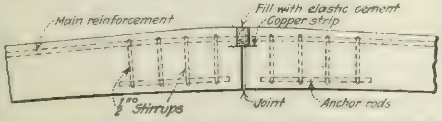


FIG. 3—DISCARDED DESIGN, PERMANENT CROWN HINGE

The width of the first section built was 22 ft. and $\frac{1}{16}$ in. deflection noted for a 40-ton test load at the crown.

The Bronx River Parkway extends from Bronx Park, New York City, to Valhalla, Westchester County, New York, and is being developed by the Bronx Parkway Commission of the State of New York. Madison Grant, William W. Niles and Frank H. Bethell are the commissioners, Jay Downer, engineer and secretary and L. G. Holleran, deputy chief engineer. The design of these bridges was developed by the writer, with the assistance of D. P. Babcock and J. J. Carroll in carrying out the computations and details, and was reviewed as to general practicability and analysis of stresses by N. Casores under direction of Shortridge Hardesty of the firm of J. A. L. Waddell, consulting engineer. The architectural treatment of Swain St. bridge was developed by Charles W. Stoughton, architect, of New York City, and the result will be a very beautiful structure.

The Palmer Ave. and Swain St. structures are being built by the commission's construction force. L. A. M. Bushnell is in direct charge of the work under Gilmore D. Clarke, superintendent of construction.

Solid Wood Decks With Asphalt Surface on Chicago Bridges

A solid timber deck composed of planks alternately 2x6 and 2x4 in. set on edge so as to form a grooved surface and covered with a bituminous wearing surface has been in use on some Chicago bridges for three years, and was described in *Engineering News-Record*, Nov. 13, 1919, p. 866. According to Alexander Murdock, city engineer, and Thomas G. Pihlfeldt, bridge engineer, the results have been satisfactory where asphalt was used. But where the surfacing was of torpedo sand and coldpatch composition the pavement became so hard as to crack under traffic and jar out of the grooves. No trouble was experienced from flowing of the asphalt in hot weather, and the waterproof character of the pavement has been very noticeable, as indicated by keeping the steel under the floor clean and free of rust. Up to date the preferred pavement for bridges is of 4-in. creosoted blocks laid with 1x3-in. strips between the rows of blocks to form grooves and thus afford a good grip for horses. This block pavement is laid on 6-in. creosoted sub-plank.

Economic Theory of Highway Grades

Tests in Iowa Give Working Equations for Both Automobiles and Commercial Vehicles —Relation of Grades to Fuel Cost—Momentum Grades Economical

By T. R. Agg
Professor of Highway Engineering, Iowa State College, Ames, Iowa

INVESTIGATIONS to establish the fundamental theory of highway grades were started in 1919 at the Iowa Engineering Experiment Station and the work has continued until the present time. It now appears that a tentative theory of highway grades may be proposed, but several years' additional work will be required to evaluate all of the variables that enter into the problem. In 1920 the work at Ames was correlated with the program of highway research proposed by the Advisory Board on Highway Research of the National Research Council. By so doing the final conclusions will be reached more quickly than otherwise because a number of investigators are now working on some phase of the problem.

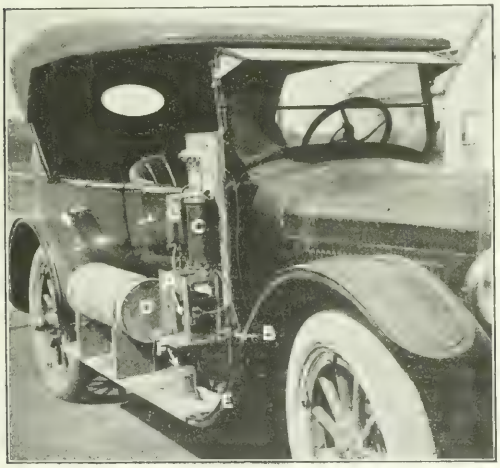


FIG. 1—FLOWMETER ATTACHED TO AUTOMOBILE
A is the diaphragm, B the piezometer; C, an ordinary vacuum tank; D, an auxiliary gasoline tank; E, the speedometer cable that drives the paper rolls; F, the clock for indicating speed, and G the spark coil for furnishing the high tension recording spark.

The first attempts to measure the effect of highway grades on fuel consumption and speed were crude and yielded little real information. A few vehicles were equipped with calibrated tanks for gasoline and trips were made up hill and down again, the fuel consumed being carefully determined for each trip. The results of a few of these measurements of fuel consumption are shown in Table I. A little consideration of the data in that table will show that the indication is that any grade will result in greater fuel consumption than would be required for level roads. That is wholly incorrect as later investigations show, and the fallacy of the results of the measurements shown in Table I lies in the fact that the method employed does not take into account momentum effects that are always present when a vehicle is operated over hilly roads.

The next step was to secure a continuous record of rate of fuel consumption and speed while vehicles were being operated over various sections of highway among which were included grades of all kinds. The difficult part of the work was to secure a means of metering the gasoline as it was used, and much time was devoted to that particular problem. The instrument finally adopted is sufficiently accurate for the purpose of the investigation and is readily attached to any vehicle and fairly sturdy. Researches that have been conducted elsewhere show that rate of fuel consumption is not a direct measure of power delivered by the vehicle, due to characteristics of the throttle-governed, four-cycle, gasoline motor. In the Ames investigations fuel consumption was used to determine the effect of grades and while the comparisons thus made are not exact, they do serve to uncover the principles underlying the theory of grades.

The Ames flowmeter is shown in Fig. 1 and the form of record obtained from it is shown in Fig. 2. The instrument is so designed that the velocity head in the gasoline flowing to the motor is measured through the medium of a piezometer ring and a sensitive diaphragm. The instrument is calibrated on the vehicle upon which it is to be used. The record of variation of head of gasoline is punched on the paper by a high-tension spark. Vehicle speed is also recorded on the record paper by a spark. The calibration curve for the flowmeter is shown in Fig. 3.

After the instrument was calibrated the vehicle was operated over various sections of highway in a normal manner, there usually being five round trips in a series of runs. The flowmeter data was then platted on profile paper along with the road profile and the speed curve so that they could be studied. Fig. 4 shows the gasoline profiles for five runs over a section of highway and indicates the consistency that might be expected. Fig. 5 shows all of the data for a series of runs over one of the sections of road and illustrates the complete record for one vehicle on the highway. About thirty-five such diagrams were made up in the course of the investigations.

Tentative Theory of Grades—A consideration of all of the data so far obtained indicates that if only speed and fuel economy are considered the most economical grades will be those complying with the following:

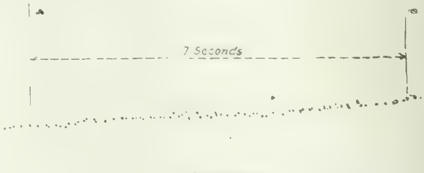


FIG. 2—PART OF RECORD FROM FLOW METER

A. The grade should permit the vehicle to descend without using brakes and without attaining an unsafe speed.

TABLE I—QUANTITY OF GASOLINE USED IN ASCENDING HILLS
(Fourth Gear is "high," First Gear is "low")

Run	P. C. Grade	Gear	Vert. Dist. Traveled, Ft.	Ton-Miles per Gal.		Ton-Miles on 0.0 Grade in High Gear
1	5 1	2d	602	11.4	11.22	29.7
2	5.1	2d	536	11.25		
3	5.1	2d	418	11 00		
4	3.7	3d	561	14 2	13.2	29.7
5	3.7	3d		12 2		
6	5.8	2d	590	7 5		21 2

B. The grade should permit the vehicle to ascend without the necessity of shifting gears and at a speed that will give maximum economy of operation of the motor.

The above principles are in conflict, since in general the grade that will comply with (A) will be lower than required by (B). The exact values for the per cent of grade for each condition will depend upon the allowable variation in speed of vehicle, the rolling resistance of the road surface and the tractive effort of the vehicle at efficient motor speeds.

The conditions established by the statements in (A) can be put in equation form as follows:

For automobiles,

$$P_m = \frac{3.47}{L}(S_2^2 - S_1^2) + \frac{R}{20} \qquad (1)$$

For commercial vehicles,

$$P_m = \frac{3.63}{L}(S_2^2 - S_1^2) + \frac{R}{20} \qquad (2)$$

where P_m is the maximum economical *minus* grade in per cent; S_1 and S_2 are the initial and final speeds of the vehicle in miles per hour; R is the rolling resistance of the vehicle in pounds per ton, and L is the length of grade in feet. Equation 1 applies to automobiles and equation 2 to commercial vehicles. The differense is wholly in the constant and that difference is due to the difference in the moment of inertia of the rotating parts of the two classes of vehicle. For an automobile the kinetic energy due to rotating parts is taken at 5 per cent of that due to translation and for commercial vehicles 10 per cent of that due to translation. These are average values for the vehicles used at Ames.

The conditions set forth in (B) may be put in equation form as follows:

For automobiles,

$$P_p = \frac{T}{20} - \frac{R}{20} + \frac{3.47}{L}(S_1^2 - S_2^2) \qquad (3)$$

For commercial vehicles,

$$P_p = \frac{T}{20} - \frac{R}{20} + \frac{3.63}{L}(S_1^2 - S_2^2) \qquad (4)$$

where P_p is the maximum economical *plus* grade in per cent; T is the tractive effort of the vehicle at maximum motor efficiency in high gear, and the other symbols have the same significance as in equations (1) and (2).

In order to compute the maximum minus grade for any location and vehicle, it is necessary to assume values for S_1 and S_2 and to use the value of R applicable to the particular surface. P_m can then be computed. Likewise in computing P_p for any location S_1 and S_2 must be assumed and the proper values for R and T determined. Grades computed in this way will comply with the principles set forth in A and B.

Since the public highway is utilized by an exceedingly heterogenous traffic, one must assume average or typical vehicles to serve as a basis for determining specific values for the per cent grade to adopt in any particular case. This we have ventured to do and the data in Table II and Table III represent our conception of a composite automobile and a composite commercial vehicle. The most variable factor is tractive effort. At maximum motor efficiency, in high gear, the value of tractive effort is quite a variable for different classes of vehicles and the tractive effort on gears other than high gear is still more variable.

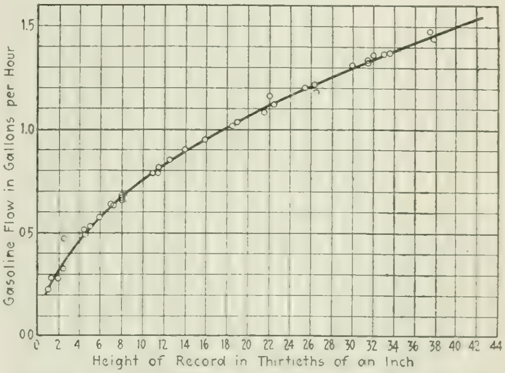


FIG. 3—CALIBRATION DIAGRAM FOR AMES GASOLINE FLOW METER, BUICK MODEL

The factor R is the sum of the rolling, air, and internal resistances up to the clutch. This does not vary widely for different vehicles but does vary with the character and condition of the road surface, the temperature and the speed.

The characteristics of the composite vehicles have been adopted after an exhaustive study of all available data and are offered as the first step in arriving at what may eventually be established as truly typical vehicles.

The significance of equations (1) and (2) is illustrated by the curves in Fig. 6. These curves are obtained by applying the characteristics of the com-

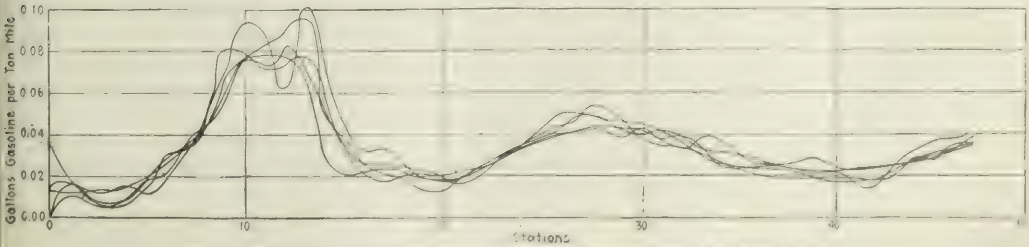


FIG. 4—TYPICAL GASOLINE CONSUMPTION RECORDS ON A GRAVEL ROAD

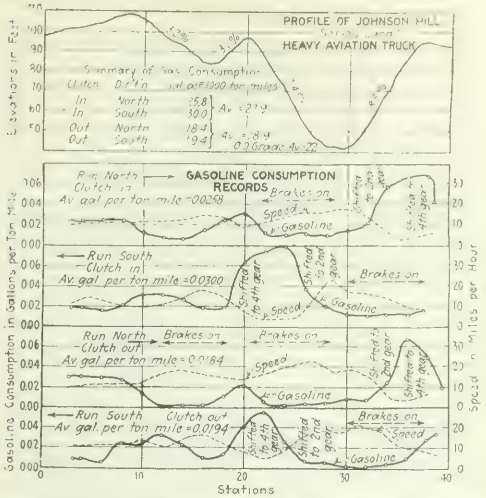


FIG. 5—TYPICAL PERFORMANCE ON HIGHWAY SECTION

posite vehicles to the equations and represent truly the economical maximum minus grades for the composite vehicles operating on paved road surfaces. In the same way the curves in Fig. 7 have been calculated to represent the actual economical plus grades for the composite vehicles.

In practice the maximum plus grade will first be determined. This represents the maximum allowable grade for the highway. But the allowable plus grade for automobiles will be much higher than for commercial vehicles and which shall govern will depend upon the character of the traffic on the particular highway.

The maximum minus grades will next be determined and these are nearly the same for automobiles and commercial vehicles. It now remains to determine whether the grade shall be made to conform with the maximum plus grades or the maximum minus grades. This is purely a matter of cost. The expenditure that may be justified for reducing the grades from the maximum plus grade to the maximum minus grade may be estimated as follows:

Let H equal the number of feet the total height must be reduced to change the grade from a maximum plus grade to a maximum minus grade.

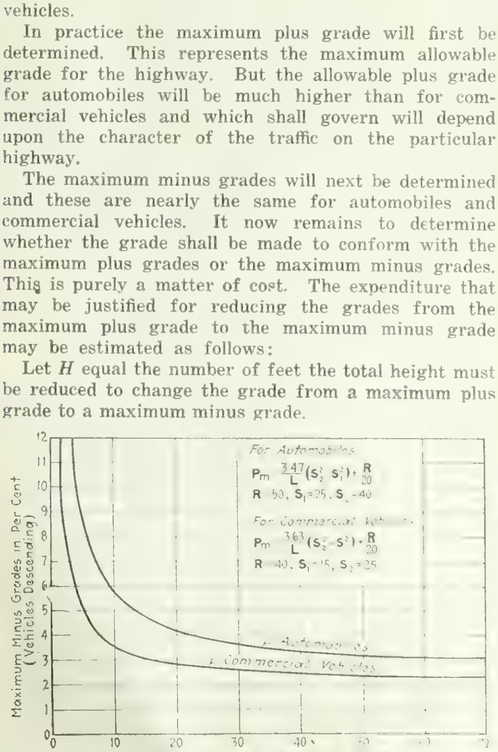


FIG. 6—MAXIMUM GRADES FOR DESCENDING VEHICLES

V = the annual traffic in millions of tons descending the hill.

C = cost of gasoline in dollars per gallon.

D = justifiable expenditure in dollars for reducing the grade.

Then

$$D = 5{,}200HVC \qquad (5)$$

Equation 5 is based on an average thermal efficiency for the composite vehicle of 10 per cent and 19,000 lower B.t.u. per pound for gasoline and the actual saving is capitalized at 4 per cent.

Usually D would be determined separately for automobiles and for commercial vehicles since the value of H would be slightly different for the two types of traffic.

Summary—The foregoing is intended to introduce a tentative economic theory of highway grades. The value of the deductions depends upon the sufficiency of the experimental data and the accuracy of the assumptions relative to the characteristics of the composite vehicles. There has been analyzed a great mass of data bearing on the subject, and extensive field investigations have been in progress for three years, but the subject involves so many variables that the results presented herein can hardly be considered more than the first step in the establishment of an adequate theory of highway grades. Amplifications and refinements to the theory will be made by those interested as rapidly as pertinent experimental data are available.

TABLE II—CHARACTERISTICS OF COMPOSITE COMMERCIAL VEHICLE

Speed Range Mi. per Hr. High Gear	Tractive Effort on Gears, Lb. per Ton High	3d	2d	Low	Roll Internal and Air Resist. Lb. per Ton Pav'ts	Grav. Mac Earth
15 to 25	130	160	250	380	40	55

Comparative Fuel Consumption on Various Gears
(Average of five series of runs)

Type of Vehicle	Ton-Miles per Gal. Gas Paved Surfaces Low Gear	Second Gear	Third Gear	High Gear
Truck, solid tires.....	9.0	16	25	30
Truck, pneumatic tires.....	11	15.0	22	30
Average	10	15.5	23.5	30

Relative Speeds with the Several Gears

Gear	Speed, M.P.H.	Per Cent of High Gear Speed
High.....	25	100
3d	15	60
2d.....	8.75	35
Low	5	20

If the principles presented herein are considered in connection with trunk-line highways, where the annual traffic may reach several million tons, it will be appar-

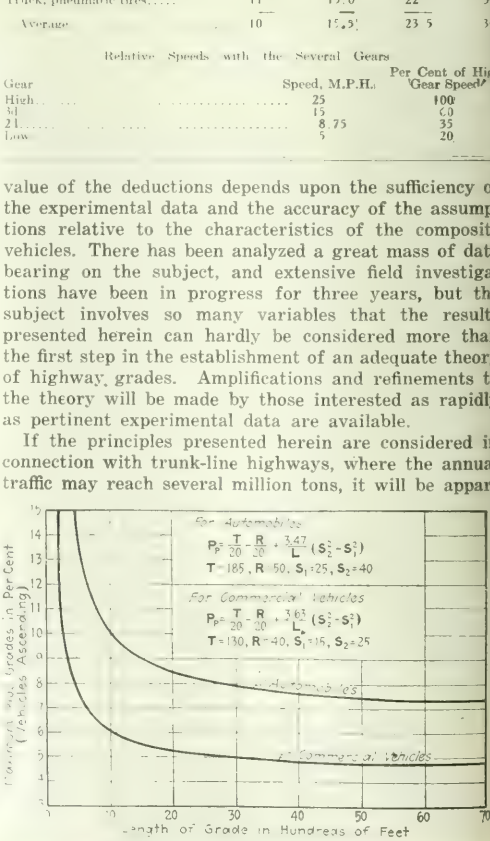


FIG. 7—MAXIMUM GRADES FOR ASCENDING VEHICLES

ent that the actual value of the fuel saved by grade reduction may reach very significant sums.

The value of lost time due to excessive grades is an even larger sum, where the volume of commercial vehicle traffic is large, and undoubtedly a similar loss accrues to a considerable percentage of the automobile traffic. It is highly important to establish a basis for evaluating lost time, but it is one of those elusive quantities that are difficult to analyze and we have as yet made little progress in that direction.

TABLE III—CHARACTERISTICS OF THE COMPOSITE AUTOMOBILE

Speed Range Mi. per Hr.	Tractive Effort on Gears, Lb. per Ton High	2d	Low	Roll Internal and Air Resist., Lb. per Ton Pav'd Grav., Mac.	Earth
25 to 40	185	400	600	50	65
Relative fuel consumption on the various gears in...	High gear 26, 2d gear 20, low gear 14				
Relative average speeds on the several gears	High gear 100, intermediate 65, low 35				

It seems to have been established that momentum grades on rural highways are economical both from the standpoint of fuel and time and that, under certain circumstances, less fuel will be required on a road with an undulating grade line than on one with very flat grades.

Fuel cost is an item amounting to only fifteen or twenty per cent of the cost of operation of a motor vehicle, but a saving of one-tenth of the fuel annually consumed in a state will amount to a large sum.

Almost invariably those things that lower fuel consumption also lower maintenance costs for the vehicle and the road, thus indirectly effecting a saving in repair bills and tire wear, which is considerably larger than the fuel saving.

One interesting fact brought out in the fuel consumption runs was the marked saving in fuel that results from coasting down hill with the motor declutched. This is a perfectly feasible way to drive an automobile but may be dangerous with a commercial vehicle. It should not be practiced with any kind of vehicle on long grades or where safety considerations require the vehicle to be kept under control.

Safety, aesthetics and drainage considerations are outside the scope of this investigation, although they are factors that must always be considered in connection with grade reduction.

Bates Road Test Develops New Slab Design in Illinois

Edges of Slab Three Inches Thicker Than Center—Requires Less Concrete—Cost per Mile Reduced—Strength Increased

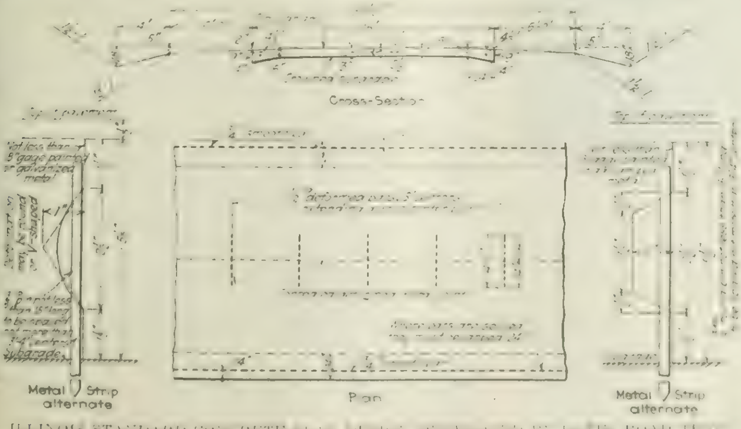
NEW designs for concrete roads and concrete base for asphalt-surfaced roads have been adopted by the Illinois Division of Highways as the result of observations on the Bates Test Road near Springfield, Ill. Precisely the same section and joint arrangement and the same 1:1½:2 concrete are employed for concrete road and concrete base. As the drawing shows, the revised cross-section provides for a thickness of 9 in. at the edges of that pavement, tapering to 6 in. at a distance of 2 ft. from the edges, and the remainder has a uniform thickness of 6 in. The amount and arrangement of reinforcement is the same as that heretofore used, with the exception of the center-joint material, which is of new design to correspond with the 6-in. center thickness.

This new cross-section was adopted as a result of the Bates road tests, which show conclusively that the strength of the edges of any rigid pavement, built in accordance with any design heretofore used in Illinois, is much less than the strength of the interior portion of the slab. The Bates tests disclosed the fact that a center thickness of 6 in. or even perhaps 5 in. is ample to support the legal load limit provided by Illinois statutes. The new cross-section takes advantage of this fact. The tests further indicate that even with a 6-in. thickness for the main portion of the slab, a 7-in. edge with the ¾-in. longitudinal bar would still not be as strong as the mid-portion of the slab. The edge thickness has, therefore, been increased.

Particular attention is called to the fact that the new cross-section provides 1 sq.ft. less of cross-sectional area than a slab having a 7-in. uniform thickness. This means that the new cross-section will require 195½ cu.yd. less concrete per mile of pavement than the standard 7-in. design heretofore used.

The designers believe, therefore, that the new cross-section will provide a pavement which not only is better able to support trucks loaded to the legal limit, but will also reduce the cost per mile. The extra cost of shaping the subgrade for the new cross-section is small, as subgrading machines may easily be adapted to cut the subgrade to the new form. Even should the subgrade be cut to the usual crown, at an elevation 6 in. below the top of the forms, and the dirt along the edges then thrown out by hand the added cost is slight.

All road [illegible] in Illinois since Oct. 31 [illegible] the construction of the new cross-section. [illegible] T. Sheets is superintendent of highways for Illinois and Clifford Older is chief highway engineer.



ILLINOIS STANDARD CONCRETE SLAB DESIGN DEVELOPED BY BATES ROAD TEST
The section requires 195 [illegible]

From Job and Office

Hints That Cut Costs and Time *For the Contractor and the Engineer*

Half-Width Concrete Pavement Is Laid with Unusual Speed

By Thomas J. Wasser
State Highway Engineer, Trenton, New Jersey

STATE Highway Route No. 1, between the city of New Brunswick and the borough of Metuchen, New Jersey, is one of the most heavily-traveled roads in the state; and is a part of the Lincoln Highway. The nature of the subsoil through this country is such that unusual construction was necessary. In order to insure proper underdrainage to avoid breaking up of the pavement, through a combination of frost action and very heavy traffic to which the road is subjected, a 6-in. layer of compacted foreign material was required, through which it would be possible for any subsurface water that works up under the road bed to reach the underdrains built along each edge of the pavement and running parallel thereto. Slag or clean steam cinders on this particular job were specified as the foreign material, and for the most part, steam cinders were used.

The pipes in the longitudinal underdrains were carefully laid to line and grade, and inspection holes, constructed of concrete, were spaced at frequent intervals, to allow inspection of the underdrainage system, which will make it possible for the forces responsible for maintenance of the highway to be constantly advised regarding the effectiveness of the drainage system.

The pavement consists of 2 in. of bituminous concrete on a 9-in. portland cement concrete base, without reinforcing, mixture of concrete being 1:3:5. The concrete curb is poured monolithic with the pavement to a depth of 15 in., or 6 in. below the main pavement. This curb holds the cinder sub-base in place, and at intervals of 10 ft., longitudinally, 5 x 5-in. openings through the curb allow the water which might accumulate under the pavement to reach the longitudinal french drains at the side of the road. A 2-in. projection is built above the concrete base to provide a shoulder for the bituminous concrete, level with the top of the finished pavement.

HALF-WIDTH CONCRETE ROAD ON LINCOLN HIGHWAY

The deep concrete curb acts as a header to retain the cinder fill put on the subgrade to facilitate subsurface drainage. Despite the fact this section is one of the most heavily traveled in New Jersey, traffic was expeditiously handled and at the same time a daily average of 400 ft. of 16-ft. pavement, together with two concrete headers, was maintained on one of the two contracts.

The pavement being built one half at a time, requires the construction of a curb in the center of the finished pavement, constructed the same as the curb along the side. This 6-in. width of portland cement concrete being light in color, makes a strong contrast with the bituminous concrete, and serves the double purpose of supporting the edge of the bituminous concrete and dividing the width of the concrete slab, and also is an important factor, from a traffic standpoint, in furnishing a permanent division mark down the center of the pavement.

The progress of construction on this section, under the traffic conditions, was unusual. One-way traffic was maintained on the old road bed, while construction was in progress on the other half of the right-of-way. Maintaining traffic, of course, limits the effectiveness of the construction forces, but in spite of this condition, a daily average of 400 lin.ft. of 16-ft. pavement, including two header curbs, has been maintained on one contract, known as Section 13 of Route 1, with a maximum daily run of 500 lin.ft.

The total length of the road was 4.74 miles. Due to the lateness of the season in which work could proceed, it was divided into two contracts, known as Sections 13 and 14, of Route 1. The total length of Section 13 was 2 miles. Total width of pavement varied from 32 to 42 ft. The total number of square yards of pavement in this section was 32,711. The construction of this section was started Aug. 22; and paving work was started Sept. 27. To Dec. 6, 19,888 sq.yd. of pavement had been laid. Section 14 was 2.74 miles in length, and the width 32 to 40 ft. An average of 500 lin.ft. of concrete base was laid per day, and a maximum of 583 ft. of 9-in. 1:3:5 concrete, mostly 16 ft. wide. The total number of square yards of paving in this contract was 49,855. Work on the contract was started Aug. 18; and paving work was started Sept. 23. The number of square yards completed to Dec. 6 was 28,434.

On Section 13, 2 miles in length, the paving of one side was completed in 42 days, or between Sept. 27 and Nov. 8. Section 14 was completed in 49 days, or from Sept. 23 to Nov. 11.

The location of the work being within truck haul of the boat wharf where barge shipments of sand, stone, and cement were received, played an important part in the speed of the work. On one section, however, it was necessary to receive cement shipments by rail. No materials were allowed to be stored on the subgrade.

The Yale-Princeton football game of Nov. 18 presented a traffic problem over this important section of the Lincoln Highway of no small proportions, but this tremendous traffic was carried over the finished half of the pavement, without accident, and without interruption to the work.

The contractor on Section 13 is C. H. Riddle, New Brunswick, New Jersey, and the contractor on Section 14 is S. S. Thompson, Red Bank, New Jersey.

Centralized Control of Road Building

By J. T. Hallett
Road Engineer, Indiana Highway Department,
Indianapolis, Indiana

In the spring of 1920 the construction division of the Indiana State Highway Commission created five residencies through which road construction was supervised throughout the state. Each resident engineer had an office force and a field force consisting of a project engineer and one or more inspectors on each federal-aid project, and an inspector on each county-aid project where the department was in charge of inspection only.

The project engineer and inspectors reported to the resident engineer in charge who condensed reports and sent them to the main office, thus having only part of his time available for supervising his project engineers.

With the resident supervision the engineer in charge of the project was required to make out the estimates of work done about the twenty-fifth of the month and submit them to the resident engineer for his check and approval before they were forwarded to the main office. There they were again checked before being forwarded to the auditor's office for payment. This method required about fifteen day's time from the date estimates were made until the contractor had received his money.

For the size of the program (about 120 miles) at that time it was found that the cost was too great, compared with the results obtained. In the fall of the same year the residencies were discontinued and all supervision was handled from headquarters. The road engineer spent all his time visiting and supervising the project engineers and inspectors. All reports were made direct to the chief engineer at the main office by the project engineers. This continued throughout the year of 1921. In the spring of 1922 an assistant road engineer and a general inspector were appointed to help the road engineer in his field supervision. Also, three supervising engineers were appointed, to each of whom was assigned a number of projects.

The state is of such size (all parts being so easily accessible) that where the road program increased in any amount it could be handled by increasing the number of supervising engineers and inspectors.

The centralized control has resulted in less cost of supervision, more uniform results throughout the state, and has enabled the chief engineer to get reports on the work quicker and more directly. Another result of the newer system is that the project engineer makes up estimates on the twenty-eighth and they are paid in from eight to ten days.

Ten Short Highway Articles By—

1-**Thomas J. Wasser**
State Highway Engineer of New Jersey

2-**J. T. Hallett**
Road Engineer, Indiana State Highway Department

3-**C. M. Hathaway**
Engineer of Construction, Illinois Division of Highways

4-**A. W. Dean**
Chief Engineer, Massachusetts Division of Highways

5-**G. H. Henderson**
Office Engineer, Rhode Island State Board of Public Roads

6-**G. E. Wright**
Assistant City Engineer, Gloversville, N. Y.

7-**Crosby Tappan**
Superintendent of Construction, Pennsylvania State Highway Department

8-**H. K. Davis**
Chief Inspector, Iowa State Highway Commission

9-**L. A. Reindollar**
Engineer of Surveys, Maryland Roads Commission

10-**F. D. Messenger**
Contract Engineer Michigan State Highway Department

Hauling Water on Concrete Paving Jobs

By C. M. Hathaway
Engineer of Construction, Illinois Division of Highways,
Springfield, Illinois

In extreme level country, such as exists in many places in Illinois, one of the chief difficulties of the paving contractor during the dry summer months is the securing of a sufficient water supply to operate his paver and to cure the finished pavement. This feature may be seemingly of minor import to the average person, yet an ample supply of water is one of the first items which the contractor gives careful consideration in making up his estimate in bidding.

During the past season several contractors have overcome this scarcity by shipping in water in tank cars, a scheme which is, of course, limited—dependent upon the length of rail haul from some large city which has available a comparatively inexhaustible water supply at reasonable cost.

In one instance noted, the job was located about fifteen miles from a large city where an available supply of water could be secured at a very reasonable meter rate. Tank cars of 8,000-gal. capacity were used, which cost the contractor a flat rate rental of $2 per day, plus an initial freight charge to and from Chicago of about $50 per car. The freight on a tank of water for the fifteen miles, by local shipment, was $10 per car, and the actual cost of the water, by meter, 15c. per 100 cubic feet.

The contractor had dug at his plant a pond or reservoir into which the contents of the tank car were discharged and from which the water was pumped direct to the pipe line. The local freight would bring out two or three tank cars daily, as required. These tanks would be discharged during the day into the reservoir and the empties would then be hauled back by local freight the same day or the following morning. Thus, six or eight tank cars sufficed to handle a job of ordinary magnitude.

Although there are no definite figures as to the cost per square yard on this particular job, a short section (one-half mile in length) constructed by force account did cost about 7c. per square yard for water hauled in this manner, which figure is unquestionably nearly double the figure which might be anticipated on an ordinary paving section where the fixed charges would be distributed over a greater yardage and where greater economy could be effected in handling.

This year's experience, however, on several jobs, would indicate that this method of furnishing water, which has heretofore been considered entirely out of reason due to the cost, may under favorable conditions be utilized to advantage in other instances.

From Job and Office

Hints That Cut Costs and Time

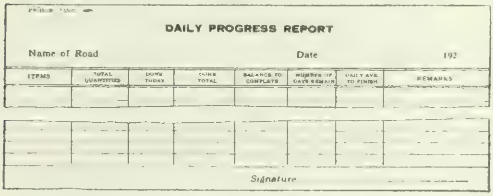
Co-Operation Between Field and Office on Highway Construction Progress

By A. W. Dean

Chief Engineer, Massachusetts Department of Public Works, Division of Highways, Boston

OUR system on important work provides for close touch between the main office and the progress of the work outside. In securing this, provisions are made in the contract for certain progression and this is followed up by means of daily and weekly reports.

The daily report is made out by the resident engineer directly in charge of and located on the work, and a copy is mailed each day to the office of the chief engineer, the office of the district engineer, the contractor, and one kept in the files of the resident engineer. The weekly report, which is virtually a progressive chart, is made up at the district engineer's office. It is kept there in the form of a tracing which is blueprinted each week and blueprint copies are mailed by the district engineer to the resident engineer, contractor, and the chief engineer's office.



DAILY PROGRESS REPORT

Name of Road Date 192

ITEMS	TOTAL QUANTITIES	DONE TODAY	DONE TOTAL	BALANCE TO COMPLETE	NUMBER OF DAYS REMAIN	DAILY AVE. TO FINISH	REMARKS

Signature

FIG. 1—DAILY REPORT OF RESIDENT ENGINEER

Copies of this report are sent to the chief engineer, the district engineer and the contractor. One copy is retained by the resident engineer.

We find that the contractor values greatly the information which he obtains from these reports and charts. By these means the various elements of the work are each given their relative importance when the progress is considered. Any elaboration desired may be accomplished on the graphic chart, as for instance, where one-half of the roadway has to be constructed before the other half is done to provide for traffic, and when a concrete road is being constructed where two or more mixers are in operation at the same time on several sections.

It is obvious that work must be planned and usually contractors require assistance in this planning or laying out of the work before it is done. By comparing the actual progress with the graphic chart showing the ideal desired, opportunity is given for correction.

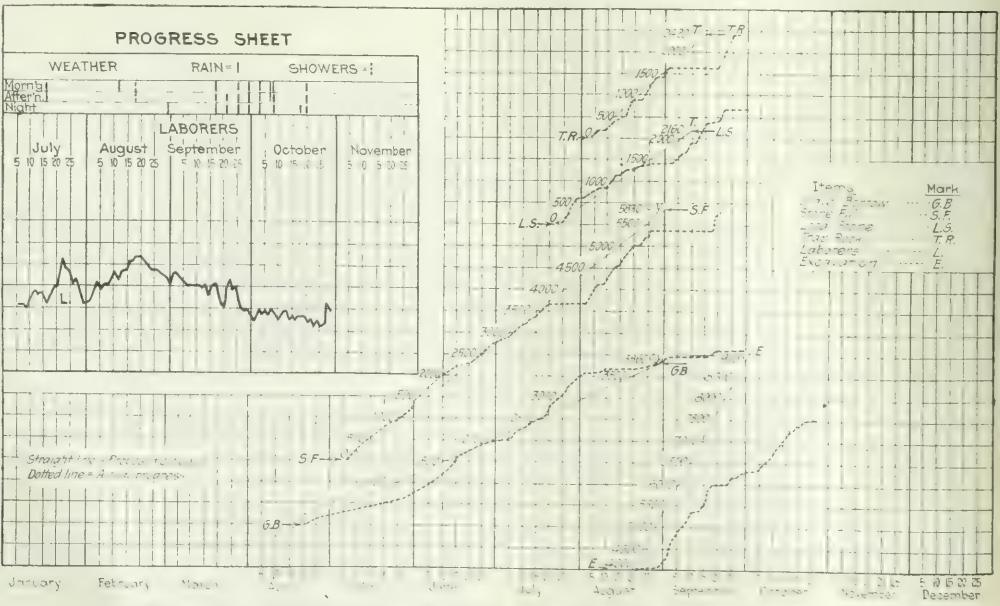


FIG. 2—PROGRESS IN ROAD CONSTRUCTION CHECKED AGAINST IDEAL PLAN

Every principal item in the contract has been planned and its ideal progress charted. As the work proceeds means are at hand to speed up here and there to approximate the ideal progress.

Use of Photography and Other Features in Hastening Road Plan Completion

By G. H. Henderson

Office Engineer, State Board of Public Roads, Providence, Rhode Island

OFFICE engineering in the state highway department of Rhode Island has been carried on under three severe handicaps—lack of space, lack of help and lack of light. The first feature is the most serious because, with quarters at least double the capacity we now have, we probably could eliminate the second.

From Job and Office

For Contractor and Engineer

Owing to the congestion in our drafting room, it is difficult to divide all of our work into classes and to delegate permanently the various classes of work to separate forces, although this is done as far as practicable. The various branches of our work are carried on simultaneously with concentrated effort upon the jobs nearing completion. Lack of space, in limiting our force, sometimes requires working overtime. Our conditions are such that we constantly are on the alert for short cuts and the elimination as far as possible of duplication of labor. As our state is small, smaller than many single divisions in some other states, our engineering for the whole state is centralized in the one office and all plans, designs, specifications, etc., are prepared in this office.

The principal plans or tracings for each of our projects are as follows: First, a plan and profile for each and every mile, plotted to a scale of 40 ft. per mile horizontal and 8 ft. vertical and drawn on a sheet of heavy detail paper 36 in. wide and 14 ft. long; second, cross-sections for a mile of road corresponding to that on the plan and profile, drawn to a scale of ¦ in. per foot on a roll of profile paper of medium thickness and 22 in. wide; third, plans to accompany drainage agreements; fourth, plans for land condemnation; and fifth, construction plans laid out to satisfy federal standards as well as our own.

Relations between the surveying parties and the office are close and conferences concerning locations are more or less frequent before and during the survey. The office therefore has first-hand knowledge as to how best to lay out the traverse and profile to take care of possible realignments during the design.

All attention is first focussed on the main detail plan and the cross-sections and these are plotted, checked and inked as rapidly as possible, for these are the plans used in the design and finally they become the record plans for the office. The size and scales used we have found most convenient in our fielding work as we deem it desirable to have upon a single sheet at least one mile of road in order to get a proper perspective of location and grades. All proposed drainage structures are sketched on the plan as soon as fielded for design. Then the plan is immediately photographed in sections and reduced to a convenient size for handling. This enables our right-of-way man to have a copy long before tracings could be made, and enables him to look up ownerships along the highway or proposed right-of-way both for proposed new drainage flowage on private property and for possible land condemnation.

The owners of land upon which new surface water flowage is proposed are interviewed first and agreements reached as soon as possible. As there is no law in this state that permits us to cause the flowage of surface water on a person's land without his consent, failure to agree with the owner means change in design. This use of photography more than justifies its expense for it hastens final determination of drainage structures, lines and grades. All questions as to location of new structures are speedily answered and we do not lose the use of the plans longer than is necessary to photograph them. It is *always* bad to have delays in final completion of plans, but in our congested quarters it is *disastrous.*

In the case of cross-sections one plotting suffices in our scheme, the roll being marked off in 36-in. lengths, which is standard for federal aid and also for our own construction plans, and the sections are plotted within the sheet limits. The roll is printed in one operation and the prints cut to the standard lengths.

All other plans and profile except special detail sketches which are drawn to special scales are traced from the original large detail plan.

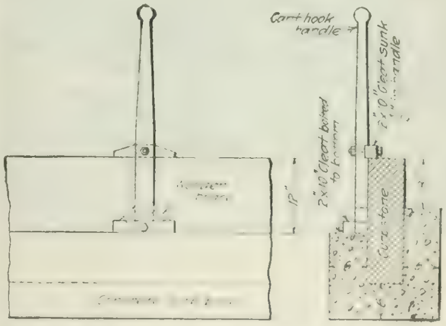
Simple Tool Regulates Depth of Concrete in Curb Base

By G. E. Wright

Assistant City Engineer, Gloversville, N. Y.

WHILE SETTING curb in concrete on the paving jobs of Gloversville, it was discovered that the base concrete was often left too high on the front side of the curb. When the expansion joint was placed the base concrete either had to be cut away at considerable labor and expense, or the joint would protrude above the pavement. To overcome this bad condition, William Karg, the sub-contractor who did the curb setting, devised a simple tool the use of which eliminated the above-mentioned condition.

The tool was made of a handle of an old cant hook sawed off about 3 ft. from the top. A cleat about 10 in. long was set into the side of the handle 12 in. from the bottom. This cleat projected from the cant-hook handle about $1\frac{1}{2}$ in. and was bolted through to make firm connection. Another cleat was fastened to the bottom of the handle, making the distance between the bottoms of the two cleats 12 in., or the height of curb top above finish grade in the curb base. The bottom cleat was braced to keep it at right angles to the handle. The lower cleat was shod with galvanized iron.



TOOL CONTROLS GRADE IN PLACING CONCRETE

As the base concrete was poured the tool was used to ram the concrete down to grade where it was too high. In case concrete was not poured to grade, the tool discovered such sections.

The work was done in connection with the city's season paving program by Morrell Vrooman, Inc., general contractor. G. M. Nagany was in charge for the contractor with the writer in direct charge of the work for the city under H. J. Hammer, city engineer.

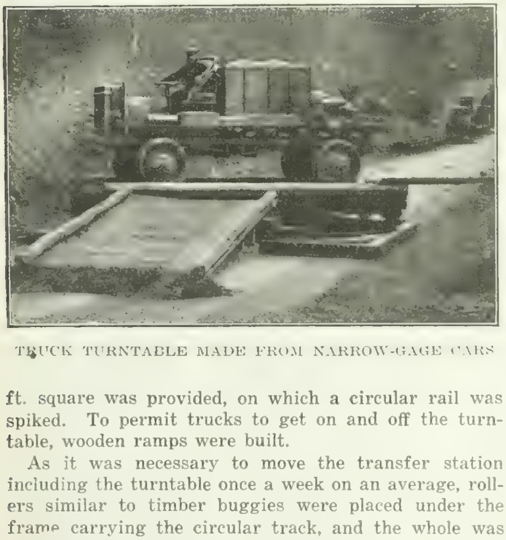
Turntable Used in Concrete Road Work Is Made From Industrial Flat Cars

By Crosby Tappan
Superintendent of Construction,
Pennsylvania State Highway Department,
Harrisburg, Pa.

THE PENNSYLVANIA State Highway Department, through its construction bureau, has recently completed concreting 22½ miles of road between Trout Run and Blossburg, Pennsylvania. All material had to be imported and the only railroads were located at the two ends of the job, so that all materials had to be hauled over the road. For transporting materials it was decided to use a combination of trucks and industrial railroad, carrying loaded batch boxes on trucks as far as the concrete was cured and ready for use, and there transferring the batch boxes to narrow-gage railroad cars. The cars were then hauled by locomotives to the mixer.

The trucks at the disposal of the department were of such length that they required considerable space in which to turn, and this being lacking on the roadbed without the use of mechanical means, it was decided to use a turntable for turning the trucks.

There were available former Army narrow-gage flat cars with platforms about 24 ft. long and 6 ft. wide. Two such car platforms were taken from off their trucks and a home-made center bearing placed under each. Under each end of the platform were placed two car wheels, which were provided with short axles working in suitable boxes. A wooden framework about 18 ft. square was provided, on which a circular rail was spiked. To permit trucks to get on and off the turntable, wooden ramps were built.


TRUCK TURNTABLE MADE FROM NARROW-GAGE CARS

As it was necessary to move the transfer station including the turntable once a week on an average, rollers similar to timber buggies were placed under the frame carrying the circular track, and the whole was pulled ahead to its new location by a truck. This turntable was turned with a fully loaded truck on it by one man and gave first-rate service during the whole length of the job.

Reproduced herewith is a photograph showing this turntable in operation. The total cost of each turntable, exclusive of the flat car platform and wheels, which, as stated above, had been turned over by the government to the highway department, was a little over $200.

From Job and Office
Hints That Cut Costs and Time

Preparing a Dusty Subgrade for Concrete

By H. K. Davis
Chief Inspector, Iowa State Highway Commission,
Ames, Iowa

IN NORTHWESTERN Iowa the highway construction season of 1922 was ushered in by a long-continued dry spell which, though perfect as construction weather as regarded speed alone, was the cause of many invectives by the engineers when quality of work was considered.

Miles of embankments, roughed in during this dry weather, lay in continuous piles of lumps and clods impossible to finish to any desirable shape; or, if traffic was permitted over the new dumps, the loose clods and earth wore into a series of bottomless ruts.

Where paving was to be laid this was a particularly troublesome condition. The specifications and inspection on such work are fairly rigid in Iowa and the inspector invariably insisted that this fine dust subgrade be spread smooth and true to cross-section and then be thoroughly wet before concrete could be laid.

It soon became apparent that ordinary treatment such as spraying the usual amount of water around the mixer was not satisfactory. If sufficient water were used to saturate two or three inches of dust it became soft mud which, under no circumstances, could be formed into a satisfactory subgrade. If less than this amount were used the unwetted dust beneath permitted the wetted part on top to stick to the feet of the workmen and the wheels of the trucks, making, if possible, a worse condition of soil from which to form a subgrade. Then, too, the mud was tracked into the concrete.

One engineer conceived the idea that wetting that particular material the evening before would allow the water to "settle down" to where it would leave the subgrade material moist but not muddy by the time work began the next day. It was tried and proved a complete success. The subgrade after that looked as if made of freshly excavated damp earth, was easily workable and remained well packed under the traffic.

An additional advantage was noted that converted the engineering force to the new scheme. There was a tendency during this dry period for the concrete to develop shrinkage cracks, or "checks." When thorough saturation of the subgrade was secured by the above described method the cracking ceased.

As summer advanced the dry weather caused a similar dusty condition on subgrades in other regions. The complete success of the treatment in northwest Iowa caused it to be adopted in other places. One type of soil gave trouble upon first trial. It contained a considerable per cent of sand and at first glance appeared to be a loam. Actually, when thoroughly wet it became very sticky and behaved like a gumbo. The next morning it was a loblolly. This nonplussed the sponsors of the scheme, but by the second day it was in fine condition to work. Thereafter, on this stretch of gumbo the wetting of subgrade was done two evenings ahead of the concrete and the contractor and inspector laughed at the dry weather.

From Job and Office

For Contractor and Engineer

Central Mixing Plant Used In Widening Macadam Road with 3-Ft. Shoulders

By L. A. Reindollar

Engineer of Surveys, Maryland State Roads Commission, Baltimore, Md.

TRAFFIC demands made upon public highways, particularly upon main traveled routes, often necessitate the use of novel means while reconstruction is going on. As many roads must be kept open while work is in progress construction or reconstruction of half the width of road at a time is becoming popular. This method, combined with the use of an efficient central concrete mixing plant, allowed an unusual degree of speed in widening with concrete shoulders a 12-mile section of existing macadam along the old National Pike between Frederick and Baltimore, Md.

The central mixing plant was established in about the center of the job, where a siding with a capacity of about ten cars was built. In about the center of this was erected a bin with a capacity of 200 tons, elevated about 66 ft. above the tracks. A pit was built under the tracks and material was dumped from the cars and conveyed to the bin by a specially-built bucket conveyor. The bin was divided into two compartments and sand and stone were diverted from the conveyor to the proper compartments by a chute operating on a swivel.

The bins were built so that material ran by gravity to a measuring hopper installed directly under them, emptying into a mixer of 1-cu.yd. capacity. Concrete was discharged from the mixer drum into trucks.

The original construction of the National Pike over this widened section was of macadam, 15 ft. in width, and with a crown of from ½ to ¾ in. to each foot of road width. The widened roadway was to have a crown of ¼ in. to each foot of width necessitating making the edge of the concrete higher than the edge of the macadam, and the digging of a shallow trench to subgrade.

The grading was done with a leaning-wheel grader equipped with a scarifier and blade and was pulled by an 8-ton caterpillar tractor. This mechanical outfit with ten men could prepare about 1,800 lin.ft. of subgrade per day.

A fleet of eight 5-ton trucks were used to haul the mixed concrete, and at no time was concrete in transit more than 30 min. before being put on the roadway.

The shoulders were built 3 ft. wide on each side throughout with the exception of the inside of curves, which were widened to 6 ft. All curves were banked. The 12 miles of shoulder on both sides were completed in 85 days—1,400 lin.ft. being the shortest day's run and 2,600 ft. being the maximum. Shoulders were built on one side of the road at a time and the macadam was built up adjacent to the shoulders by the state's maintenance forces, as soon as the concrete had cured.

In curing the concrete a motor truck equipped with a 600-gal. tank was used for sprinkling the concrete, which was then covered with a 2-in. layer of earth.

This work was done by Thomas, Bennett and Hunter, contractors of Westminster, Md., under the supervision of W. F. Childs, district engineer, Frederick, Md.

Policy in Advertising for Highway Bids

By F. D. Messenger

Contract Engineer, Michigan State Highway Department, Lansing, Mich.

THE Michigan State Highway Department has received many favorable comments from contractors and others interested in the state highway work concerning the method used by the department in advertising and receiving bids on state highway work. The efficiency of the system is apparent particularly during the early part of the construction season when there are a large number of contracts to be awarded.

By way of explanation it should be noted that the counties wherein the proposed construction is located pay a certain percentage of the total cost of the construction, which varies from 5 per cent to 25 per cent, depending upon the valuation of the county and the number of miles of trunk-line road within its borders.

Therefore, bids are received in all cases at the offices of the boards of county road commissioners by a representative of the state highway department. This tends to increase co-operation between the local authorities, the state highway department, and the contractor, as local authorities are, in many instances, better informed as to special conditions concerning projects, and are anxious to co-operate with contractors in informing them of these conditions. Also, bids are received close to the job and contractors can secure general information concerning sources of material, freight rates, etc., by mail and then go over the project on the ground just before the receipt of bids and be on hand at the time bids are opened without having to make a journey from the project to the state capitol.

The main point, however, is in the manner of handling the bids when a large number of projects are to come up at approximately the same time, and the method may be briefly outlined as follows:

Proposed projects in a certain section of the state are tabulated and a series of bids outlined which result in bids being received in one county seat generally on the second day in the week, with bids on the succeeding days at adjoining county seats. Bid openings are set for such hours that a contractor, traveling either by rail or automobile, can be on hand when bids are opened at one county seat, and, if he is not the low bidder, have time to look over the job in the next county and submit a bid the next day on that job, and so on throughout a series of bids covering in general four or five days. This makes it necessary for contractors to tie up in certified checks only a relatively small amount of money, as certified checks are returned as soon as bids are opened to all others than the two lowest bidders.

If bids are received on a large number of jobs at one time, small contractors may be able to bid on only two or three of the jobs and may be low on none, while other contractors may endeavor to bid on all of the jobs and be low on more than they can handle. And if they bid on several jobs the amount of money involved in certified checks becomes considerable.

It happens many times that there are several sizable projects on which bids are to be received at the same county seat and in that event bids on two or three of the jobs would be received in the morning and on the balance in the afternoon. The advantages of this detail are obvious.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Engineering, Salesmanship and Personality

Sir—Referring to the articles by A. R. Hirst and Major F. S. Besson in *Engineering News-Record* of Dec. 14, pp. 1030 and 1035, I wonder how many readers connected them up, mentally, as I did. Is it not true that too many engineers fail to use the elementals of salesmanship when they go before their boards with recommendations, often the result of many weary hours of endeavor to arrive at the best and cheapest way to do a certain piece of work? They seem to feel that their audience will understand the whole proposition as clearly as they themselves do; and they are disappointed and discouraged if they meet opposition. Let such projects be put down in black and white (or blue) and four times out of five some hard-headed member of the governing body will be won to the project and assist in putting it over too.

Personality is a great thing, and most valuable too, but I disagree with Mr. Hirst in putting it before education. There are already too many "engineers" with nothing but personality—and gall—who are directing the expenditure of public funds. In my judgment, this is the cause of that same public's dissatisfaction with public works in general, and road construction in particular. **E. M. Clarke.**

Cranford, N. J., Jan. 1, 1923.

A Defense of "Sales Engineer"

Sir—The writer has read with much interest the protest by Mr. Bedell in your issue of Dec. 28, against the term "sales engineer," and also your editorial, because he would probably fall under this opprobrious classification. In his instance, the honorable and desirable portion of this title was achieved by means of a technical engineering education and fifteen years of what might be claimed without undue immodesty as fairly successful practice of the profession. An unfortunate degeneration into sales work is responsible for the undesirable prefix.

This letter seems to have been dictated according to the old idea, happily rapidly vanishing for the good of the profession, that the engineer belongs to a special haloed class with a corner on honesty, while all manufacturers and salesmen are of necessity crooks. It is stated in the letter that "the ethics of the two occupations are incompatible. Should an engineer use a salesman's methods, he would be accused of sharp practice." This is ridiculous. Honesty is not a question of vocation but of principle. Moreover, if some of the salesman's "savoir faire" and ability to get along with others could be acquired by the average engineer, there would be less friction than at present exists in many engineering departments.

It is further stated that "a salesman has little identity of interest with his customer," while an engineer "gives service to and is paid by the customer whose interests and his are one." This statement shows the complete lack of knowledge of business principles so often found among engineers and so unfortunate for the profession. It is axiomatic in any progressive business of today that the interests of the buyer and seller must be identical, that service must be given, and that a satisfied customer is the best possible asset. It is further stated "it is to be regretted that a name as soon as it gets a reputation that is at all advantageous, is borrowed or stolen by others for its reflected credit." This reminds the writer of a remark made to him while still a bona fide engineer by a salesman, who intended to be complimentary: "Do you know, somehow you don't look like an engineer."

It is a fact that the title "sales engineer" may be misapplied, just as the title "engineer" is often misapplied, but the evolution of the sales engineer is a legitimate development of modern day progress. As properly used the term may be applied to the man who, while he may sell a given commodity, is often called upon for the most technical sort of advice as regards the use, installation, or operation of his commodity. His technical knowledge is special and acquired through intensive technical training, and many times is far in advance of that of the engineer on his particular subject.

The engineer receives remuneration for the sale of his knowledge by means of a salary, while the sales engineer receives his remuneration through the sale of his product, which, as incomprehensible as it may seem to some, he may really and honestly believe to be the best possible for the service required. **A. H. Rhett.**

New York, Dec. 29.

Color and Harmless Bacteria in Water

Sir—A very interesting argument in favor of slow sand and against mechanical filtration of colored waters by C. M. Saville appeared in *Engineering News-Record*, Sept. 7, 1922, p. 380, and an abstract of a new method of color removal by slow sand, by H. W. Clark, in the same journal of Sept. 28, 1922, p. 514. Francis B. March, in Letters to the Editor, Oct. 12, 1922, p. 624, suggested that hydrogen-ion tests on reservoir water might save the cost of filtration. It is the writer's opinion that mechanical filtration is still the best method of color removal measured by work done in relation to cost of doing it, and chlorine treatment still the cheapest method of killing bacteria.

Water supplies have "color and harmless bacteria" because of the material on the earth over which the water has passed on its natural course to storage or use. The color is present because colored waters are generally soft and thus are excellent solvents for dissolved or colloidal matter, such as humic acids and decayed vegetable matter, and because the waters pass over soils or earth containing more of these substances than of finely suspended and colloidal clay. The "harmless bacteria" come from the decomposition of vegetable or organic matter.

Suspended particles of mineral or organic nature subside if their velocity is retarded sufficiently. Colloidal particles subside if they are transformed into larger size suspended form (i.e., increased in size in relation to mass weight) and dissolved particles subside if they are absorbed or enclosed by such substances as colloidal clay, aluminum hydrate or iron hydrate, or if they unite chemically with a substance or substances which will form settleable suspended particles, and if the velocity of the final reaction substances is sufficiently retarded.

Colloidal clay has some absorption power for dissolved and colloidal color, and for both dissolved and colloidal substances, but this property does not appear at present to have a value anywhere near as great as the absorption power of aluminum hydrate or iron hydrate.

In reservoirs there is, doubtless, some interaction between color and colloidal clay, but generally the latter is present in very small amounts compared with color. There is almost always some oxidation of color in reservoirs by the action of sunlight and dissolved oxygen and some subsidence of the interacting compounds. It would not be economical to subside much color or colloidal or suspended clay or alum hydrate or iron hydrate in an expensively constructed reservoir. The subsided color and organic matter would decompose and form noxious odors and tastes—perhaps iron sulphide—if they were large in amount so as to use up the oxygen of the water at the lower levels of the reservoir.

The pH concentration of most untreated waters is the resultant of free ions in balance as alkalinity bicarbonates acting against free carbon dioxide. If there is no free carbon dioxide in the water, there will be all bicarbonates or bicarbonates and normal carbonates, or else, in extreme cases, normal carbonates and caustic alkalinity, as when an excess of lime or caustic soda is present.

From the records of numerous experiments, it appears that alum hydrate begins to precipitate at a pH of about 4 and is complete at about 7, with the optimum isoelectric point at about 5.6. If a water has high alkalinity it might coagulate and precipitate excellently at 7 to 7.5, but it would coagulate with less aluminum sulphate and at less cost if the pH could be economically taken to 5.6 to 6. Sulphuric acid or carbonic acid will lower the pH economically.

In my experiments reported in *Engineering News-Record*, Sept. 7, 1922, p. 391, I carried the pH from 5.5 to over 7.5 and used chlorine to prevent the resolution of color by high soda-ash pH concentration. Soda appears to have a greater resolution power over aluminum hydrate than an equal amount of carbonate or hydrate of lime, measured by alkalinity. Soda ash causes no increase in hardness in the water but has less power to prevent corrosion than an equal amount of lime measured by alkalinity, but lime increases the hardness and the soap-consuming power of a water.

The natural alkalinity of most waters appears to be due to bicarbonates of lime and magnesia and in most mechanical filtration plants aluminum sulphate is added until a good floc is obtained without any attempt being made to control the pH unless it naturally happens to be low, when the best results are accidentally obtained. This is the reason why an advocate of slow sand filtration has such a good argument against mechanical filtration from the occasional poor results given by the latter. Generally, the poor results are not necessary.

Sunlight, carbonic acid and partly decomposed proteid organic matter promote algae growth. If the feeder brooks to a reservoir are treated with copper sulphate to kill or prevent algae growths the materials which promote growth are still in the water, and the same or a different species may develop in the reservoir later. This treatment also has a similar result when algae are killed in the reservoir itself. Algae are especially detrimental to long or even average runs between cleaning slow sand filters and without any aluminum hydrate in the sand to help remove color. At a large experimental slow sand filtration plant in Massachusetts, on a water with a color of about 40 to 50 on the platinum scale, turbidity 1, and a filtration rate of about 3 m.g.d., approximately one-third of the color was removed, but I understand that the filter had to be raked every four to five weeks to give the required rate of filtration. Another city plant in New England will shortly be changed from slow sand to mechanical filtration, I have been informed, because the beds will not filter sufficient water for local consumption.

Robert Spurr Weston, George A. Sampson and the writer decided several years ago that a solution of copper sulphate, sprayed over the water to be treated as a pond, lake or reservoir—was much more liable to be thoroughly mixed and much less liable to kill fish by excess concentration of the chemical where locally applied than by the usual method of dragging copper sulphate in a burlap bag behind a boat.

I regret to learn that there are doctors and engineers who still object to mechanical filters because "dope" must be used with them. Probably this means aluminum sulphate. Chlorine was used on Hartford, Conn., water before slow sand filters were installed and the people must have become thoroughly accustomed to this kind of "dope" without any harmful effects. Chlorine is used in over 1,000 places throughout the United States at the present time, and both the typhoid death rate and the total death rate are lower than before chlorine was used.

The aluminum sulphate used with mechanical filters in well-operated New England plants, and many others, is removed and the filtered water has as little or less aluminum salts than the untreated water. As long ago as March, 1915, the Belfast, Me., reservoir water had 1.1 p.p.m. of aluminum salts Al_2O_3 and the filtered water 0.13 part.

After working on many waters, industrial wastes and different kinds of sewage, it is the writer's belief that it is much cheaper, measured by work done compared with cost of doing it, to alum coagulate and mechanically filter colored waters than to store the water sufficiently long to kill bacteria and lower color, or to slow sand filter the water, or to spend as much money to improve the watershed. In purifying turbid waters chemical treatment alone or with mechanical filtration is the only method which has given satisfactory economical results. Chlorine still leads in low cost of pathogenic, sewage and harmless bacteria removal, measured by laboratory tests and lower death rates.

ARTHUR L. GAMMAGE.
Chief Chemist, Weston & Sampson.
Boston, Mass., Dec. 15, 1922.

Ironwood Long Lived in China

Sir—I notice in your issue of Oct. 12, 1922, a report by C. J. Embree on greenheart as a teredo resistant on the Panama locks. One of the authorities mentioned by Mr. Embree as having been consulted originally is "Timber" by J. R. Baterden, in which (p. 124) the author states authoritatively that greenheart is *not* proof against the teredo.

In view of this, and of the remarks on billian or ironwood (p. 196) which he states is "one of the few timbers practically impervious to the teredo," it seems somewhat surprising that the latter was not selected in preference to greenheart.

The experience with billian in this colony is that for underwater work it is unsurpassed, but, curiously enough, it is not proof against white ants. We have old military piers here, originally constructed entirely of billian. The piles show no signs of deterioraton, but the superstructure has had to be replaced by reinforced concrete.

C. W. DAVY,
Colonel, Chief Engineer, British Forces in China.
Hong Kong, Nov. 23, 1922.

The Railways and the Motor Truck

Sir—Your gentle criticism of Mr. Hirst and of the *Wall Street Journal* under the heading of "Much Heat but Little Light" in *Engineering News-Record* of Dec. 21, 1922, p. 1055, is admirable. It is to be regretted that Mr. Hirst did not confine his discussion to the fundamentals of highway department organization, with which subject he is familiar.

"Most of the railroad executives" are not at all alarmed about "the motor trucks and the motor buses making it impossible for them (the railroads) to operate at a profit." Such an effect is possible in certain isolated cases in Mr. Hirst's state, particularly and specifically where short and well-paved highways parallel a financially weak but exceptionally well managed railroad. But it is not a condition general throughout the country, as Mr. Hirst implies. In fact, there are many well informed persons who hold that motor trucks, motor buses and good roads are helps rather than hindrances to the railroad's earning power, in that they promote interchange of ideas and business which indirectly is of universal benefit.

In his condemnation of most of the railroad executives Mr. Hirst is sadly misinformed. If the board of directors of a railroad could appropriate a definite amount of money with the positive assurance that this amount would be forthcoming (as is Mr. Hirst's case) it is possible that they would show more activity. The wonder is not that the railroads can operate as well as they do, but that they can operate at all under their handicaps, restrictions and present and prospective legislation.

Mr. Hirst's problems at their most difficult stages are as nothing when compared to those of a railroad executive. If he had to raise the money he spends it is possible he would have a much clearer appreciation of the problems confronting the railroad executive. It is to be regretted that Mr. Hirst in his enthusiasm over his own particular life's work saw fit to attack the work of the highly efficient body of executives who manage the American railroads.

W. J. HOWARD,
Engineer, The Kelly-Atkinson Construction Co.
Chicago, Dec. 28.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Suspension Cable on Bridge at Kelso, Washington, Parts; From 12 to 15 Lives Are Lost

Failed at Point Near Where Cable, of 5 Strands of 1¾-In. and 1¼-In. Galvanized Material, Entered Anchorage

Special Correspondence

FROM 12 to 15 persons were drowned Jan. 3 when the five-strand upstream cable of a suspension bridge across the Cowlitz River at Kelso, Wash., parted at a point near where it entered the anchorage. The bridge was a timber structure with one 300-ft. suspension span and a 100-ft. double-leaf vertically-hinged span. Suspension cables ran from the west anchorages over three timber towers; one at the west end of the 300-ft. span and one each side of the channel. As the upstream cable failed, that side of the suspension span dropped to the river. A six-mile current caught the floor broadside and overturned the three towers, dropping the channel span into the water.

Four 2-in. galvanized cables supported the suspension span, there being two cables to each side. These cables, run from the west anchorages over the three towers, engaged four turnbuckles on the east end, two to each side of the bridge. The two turnbuckles on the side which failed were connected to the anchorage by five cables. Two of these were 1¾-in. material and looped through a ring sheath to one turnbuckle. The other three cables (one 1¾ in. and two 1¼ in.) looped through a similar ring sheath to the other turnbuckle. No equalizers were used. This tackle extended to the anchorage about 20 ft. into the ground.

All cables were galvanized but lacked other protection. The five cables parted at a point near where they entered the anchorage. As yet they have not been dug out to be examined. The portions of the cables below ground show marked deterioration. Above ground they are apparently in good condition.

The structure was built in 1905 for light loading. It was washed out the next year but replaced in 1907 and in 1915 it was partially retimbered. The original cables and anchorages remained. During the last six months the traffic had been increased many times over the original normal traffic by a large sawmill development in the vicinity. The bridge is a county structure not subject to state inspection or maintenance.

The state is building a concrete and steel bridge just downstream from the structure which failed.

Minneapolis Plans Large Addition to Water Supply

Minneapolis will begin work this spring on an addition to its water-works system that will add 40 m.g.d. to its daily capacity, will cost, as estimated, $2,673,360 and will require three years to complete. The Mississippi River will continue to be the source of supply. The present reservoirs and filter plant at Columbia Heights, just outside the city, provide a maximum of 62 m.g.d. The proposed project contemplates a pumping, storage and filtration unit on a 40-acre site owned by the city of Fridley. A report prepared by J. A. Jensen, supervisor of the water-works, contains these estimates of oost:

Intake, screen house and pump wells, complete, $181,860; low service pumping station, complete, $207,330; coagulation and mixing basins, 60-m.g. capacity, $506,700; twelve filters, 40-m.g.d. capacity, $489,600; clear water basin, 60-m.g.d. capacity, $222,830; force main, 48-in. pipe, $153,000; low service pumps and equipment, 75 m.g.d., $118,650; high service pumps and equipment, 75 m.g.d., $130,050.

According to N. W. Elsberg, city engineer, the capacity at the Fridley site eventually will be increased to 100 m.g.d. The water-works committee of the City Council has approved the Jensen report and steps are being taken for a preliminary bond issue to start construction.

In the last four years, the average daily consumption of water in Minneapolis has risen from 89 to 100 gal. per capita.

To Investigate R.R. Equipment

Acting on its own initiative the Interstate Commerce Commission has ordered an inquiry to determine whether the American railroads have adequate equipment of locomotives and cars and whether interchange practice is sufficiently developed.

Wage Conference in Coal Industry Adjourned to New York

The conference between the coal miners and operators which met at Chicago on Jan. 3 to fix wage scales for the bituminous field has adjourned without reaching any agreement. The conference included fifteen districts and in the opinion of some was too large and represented too many divergent opinions among the operators.

It is expected that a call for another meeting in New York between Jan. 17 and 22 will be issued shortly. This call, it is understood, will include the old central competitive field of Illinois, Indiana, Ohio and Western Pennsylvania, and possibly some additional districts. From present indications the issue to be settled at the new conference will be as to whether agreements shall be on the basis of individual districts or on the basis of the old central competitive field or some modification thereof.

Indianapolis A.A.E. to Attack Smoke Nuisance

The Indianapolis Chapter of the American Association of Engineers is mapping out a program covering two or three years by which it will try to abate the smoke nuisance in that city. A committee appointed by the mayor has been working for several months and steps have been taken to reduce the smoke created by some of the public buildings. The Board of Public Works now has several proposals to install equipment looking to this end, and if this should prove to be successful a number of business firms probably will follow suit. It is said about 90 per cent of the smoke nuisance is actually caused by the house furnace and studies are to be made toward development of a practicable method for application to them.

It is agreed that educational methods rather than force will bring about the most satisfactory results. A study is to be made of smoke abatement in other cities and an effort will be made to have the smoke inspection department manned by competent engineers, to check up installations and assist coal users. Purdue University will be asked to conduct a comprehensive coal consumption, smoke and soot survey of the city.

Harding Urges U. S. Join in Road Congress

In a recent message from President Harding to Congress there was included recommendation that the United States become officially represented in the Permanent Association of International Road Congresses. A part of the President's recommendation was that the Secretary of Agriculture be permitted to advance the necessary funds for membership out of an administrative fund provided by the Federal Highway Act of 1921.

"I believe it is altogether desirable," said the President, "for the United States to have representation in this association, and I strongly recommend the granting by Congress of the authority requested by the Secretary of Agriculture."

The State Department will be requested to place the matter before Congress with a favorable recommendation that the United States become a member of the organization.

Senate Passes Science Center Building Bill

The Senate has passed the Fernald resolution reported from the Public Buildings and Grounds Committee providing for a commission to consider the proposal of the American Arts and Industries Association, Inc., to erect in Washington, a $30,000,000 building as a national center for applied and industrial arts. The resolution now goes to the House for action. This will not be a government building but will be paid for by membership.

Engineers Take Part in Science Meeting in Boston

At the 76th meeting of the American Association for the Advancement of Science in Boston during the week of Dec. 26, engineering was represented by two sections, Section K, social and economic sciences, of which Dr. Henry S. Graves, of Yale Forest School, Yale University, is vice-president and chairman, and Section M, engineering, of which F. M. Feiker, vice-president of McGraw-Hill Co., Inc., New York, is vice-president and chairman.

The relation of the engineer to conservation was the keynote of the joint meeting of these two sections. John T. Black, state health commissioner of Connecticut, presented a paper on "Conservation and Industrial Waste," and William S. Murray, New York City, spoke on "The Conservation of Power." O. C. Merrill, secretary of the Federal Power Commission, Washington, D. C., was to have spoken on "The Federal Water Power Policy," and Brig.-Gen. Harry Taylor, Corps Engineers, Washington, D. C., was to have presented a paper on "Problems of Flood Control," but badly-delayed trains prevented them from doing so.

At the meeting of Section M the principal discussion was "The Place of the Engineer in Civilization." Dr. Ira N. Hollis, president of Worcester Polytechnic Institute, in his paper on this subject pointed out that from earliest history emphasis had been placed upon the man who produces and that the root names for *producer*, in several of the earlier languages, are synonymous with the modern definition of the term *engineer*. In an address on "The Growth of the Mining Industry in Canada," Dr. J. B. Tyrell, retiring vice-president of the section, pointed out the part that steam railway transportation plays in the development of the mining industry as one practical illustration of the engineer's place in utilizing our natural resources. Harrington Emerson emphasized the fact that the engineer is deeply concerned with civilization because of his control over the instruments of production and the need of his analytical study of facts for the solution of present-day problems. The paper, "New Phases of Engineering Education," by Prof. C. F. Scott, of Yale University, president of the Society for the Promotion of Engineering Education, was presented in Prof. Scott's absence by Dr. Dugald C. Jackson, and indicated that because engineering is coming to take such a large place in our modern life it is essential that the training of engineers be approached with a new viewpoint.

At the evening session an illustrated address on "Engineering and Scientific Developments of South America" was given by Calvin W. Rice, secretary of the A. S. M. E.

Brazilian Engineering Club Elects Americans Members

In a cablegram recently received advice is given to the effect that the Club de Engenharia of Rio de Janeiro, has elected Verne Leroy Havens, editor of *Ingenieria Internacional* an honorary member. Other honorary members are Edward Wegmann, Samuel M. Vauclain, and Calvin W. Rice. Josiah Spurr and Louis Hirt have been elected corresponding members.

Award N. Y. Transit Contracts for More Than Two Million

The New York Transit Commission has awarded three contracts for rapid transit construction which amount to $2,325,983. The Ft. Hamilton extension contract has been awarded to the T. A. Gillespie Co., on its bid of $1,485,151. The 14th St. extension went to Frederick L. Cranford, Inc., whose bid was $750,982. A contract for two additional elevators at the 168th St. Station of the West Side subway has been awarded to the Otis Elevator Co. for $89,850.

Syracuse Garbage Reduction Works Closed

The garbage-reduction plant of Syracuse, N. Y., was shut down on Dec. 10 and since then the garbage has been buried. The plant was built by the city and went into operation March 1, 1921. A change of city administration took place Jan. 1, 1922. The present administration states that for the ten months of operation in 1921 the plant was operated at an average loss (meaning net cost) of $8,000 a month and that this has been reduced by $1,000 a month since then. Proposals were invited a few months ago for the private operation of the plant. An offer of the rate of about $4,000 a month was received. Its adoption was advised by the mayor but was blocked by the city council.

Topographic Survey Appropriation Increased to $500,000

Washington Correspondence

In the face of strenuous objection from House leaders, the lower chamber of Congress, sitting as a committee of the whole, overrode the Appropriations committee and the Bureau of the Budget and voted to increase the appropriation for topographic surveys from $324,500 to $500,000. The fight for the increase was led by Representative Temple, of Pennsylvania.

Representative Mondell, the majority leader, predicted that the action of the Committee of the Whole would react adversely on appropriations in the future. He said the amendment provided more money than could be expended in an orderly and economical manner during the course of the next fiscal year.

C.N.R. Considers Electrification of Ontario Line

Sir Henry Thornton, president of the Canadian National Railways, announces that the C.N.R. board proposes to electrify or otherwise improve the service in the vicinity of Toronto and Hamilton from time to time as circumstances and the demands of the traffic justify. He states that "as a preliminary step, an examination of the services between Toronto and Hamilton and Niagara Falls and eastward from Toronto towards Cobourg will at once be put in hand with a view at least to partial electrification as soon as possible. Other developments will follow as may be required."

Fred T. Ley Company Sued on War Fraud Charge

Government Seeks to Recover $5,000,000, Alleging "Unconscionable Waste" in Devens Construction

Supplementing previous suits of a similar nature the U. S. Government on Jan. 3 instituted in Boston action against Fred T. Ley & Co., Inc., of Springfield, Mass., to recover $5,000,000 for alleged breach of contract in the construction of Camp Devens army cantonment. A writ of $8,000,000 was given the U. S. Marshal, but the declaration, which will not be officially filed until a return is made on the writ, will ask that $5,000,000 be returned. The writ is returnable on the third Tuesday in March, and some belief has been expressed in Boston to the effect that actual trial will not come before fall.

The charge is made by the government that the Ley company was guilty of "great and unconscionable waste" of materials in the cantonment construction work; that unskilled workmen were paid the same scale as that given skilled workers, and in many cases far in advance of the local scale for the same labor; that large amounts of unnecessary work were permitted to be done; and that "loafing" was permitted as well as "sabotage on the part of workmen and laborers."

It was stated in the declaration of the government that owing to the diversity of interest occupying the government at the time the construction was going on it was impossible for proper federal supervision to be given, and that as a result advantage of the situation was taken by the defendant.

The declaration further charges that the Ley company "counselled, advised, permitted and connived in the carrying out of the work in a grossly negligent and wasteful manner in utter disregard of the terms of the contract."

Dust Explosion Wrecks St. Louis Flour Mill

The Schreiber Cereal & Manufacturing Company's mill and elevator, Kansas City, Mo., were completely destroyed by fire on Dec. 27 following a dust blast. There was no loss of life but twenty of the forty employees were seriously injured. The building was a two-story, brick structure, constructed in 1905, 50 x 125 ft. in plan, with an iron-clad frame elevator in the rear five stories high. The force of the explosion blew several men from the elevator into the street 40 ft. below and large pieces of the sheet iron sides of the elevator were found 100 ft. away. Windows in adjacent buildings were shattered and considerable damage was done due to the force of explosion.

The cause of the explosion and fire is not definitely known but it was reported by the fire chief to have been started either by a spark from a locomotive which had backed cars into the elevator only a few moments previously, or to sparks from machinery within the building. A small fire had occurred on the day previous due to a dust fire said to have been caused by sparks from a motor in the mill. Following the first fire the assistant fire chief reported a dangerous accumulation of dust and an inspector was preparing to visit the mill when the explosion took place.

House Committee Seeks Light on Immigration Needs

Washington Correspondence

Hearings before the House committee on immigration, looking toward amendment of the present 3-per cent quota immigration law rather than framing of permanent immigration legislation, have made clear that representative industries are not seeking a lowering of the bars to admit a flood of aliens but rather what they consider would be improvements upon the present system with restrictions as to numbers, tempered to meet conditions along elastic lines.

Among witnesses who have been heard by the House committee in behalf of liberalizing amendments to the present temporary law have been a committee from the National Merchant Tailors' Association; E. B. Reid, assistant Washington representative of the National Farm Bureau Federation; James A. Emery, representing the National Association of Manufacturers; J. M. Larkin, assistant to the president, Bethlehem Steel Corporation; and M. H. Ward, representing the National Council of State Manufacturers Associations.

The witnesses all have agreed that immigration should be by selection. The manufacturers have asked an amendment which would make the incoming quotas net; that is, add to the quotas the number of aliens who leave the United States for their native lands. Representatives of the industries also urge that the Secretary of Labor be authorized to increase the quotas whenever it can be established to his satisfaction that a shortage of any kind or class of labor exists. It also has been proposed that immigration policy be administered by a board comprising the Secretaries of Labor, Commerce and Agriculture. Changes in the literacy tests also have been requested, it being contended that the present system does not accomplish its purpose. All witnesses have urged that examinations be at the port of embarkation rather than after arrival in the United States.

Chicago Sanitary District Budget $11,500,000 for 1923

Engineering work confronting the Sanitary District of Chicago during 1923 is outlined in a recent report of E. J. Kelley, chief engineer, to the trustees. Of work under contract the estimated expenditures will be $4,894,000. In order to complete eight projects under way additional contracts totaling $1,093,000 should be let early in the year.

During 1923 various new projects may be started, of which the $13,500,000 North Side treatment works and the $8,500,000 North Side intercepting sewer are the largest. Remodelling Lawrence Ave. pumping station at a cost of $500,000 is considered important and the regulation works at the outlet of Lake Erie and Lake Ontario may become urgent. The largest expenditures during 1923 are estimated as follows: North Side works, $5,000,000; North Side intercepter, $2,000,000; three bridges, $1,700,000; remodelling Lawrence Ave. station, $400,000. The ultimate total estimated expenditures for the projects named and twenty-one others is $77,811,500, of which $11,511,500 may be spent this year.

Hoover Declines Transfer from Commerce to Interior Post

Secretary Hoover has declined the invitation of the President to become Secretary of the Interior in the place of Secretary Fall who recently resigned that office. In a statement announcing this decision he recalls that when he accepted the office as Secretary of Commerce he did so with the intention of making that department an effective and helpful organization in the interest of American business. Although this work has been put in hand, it is not yet in a condition satisfactory to Secretary Hoover and until it is he does not wish to leave his present post.

Among the candidates for the office who have been discussed since Secretary Hoover's declination is John Hays Hammond, the mining engineer, now chairman of the President's Coal Commission, which is investigating the coal industry.

Indiana County Highway Engineers Under New Licensing Law

The first state-wide examination of applicants for license under the 1921 Indiana act for registration and examination of professional engineers and land surveyors, was held recently in the State House in Indianapolis. R. L. McCormick, a member of the faculty of Rose Polytechnic Institute, is chairman of the board. Twelve persons made application to take the examination.

U. S. Lesh, attorney-general of Indiana, has ruled that if a county surveyor in Indiana desires to perform the duties of a county highway engineer, he must obtain an engineer's license under the 1921 act. The head of the state tax board asks for a ruling on the question, which was raised in the case of a county-surveyor elect who is said to have no license under the 1921 act. Licenses are obtained only after passing regular examinations conducted by the board charged with administering the act.

Bolivian Government Will Build Railway Extension

Proposals for the completion of the Potosi-Sucre Railway in Bolivia have been rejected as unsatisfactory and it is reported that the Bolivian Government has decided to carry out the work instead of letting it by contract. The same course was followed in the construction of the present part of the line, the work being done under the direction of W. L. Milner, now general manager and chief engineer. This project was noted in *Engineering News-Record*, Aug. 31, 1922, p. 352.

Am.Soc.T.M. Annual Meeting Definitely Fixed

The executive committee of the American Society for Testing Materials has announced that the twenty-sixth meeting of the society will be held at Atlantic City, N. J., at the Chalfonte-Haddon Hall Hotel, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week, depending on the development of the program. No announcement has yet been made regarding the details of the meeting.

Army Report on Astoria Advises Filling Streets Only

With the sanction of President Harding, bills have been introduced in both the Senate and the House of Representatives which propose expenditures from the Federal Treasury to aid in filling in the area in Astoria swept by fire on Dec. 8. (See *Engineering News-Record*, Dec. 14, p. 1041.) The bill introduced by Senator McNary makes $500,000 available from an unexpended balance in the rivers and harbors fund which would be used for dredging the channel in front of the city and delivering the dredged material to the burned area.

The work to be done is covered in a report from Colonel T. M. Anderson, Sixteenth Infantry, U.S.A., as follows: "Restorative measures are beyond the power of municipality and state. The municipality is absolutely bankrupt through previous heavy issues of bonds for former street, municipal, and port terminals. Immediate relief work as follows is recommended: The construction by the United States Government of bulkheads for streets in the affected districts, the same to be filled by sand, dredged from the harbor along the Astoria waterfront which in places is in need of dredging. The restoration also of the sewer, water and electric systems. This latter work, as stated above, cannot be done by this bankrupt city and is absolutely necessary before the devastated district, which comprises all the business section of the city, can be reconstructed. The rehabilitation refers to municipal work only—street, water and sewerage systems—together with fire and police wiring. No portion is for property owned by private individuals. The estimated cost is $1,250,000."

In a more detailed report Major Richard Park, Engineer Corps, U.S.A., states: "The burned-over area is already filled to the basement floor level and street plans call for sand fill only between retaining walls under the curbs. It is unwise to fill the entire area to street level and then excavate for basements, which would call for retaining walls in any event, and the removal of sand when excavating basement. About 125,000 cu.yd. would be needed to fill under the streets and between the retaining walls, costing $25,000.

"Colonel Anderson's report estimating $1,250,000 as cost of retaining walls, fills, pavements, water and sewer systems rebuilt on this basis has been roughly checked by me and appears reasonable."

New York State Canals Report Heavy Tonnage for 1922

State Superintendent of Public Works Charles L. Cadle reports for 1922 the largest tonnage carried on the New York State Canal system in any year since 1913. The Erie Canal is credited with 1,485,259 tons, the Champlain Canal with 335,844 tons, the Cayuga-Seneca Canal with 42,592, the Oswego Canal with 9,470, the New York City Canal terminals with 76,519, and the Buffalo Canal terminals with 38,451 tons.

The Erie Canal traffic between Troy and Buffalo showed an increase of 50 per cent over that of 1921.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12.

AMERICAN ROADBUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 15-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17-19.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Annual Convention, Chicago, March 13-15.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

The Harvard Engineering Society will hold its annual dinner in New York, Feb. 1, at the Harvard Club. President C. R. Richards, of Lehigh University, Dr. Charles P. Berkey, Columbia University, and Albert Palmer, president of the undergraduate section of the society, will be principal speakers.

Personal Notes

L. H. BOND, district engineer of northern lines, Illinois Central R.R., has been appointed assistant engineer of maintenance-of-way, with headquarters at Chicago, succeeding W. G. ARN, promoted to assistant chief engineer of Chicago terminal improvements. M. M. BACKUS, district engineer of western lines, succeeds Mr. Bond as district engineer of northern lines, with headquarters at Chicago.

F. C. SHENEHON, consulting engineer of the firm of Shenehon & Meyer, Minneapolis, Minn., has been appointed vice-president and general manager of construction and engineering of the Byllesby Engineering & Management Corp. In addition to numerous engagements on federal water power and Great Lakes problems, he served eight years as dean of the college of engineering at the University of Minnesota. As consultant for the Sanitary District of Chicago, he studied the regulation of lake levels by proposed controlling works in the Niagara and St. Lawrence Rivers. Mr. Shenehon will move to Chicago.

J. E. FANNING, roadmaster of the Iowa division, Illinois Central R.R., has been appointed district engineer of western lines, with offices at Waterloo, Iowa, to succeed M. M. Backus, who has been promoted. N. R. HILL succeeds Mr. Fanning as roadmaster, with offices at Fort Dodge, Iowa.

OTTO E. OSTHOFF, vice-president and chief engineer, H. M. Byllesby & Co., Chicago, has resigned. Mr. Osthoff is one of the original members of the company.

GORDON L. SHANKS has recently been appointed chief draftsman in charge of design on a large oil refinery extension program for the Royal Dutch-Shell Oil Co. at Nood River, Illinois. Mr. Shanks spent a year recently in Tampico, Mexico, on similar work for the same company.

CHARLES S. BILYEU, formerly assistant to the president, Gulick-Henderson Co., consulting and inspecting engineers, has resigned that position and has joined the construction department of Sanderson & Porter, engineers, in the New York Office.

J. R. VERNON, assistant division engineer for the Wisconsin Highway Commission, has resigned, and has accepted a position with the Johnson Service Co., engineers and contractors of temperature regulation and humidity control systems, Chicago, Ill.

FRANK WILLIAMS, for four years state engineer of New York and as such a member of the New York Tunnel Commission, his term expiring Jan. 1, has been elected by the New York and New Jersey Tunnel Commissions a member of the board of consulting engineers for the Hudson River vehicular tunnel.

E. L. SAUVE, Fullerton, Neb., has resigned his position as labor superintendent for the Laurentide Co., Grand Merle, P. Q., and is now construction superintendent with the Fargo Engineering Co., consulting engineers.

THE TECHNICAL ADVISORY CORP. has been retained by the McDonald Construction Co. of New York to assist in organizing its forces for the purpose of constructing a joint system of state, county and municipal roads in the vicinity of Tampa, Fla. Marshall W. Brown, formerly lieutenant-colonel of engineers, A. E. F., is actively engaged in the work of organization and will be in Florida about two months.

H. A. DIXON, chief engineer, Western Lines, Canadian National Ry., Winnipeg, has been appointed chief engineer, Canadian Northern Pacific Lines. T. H. WHITE, formerly chief engineer, Canadian Northern Pacific Lines, Vancouver, B. C., has been appointed consulting engineer.

S. R. LAMB, resident engineer McLennan, Alberta, has been nominated engineer of maintenance-of-way of the Edmonton, Dunwegan & British Columbia Ry. I. S. REID, chief engineer of the road, has resigned.

W. L. CORTON, chief engineer with the public utilities commission at Boise, Idaho, has resigned. His resignation became effective Jan. 1.

W. M. JONES, formerly with Dwight P. Robinson & Co. and the J. G. White Engineering Corp., and now of the firm of Jones and Beardslee, architects and engineers, Bergenfield, N. J., has been appointed engineer for the borough for the year of [illegible].

C. M. BABCOCK, state highway commissioner, Minnesota, is seeking a $20,000,000 bond issue of the legislature now in session, the proceeds to be used in hard-surfacing state highways, one-half to be expended this year and the other half in 1924. He holds that paving roads now where traffic is heavy will prove wise economy and points out that the proposed bond issue, instead of increasing taxes, would merely anticipate receipts from motor vehicle taxes, which would be expected to pay interest and principal eventually.

C. I. FELPS formerly division engineer of the Kansas Highway Department, has been appointed assistant state highway engineer in charge of road and bridge work. F. W. EPPS formerly bridge engineer has been appointed division engineer to fill the vacancy created by Mr. Felps's advance.

R. C. HAM, formerly county engineer of Ford County, Kansas has resigned to accept a position as county engineer of Jefferson County, Kansas.

J. E. STEARNS, formerly city recorder, has been appointed city manager of La Grande, Ore., to take the place of A. A. KRATZ, who has resigned to take up the practice of civil engineering.

A. W. SANBORN, who has been deputy surveyor general of California for the past 17 years, has resigned and will take up his residence in Los Angeles.

R. M. SMITH, former assistant city engineer of Kenosha, Wis., has been appointed city engineer. P. J. HINTGEN, former city engineer, has been promoted to director of public works.

ACME ENGINEERING CO., Waukesha, Wis., has been incorporated to carry on a general engineering business. Fred H. Grohl, formerly with the Universal Engineering Co., Eau Claire, is president. A. C. Nickel, vice-president, and G. H. Nickel, formerly division engineer of the Wisconsin Highway Commission, is secretary-treasurer.

FRANZ & BOND, architects and engineers, 189 High St., Holyoke, Mass., have dissolved partnership due to the appointment of Philip H. Bond as city engineer. Fred H. Franz will carry on the business at the same address.

JOHN DUFF, county engineer, has been appointed construction and maintenance engineer of Chelan County, Wash.

ALFRED J. T. TAYLOR, formerly head of the Taylor Engineering Co. of Vancouver, B. C., has been appointed vice-president and managing director of the Combustion Engineering Co., Ltd., of Toronto.

WILLIAM CHISHOLM, of Antigonish, N. S., has been appointed minister of highways for Nova Scotia, succeeding H. H. Wickwire, who recently died.

M. J. RUTLEDGE, formerly with Henry Holgate, consulting engineer of Montreal, has been appointed town manager of Woodstock, N. B.

R. M. MURRAY, consulting civil engineer, has opened an office at 326 Hutton Bldg., Spokane, Wash., and will specialize in [illegible] engineering.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Review of Construction Equipment and Materials During 1922—Part II

DEVELOPMENTS in construction equipment and materials during 1922, as noted in "Engineering News-Record's" review beginning in last week's issue, took the form of improvements in details rather than in new types of machines. The opening installment of the review included power shovels, concrete chuting equipment, industrial locomotives, elevating loaders and rock crushers. This week additional classes of equipment are covered.

Road Grading Equipment

A NEW feature of road-grader equipment introduced last year provided for varying the width of the blade by means of hinged wings at each end. These wings, 3ft. long, may be extended in line with the blade for full-width cuts, folded all the way back for narrow cuts, or set at right angles to the face of the blade to form a wheeled scraper. Another innovation was the use of sectional grader blades in three pieces with hinged joints to make the cut conform to the crown of the road.

A number of scarifier attachments for use on graders and rollers were produced. In the case of attachments to road rollers pneumatic and steam control devices were developed, while in the case of attachments to graders the designs cause the scarifier to be raised and lowered with the blade. One manufacturer altered the design of its subgrader to produce the new cross-section required by revised road specifications in Illinois.

In addition to the blade graders proper, several new types of tractor-operated road drag, under names such as pressure planes, were put on the market. A gas engine subgrade road roller weighing only 3 tons was among the year's offerings.

Austin Manufacturing Co. FOR BLADE graders an attachment, known as the double-ender, was designed for lengthening the blade 3 ft. on each end. It consists of hinged wings which may be folded back for a narrow cut, extended straight out for maximum width, or set at an angle of 90 deg. with the blade thus converting the equipment into a wheeled scraper for moving dirt to fill holes.

Scarifier attachments, pneumatically operated when used with road rollers and attached directly to the blade when employed on a grader, were perfected during the year. In addition, a pressure road plane for maintenance work, designed for operation with a tractor, was developed. It is of all-metal construction with long runners which prevent the plane from dropping into low spots in the road. Another feature is the provision made for transferring a portion of the weight of the tractor to the runners. Hand levers adjust both front and rear blades.

Subjects Covered by Review

Last Week

Power Shovels
Concrete Chuting Equipment
Industrial Locomotives
Elevating Loaders
Rock Crushers

This Week

Road Grading Equipment
Concrete Mixers
Concrete Road Building Plant

Next Week

Cranes, Buckets, Hoists, etc.

Specifications for concrete roads by the Illinois State Highway Department resulted in the development of a light three-wheeled motor roller weighing only 3 tons, claimed to be the first of its kind on the market. This machine is intended to serve not only as a subgrade roller but also as a maintenance outfit, for which attachments of blades and scarifiers are furnished.

For its Little Western grader the Austin company has developed a scarifier attachment which is fixed to the circle; it may be raised or lowered with the blade to vary the depth of cut.

The Austin single-cylinder, 10-ton motor roller is now equipped with a self-starter. During the year improvements were made to eliminate vibration from motor rollers so as to make them acceptable for compacting hot material.

Avery Co. ON ITS road "razer" the Avery Co. used a grading blade built in three sections, two 5-ft. lengths and one 2½-ft. length, overlapping and hinged at the joints to make the cut conform to the crown of the road. The blade may be

(Continued on p. 93)

More Suggestions—

For Better Equipment and Repair Parts Service

IN THE Dec. 14 issue was begun a discussion of "Better Equipment Maintenance and Repair Parts Service." Its object is to show how some of the misunderstandings between maker and user of construction machinery can be avoided. This week's contribution is a recital of experiences by manufacturers of steam shovels and cranes:

From a Maker of Cranes, Hoists and Excavating Machinery

IN supplying repair parts for construction equipment the following difficulty sometimes arises:

Users of our machines sometimes rent them to other contractors in differerent towns and the contractor who rents the machine frequently has occasion to send in for repair parts. In doing this he does not give the number of the machine, nor does he give the number of the part, which is very confusing. Furthermore, he signs his own name to telegrams ordering the renewal parts without giving the machine number. We are, therefore, at a loss as to who the owner of the machine is and his credit rating.

Another source of trouble is that the foreman on a job frequently signs his own name to a wire ordering repair parts, giving no further information, and we are absolutely at a loss to know what machine repair parts are wanted.

From the Marion Steam Shovel Co., Marion, Ohio

WE welcome the opportunity you have given us to enumerate briefly some of the shortcomings of our customers in the matter of ordering spare and replacement parts, which react to their own disadvantage in securing prompt and efficient service.

Every day we receive orders with the factory or serial number of the machine omitted. Our records are maintained according to these serial numbers and in cases where a customer owns several machines it is necessary for us to hold the order and write or wire for the information lacking. Through the medium of our repair lists and correspondence we constantly emphasize the importance of giving the factory number of machine with each order, but this item is too often overlooked.

We also ask the customer to be specific as to the description, casting number and shipping instructions. For instance, a customer just wired today: "Express at once follower plate for 300 engines." We assume that a piston follower head is wanted, but as there are three different types of engines used on the machine we cannot fill the order until we get a reply to our message asking for the specific information that was lacking in the first telegram. Instances, of which this one is typical, are repeated each day.

Occasionally we receive a wire order signed by some unknown individual and not giving the firm name from which proper identification can be established. It is always embarrassing both to the user and ourselves when it is later found that the individual proves to be an official of a highly rated company. If orders were always signed with the company's name first and then the individual many troublesome annoyances would be eliminated and unnecessary delays avoided.

Don't make your telegrams too brief. State clearly what you want and see that casting numbers are correct.

Don't overlook shipping instructions. Say "freight," "express" or "parcel post" and give destination.

Don't order special fittings and expect immediate shipment.

Don't fail to take up COD shipments. It helps you to get material on open account later on.

Don't make a practice of waiting until you are down before ordering replacements. Accidents will happen but try to anticipate your requirements for wearing parts in advance thus having them on hand when needed.

Don't send us a wire order on Saturday afternoon and afterwards complain because the shipment did not get away until Monday. Most firms do not have regular operation on Sunday.

Don't criticize us too harshly if an occasional mistake is made by us. We are human too.

To sum up the whole situation we append a list of "Don't" for the benefit of those who are inclined to neglect the seemingly little details which contribute so largely to first class repair service.

The discussion will be continued in next week's issue.

You are invited to participate in it.

Gypsum Industries Association Dissolved by Court Order

In a decree signed last week by Judge Knox of the Federal District Court, New York, the Gypsum Industries Association was ordered dissolved as a combination in restraint of trade. The decree, according to Col. William Hayward, U. S. Attorney, who conducted the case for the federal government, is of far-reaching importance because, for the first time in the history of the Sherman law, there is set forth a code of principles governing trade associations. The decree prohibits agreement to: fix or establish prices; establish or maintain uniform prices; advance or decrease prices; limit, curtail or otherwise control production; fix boundaries of sales open only to certain members; and effect any discrimination in prices.

Further details appear in "The Business Side of Construction," p. 97.

Review of Construction Equipment and Materials During 1922

(Continued from p. 92)

raised by a power-lift device. The outfit is mounted on three wheels to minimize turning space.

Buffalo-Springfield Roller Co. A NEW model of three-wheel motor roller was announced during the year. The power unit is a horizontal two-cylinder opposed type gasoline engine, which, it is claimed, eliminates vibration and provides for the steady rolling desirable in laying asphalt and other bituminous pavements. The machine may be equipped with a pneumatically controlled pressure scarifier.

Lakewood Engineering Co. TO MEET the requirements of the new subgrade design specified by the Illinois highway department a subgrader in a new model was developed with an all-steel frame. A jack lever enables the machine to be raised on a turntable.

Stroud & Co. A WORM-GEAR device was installed on the Stroud elevating grader to raise and lower the carrier. Other improvements included a new lubricating system and a cast steel front bolster. To run the belt on the elevating grader an auxiliary gasoline engine was installed.

Western Wheeled Scraper Co. FOR ATTACHMENT to its standard grader a scarifier was developed which rotates and is raised and lowered with the blade, always remaining parallel thereto. When not desired for use the scarifier may be raised, thus allowing the blade to do its regular work. For road maintenance the points of the scarifier may be allowed to project 2 in. below the blade to loosen the material and facilitate the work of the blade.

Concrete Mixers

CONCRETE-mixer types divide naturally into two classes, one, the large-capacity, heavy pavers, and the other the smaller building and general construction mixers.

In the design of the large pavers the trend has been toward the production of self-contained units with power operated accessories in the form of charging skips, derricks for handling batch boxes, boom-and-bucket or chute delivery systems. As in the power-shovel field, there has been an increasing use of crawler traction mounting, while a comparatively new trend is seen in the rapidly increasing employment of rubber tires on wheel-mounted machines. This practice is more noticeable in the small and medium sized units, particularly those which must be moved frequently from one job to another. This year's design has developed several safety features, among them a double cable on the charging skip to forestall accident in case of the breakage of one cable and a skip guard to prevent injury to workers during the lowering or raising of the skip. The use of multiple-cylinder gasoline engines, instead of steam, for power has shown an increase.

A survey of developments in the building and general construction type of mixer, as distinguished from the paver, indicates that more stress is being placed upon mobility. Mixers are being mounted on Ford trucks and the use of both solid and pneumatic tire mountings has scored a big increase during the year. This holds true not only for the medium sized units, but also on the small types in which rubber-tired trailer mountings are now standard equipment. On building mixers, also, two-cylinder gasoline engines are being used more extensively on the grounds that they create less vibration than the one-cylinder engines. Four-cylinder gasoline engines are also favored. Many other detailed improvements.

American Cement Machine Co. RUBBER-TIRED WHEELS are being used for equipping a part of the line of concrete mixers manufactured by the American Cement Machine Co. In the case of the Packard tilter mixer and the Boss highway special mixer cord tires are used so that these machines may be hitched to the back of a motor truck and moved quickly from one job to another. Tire replacement can be made with standard Ford tires.

Chain-Belt Co. THE USE of concrete mixers equipped with rubber tires, the Chain Belt Co. has found, is becoming increasingly popular. The company cites the case of seven Rex mixers operated by the city of Milwaukee and a Rex paver purchased by the Milwaukee Railway & Light Co., both equipped with rubber-tired wheels.

Koehring Co. ON ITS 34-CU.FT. PAVER, a self-contained unit with multiplane traction, power charging skip and delivery boom and bucket, the Koehring Co. has introduced, for purposes of safety, a double cable on the skip and has equipped the unit with a power operated derrick for transferring batch boxes from industrial railway cars to the skip of the paver, where an automatic arrangement dumps them from the bottom without tipping the boxes. In the upper part of the charging skip a curved steel plate has been placed to prevent damage from batch boxes bumping against it during discharge. To accommodate all methods of loading by truck and industrial railway the skip has been widened and made a trifle larger than formerly.

The pavers are equipped with solid rubber tires when called for to facilitate moving over city streets without injury to the pavement or the mixer. Rubber-tired mountings are also supplied for the company's construction mixers for towing behind motor trucks. The construction mixers are built in what are known as right and left side types, so that when used in a battery of two the control levers are close together and may be operated by one man stationed between the machines.

Jaeger **Machine Co.** A LIGHT-WEIGHT trailer mixer in two types, two-wheel and four-wheel, equipped with pneumatic tires, was announced by the Jaeger company. Mobility is the chief feature of these units. When ready to move it is merely necessary to attach the trailer to a truck or automobile and, with the rubber-tire equipment, speeds of 20 to 30 miles an hour can be made with safety.

Lakewood **Engineering Co.** IN THE POWER equipment for concrete pavers the Lakewood Engineering Co. has observed an increasing tendency toward the use of multiple-cylinder gasoline engines instead of steam engines. Among improved features of its equipment are the use of replaceable bronze bushings for bearings, stronger and simpler clutches, and the use of two simple valves instead of the usually troublesome three-way water valve.

In the case of building mixers (from ½- to 2-yd. capacity) four-cylinder gasoline engines have in many instances been substituted for steam engines and boilers and lubrication has been improved by the application of the Alemite system.

On the small mixers (one bag and less) the use of rubber tires and spring suspension for increasing the mobility of the unit has been one of the features of the year. On these small mixers, also, the two-cylinder gas engine is being employed to reduce vibration caused by the single-cylinder power unit. The Lakewood company has found the two-cylinder engine more satisfactory in operation than the single-cylinder engine.

T. L. Smith Co. THE NEW Smith pavers during the year were equipped with full-length traction and, in the case of gasoline-engine-operated units, with a new type of heavy duty Wisconsin four-cylinder engine. On machines with boom-and-bucket discharge a new type of cross-dump, large-capacity bucket was introduced. On the non-tilting drum type the manufacturers offered rubber-tired wheels in addition to the standard wheels.

Concrete Road-Building Plant and Equipment

DEVICES for measuring, storing and loading sand and stone aggregate for concrete from overhead bins into motor trucks or industrial cars are now available and there is in course of development complementary equipment for handling and loading cement. More extensive use of mechanical subgrading and finishing machines operating along steel forms for concrete roads has led to use of metal of increased thickness in the forms — $\frac{3}{16}$ in. has been adopted by several manufacturers. To eliminate lost time in haulage and also to protect the subgrade several types of turntable for motor trucks have been brought out, one of them occupying only one-half the width of the subgrade and revolving over the side form. During the year manufacturers improved some of the details of finishing machines and designed a hand-operated belt float and bridge. A new type of premolded bituminous-felt joint was announced differing from former straight-faced types in a tongue and groove feature.

Austin **Machinery Corp.** A BATCH distributor for concrete road work was developed to travel on the forms, spread the concrete the full width of the slab and strike it off. The device consists of a trough mounted on a carriage driven by a gas engine. The trough is charged directly from the concrete mixer spout and travels to the point where the concrete is to be discharged.

Blaw-Knox Co. IN ITS Batcher plant the Blaw-Knox Co. has produced a combination elevated storage bin with adjustable measuring batchers which enable the contractor to store, accurately measure, and discharge by gravity predetermined batches of sand and stone into trucks or industrial cars. For charging materials, but not for storage, a smaller type of bin is supplied with a single batch-measuring device; ordinarily two of these charging units are employed, one for sand and one for stone.

To supplement the foregoing equipment for sand and stone the Blaw-Knox Co. is developing a handling and loading device for cement. It involves overhead steel batchers or hoppers dumping directly into box-shaped truck partitions. With the arrangement proposed the handling of cement at the paving mixer will be eliminated.

Improvements in steel road forms consisted mainly in strengthening and stiffening these units, particularly at the lock joint. A heavy form, known as the Dreadnaught, made of $\frac{3}{16}$-in. steel was placed on the market during the year.

A turntable for motor trucks on road work was designed to rotate over the road form and to occupy only one-half the width of the subgrade, leaving space for the movement of vehicles alongside.

Philip Carey Co. TO FORM a tongue-and-groove connection between concrete road slabs the Philip Carey Co. designed a new form of Elastite premolded bituminous-felt joint. It differs from the previous straight-faced types in having a trough-shaped projection, through holes in which stakes are passed and driven into the subgrade to hold the joint vertical during concreting. Advantages claimed for this joint are that it prevents spalling and crushing of concrete at the joint due to slab movement, forms a watertight seal, and preserves surface alignment by its interlocking feature.

Dunn **Road Mach. Co.** SEVERAL simultaneous operations are performed by the Dunn finishing machine for concrete roads. It is a gasoline-operated carriage traveling on the forms with auxiliary strike-off which pushes surplus material ahead and smoothes the slab. Behind is the main strike-off or camber with a slow vertical movement to press down surface stone. Behind the camber are a spader and finishing belt. The action of the machine results in filling surface and interior voids, pressing out water, and smoothing the surface of the slab.

A. W. French & Co. THIS organization put on the market the concrete road surfacer developed last year by William Ord. The device carries two heavy strike-off girders which use the tops of the forms as guides. The girders work back and forth across the road as the machine advances, producing a kneading action to remove excess air and water and produce concrete of maximum density.

Heltzel Steel **Form & Iron Co.** MAINTAINING that steel forms for road construction should be of at least No. 9 gage and preferably No. 7 gage metal, the Heltzel company last year used a $\frac{3}{16}$-in. thickness of open-hearth steel. This type of form consists of two units, independent pedestals, and rail forms hung from them. To provide large bearing area a 6-in. pedestal base is standard. Flat stakes are preferred to round bars for holding the pedestals in place.

(To be continued next week)

Business Notes

FOUNDATION CO., New York, has received from its stockholders approval of a new issue of 10,000 shares of no par value, cumulative convertible 7 per cent preferred stock, which is being offered to common stockholders on the basis of one new share of preferred for each four shares of common now held.

A. R. ULBRICH, formerly sales manager of the Terry Manufacturing Co., Inc., was appointed sales manager of the National Hoisting Engine Co. of Harrison, N. J. He assumed his new duties Jan. 1.

W. W. SCOTT, JR., was elected vice-president, Laclede Steel Co., St. Louis, Mo., effective Jan. 1. His first experience in the steel business was gained in the Homestead Works of Carnegie Steel Co., in the open hearth furnace department, after which he filled various mill positions before becoming connected with the sales department of the Carnegie company in Pittsburgh.

In 1919 he was made manager of sales, Carnegie Steel Co., Tennessee Coal, Iron & Railroad Co. and Illinois Steel Co., with headquarters in St. Louis. Early in 1922 he was appointed general manager of sales of the Laclede company.

WARREN C. NIXON, secretary of the National Association of Railroad Tie Producers, and vice-president of the Western Tie & Timber Co., St. Louis, Mo., died at St. Louis on Jan. 2.

The KELLY-SPRINGFIELD MOTOR TRUCK CO., Springfield, Ohio, has been placed in the hands of a receiver on application of the Bankers Trust Co., of New York. Pearl A. Lewis was named receiver by the court and was authorized to borrow $250,000 to continue the operation of the plant.

AMERICAN CONCRETE PIPE ASSOCIATION will meet Jan. 18, 19 and 20 at the Hotel Sherman, Chicago. A special session Jan. 19 to which practising engineers are invited will be addressed by Dean Anson Marston, Iowa State College; Langdon Pearse, Sanitary District of Chicago; A. M. Hirsh, Lock Joint Pipe Co.; S. H. McCrory, chief, department of agricultural engineering, U. S. Department of Agriculture.

METAL & THERMIT CORP., New York, announces that its Jersey City welding shop, in addition to present facilities for Thermit welding repairs, has been recently equipped for making welds on lighter sections by means of the oxy-acetylene and electric processes. This service is designed for large production work. The policy of equipping welding shops with the additional welding facilities noted above, will be extended to the other welding plants of the company.

Equipment and Materials

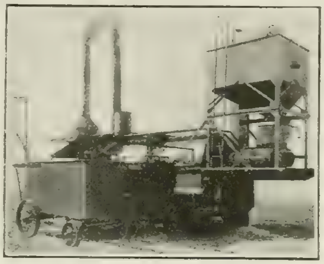
Asphalt Plant Has Three-Drum Sand Dryer Handling 120 Tons

A number of new features are included in the asphalt plant just announced by the Austin Machinery Corp., Toledo, Ohio. It is a portable unit consisting of three parts, the dryer and power plant, and two asphalt kettles. the equipment is the result of a year's test of a plant at Topeka, Kan. The plant has a capacity of from 1,000 to 1,400 sq.yd. of 2-in. asphalt top per 8-hour day.

The sand dryer will handle 120 tons of sand at 350 deg. F., to contain not more than 2 per cent moisture. The dryer embodies one of the particular features of the plant. Three drums are built into a unit, equal to a single continuous drum 4 ft. 3 in. in diameter by 40 ft. 8 in. long, giving the material an area of 438 sq.ft. of heating surface. This amount multiplied by 8 r.p.m. and the total by 1 min., the time required for the material to travel through the drums, gives an area of 12,912 sq.ft. with which it must come in contact. Thus, the highest temperature required is secured at a low fuel cost.

The kettles have a total capacity of 2,500 gal. They are heated by steam through jointless coils. This construction prevents damage to the asphalt and is superior to kettles heated by open fire.

The pug mill of 1,000 lb. capacity is chain-driven and discharges through a sliding gate in the bottom. Extra large steam jacketed steam piping is used throughout. Air is employed to agitate the asphalt. The hot sand bin is of three compartments with a capacity of 10 tons.

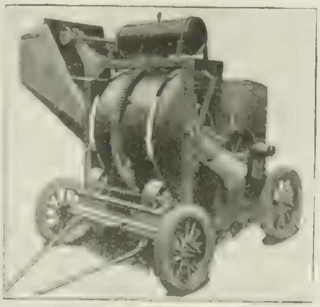


Steel Road Forms Strengthened

While preserving the basic principles of its steel forms for concrete road construction, the Blaw-Knox Co., Pittsburgh, has made certain improvements in this line of its construction equipment. The lock-joint plate connection between adjacent forms has been strengthened by increasing its weight and thickness, together with heavier riveting. The connection by which the form is staked to the ground and locked with a key or wedge has been improved by using one piece of heavier $\frac{3}{16}$-in. plate. The wedge or key has been made longer and heavier and is now provided with a hole in the small end for a cotter key or wire, thus making the wedge integral with the stake track.

The company also has placed on the market recently a heavier type of road form known as the Dreadnaught, which is made of $\frac{3}{16}$-in. extra heavy plate. This change is occasioned by the increasing use, by contractors, of heavier finishing machines and sub-grading machines traveling on the steel forms.

More Concrete Mixers Equipped With Rubber Tires



Rubber-tired wheels are being used by the American Cement Machine Co., Inc., Keokuk, Ia., for equipping part of its line of concrete mixers. In the case of the Packard tilter mixer and the Boss highway special mixer cord tires are used so that this equipment may be hitched to the back of a motor truck and moved quickly from one job to another. The company points out that until recently small mixers were generally moved at slow speeds by horses. When hauled by trucks moving at 15 or 20 miles per hour mixers equipped with small wheels and steel tires are subjected to a great deal of jolting and rattling that works bolts loose, causes parts to work out of alignment, damages the engine, and results generally in breakdowns and delays.

On the Boss type of mixer 30-in. wheels with pneumatic tires are now used not only to eliminate damage to the machine itself during moves, but also to protect city pavements. The one-bag Boss mixer is now furnished with four-wheel trucks equipped with cord tires and the Packard tilting mixer is mounted on two-wheel Ford trailer trucks, also fitted with rubber tires.

During the operation of the mixer blocks can be placed under the axles to take the load off the tires. Tire replacement can be made with either new or used Ford standard tires.

Publications from the Construction Industry

Portland Cement Stucco—PORTLAND CEMENT ASSOCIATION, Chicago, has issued a 50-p. illustrated booklet on uses of portland cement stucco for architects and builders. In addition to many photographic illustrations of stucco-finished residences and of various types of finishes possible with stucco, it contains instructions recommended for use in the application of this material and drawings of typical construction details for stucco coverings on various types of buildings.

Centrifugal Pumps—DAYTON-DOWD Co., Quincy, Ill., in a new 32-p. illustrated bulletin, features its single-stage double-suction centrifugal pumps, (Type CS.) In addition to detailed specifications, there are given tables of speed, capacity and approximate efficiencies for various sizes of pump, and a table of dimensions. There are also a series of characteristic curves plotted from tests under various conditions. One section of the text is devoted to types of drive, including electric motors, steam turbines, gasoline engines and belted connections. A number of illustrations are given showing the adaptability of centrifugal pumps to various classes of pumping service and diagrams indicate correct and incorrect methods of installing suction lines.

Rustproofing for Iron and Steel—THE PYRENE MANUFACTURING CO., Newark, N. J., has issued pamphlets explaining the Parker process of rustproofing for iron and steel. The process, invented by Thomas Watts Coslett, an English chemist, in 1907, and developed in America by the Parker Co., of Detroit, consists of dipping sheet iron or other articles into a tank filled with a dilute solution of iron phosphate, heated nearly to the boiling point by steam pipes. By this treatment the iron, to a depth depending upon the density of articles processed, is converted into a basic iron phosphate. No high heat is required as in the Sherardizing and the Bower Barff process.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Production and Materials Stocks in Ten Cities

Steel Output Increased—Gains in Lumber and Cement Shipments —Winter Brick Supply Lower Than Usual

Steel—A conservative estimate of the steel ingot output in the United States for 1922 would place the tonnage at somewhat over 30,000,000, or nearly double the production record of 1921. The output during the last year has been over 2,000,000 tons each month, since February and the new year starts in with an increased production rate and expansion in demand. The heaviest tonnages for first quarter delivery, have been placed by automobile manufacturers and railroads.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Lumber, Minneapolis, 75,000,000 ft.); time required for delivery of carload lots to city job, example: (sewer pipe. Atlanta, 6 @ 8 days); and stocks on hand in general terms, example: (common brick, Philadelphia, shortage.)

	San Francisco	Denver	Minneapolis	Detroit	Chicago	New Orleans	Birmingham	Atlanta	New York	Philadelphia
Sewer pipe....	Plenty, sizes 30-in. and under	Del. 24 hr., local plant	Sufficient	Ample for present needs	Slightly below normal	Stocks fair	Meeting strong demand	Del. take 6 @ 8 days	Mill del. improved	Stocks short
Cement.......	Low	Car conditions improved	Not much on hand	Plenty in storage	Nearby mills	Sufficient	Mills preparing for heavy demand	15 @ 20 cars	Plenty	Depleted
Lime....	Fair supply	Plenty	No shortage	15 cars	Plenty	Ample	Well supplied	20 @ 30 cars	Enough	30 cars in yards
Common brick	Plenty	4,000,000	Below normal	Local yards well stocked	Stocks lowering	Plentiful	Yards well stocked	Plenty	Dealers piling up stocks in local storage	Shortage
Hollow tile....	Well stocked	Sufficient	Below normal	Moderate reserve	Fair	Enough	Plenty	Del. take 4 @ 6 days	Prompt water deliveries	Stocks low, acct., car situation
Lumber.......	Conditions favorable to lumber movement	Stocks in good shape	75,000,000 ft.	Fair stocks, dimension lumber	Ample, for present demand	Mill demand in excess of production	Unlimited pine reserves	Plenty pine	Del. 7 @ 8 weeks from mill.	Supply limited; de- deliveries poor
Asphalt.......	Large reserves	Not less than 10 cars	Enough	Deliveries prompt	Plenty	No market	Plenty available	30 @ 40 cars	Large supplies accessible	Heavy reserves
Structural steel	Heavy warehouse stocks	Ample supplies	Enough to meet demands	Sufficient	Bought from mills outside city	Plentiful	High production rate maintained	3 @ 4 cars	Slow mill deliveries	Enough in warehouses

Lumber—An average of 388 mills reporting weekly to the National Lumber Manufacturers' Association, for the four weeks ending Dec. 23, show 794,197,310 ft. cut; 839,332,916 ft. shipped and orders covering 840,166,800 ft. b.m. These totals show a gain of 6 per cent in shipments but declines amounting to 17 per cent in production and 4 per cent in orders, during the month. According to the National Lumber Trade Barometer, Dec. 29, 1922, production stood at about 20 per cent; order 6 per cent and shipments 7½ per cent below normal.

REPORT ON COMMON BRICK FROM 97 YARDS AS OF DEC. 1, 1922

Dist. No.	Including States of	No. of firms reporting	Plants closed down	Burned brick on hand	Unburned brick on hand	Orders on books	Price per thousand at brickyard
1.	N. Y., New England..........	5	4	4,274,000	2,710,000	2,056,000	$12.00 to $18.00
2.	Pa., N. J., Md., D. C., Del....	11	0	11,792,000	7,390,000	32,165,000	14.00 to 19.00
3.	Va., N. C., S. C., Ga., Fla.....	7	1	5,168,000	4,492,000	5,754,000	13.00 to 18.00
4.	Mich., Ohio, W. Va..........	7	4	4,551,000	1,982,000	4,824,000	12.00 to 15.00
5.	Ill., Ind., Wis...............	25	2	182,930,000	29,476,000	163,448,000	9.50 to 15.50
6.	Ky., Tenn., Miss., Ala., Ark., La......................	10	2	5,620,000	3,663,000	8,991,000	9.45 to 16.00
7.	N. & S. Dak., Minn., Neb., Ia., Kan., Mo..............	7	3	4,921,000	1,445,000	950,000	10.25 to 15.00
8.	Okla., Tex., N. M............	8	1	5,071,000	2,893,000	1,552,000	7.00 to 12.00
9.	Wash., Ore., Mont., Wyo., Ida., Utah, Colo...........	13	2	6,353,000	2,500,000	1,320,000	12.00 to 17.50
10.	Calif., Ariz., Nev............	4	1	8,196,000	8,908,000	8,165,000	14.50 to 15.00
		97	20	238,858,000	65,459,000	229,225,000	

Cement—Shipments for the entire country, during 1922, eclipsed all-previous records with an estimated total between 116,000,000 and 121,000,000 bbl. Estimated production figures approach the 117,000,000 mark for the year, with current stocks at about 5,000,000 bbl., or 40 per cent under the amount on hand one year ago.

Brick—Information as of Dec. 1, received from 97 companies reporting to the Common Brick Manufacturers' Association of America and who represent about 70 per cent of the production capacity of the country, shows about 94,000,000 brick burned and 80.000,000 shipped during the month. This represents an increase of 2½ per cent in the number of burned brick on hand. Fully 25 per cent of the brick plants of the country are closed down until spring and the winter supply is smaller than usual, throughout the country.

San Francisco—Stocks of steel bars, hollow tile, structural shapes, blue annealed and black steel sheets, manila rope and cut nails in very good condition. Fair supplies of track materials, sewer pipe, metal lath, lime, steel mesh, brick and lumber; and large quantities of road oils, asphalt and galvanized steel sheets available. Stocks low, however, on cement, structural rivets and wire nails.

Denver — Dealers' stocks in good shape as far as construction materials are concerned. Plenty of freight cars available since completion of fruit crop movement.

Minneapolis—Lumber stocks, while depleted as usual at this time, are nearly normal for the season. Dealers report that approximately 75 per cent of the winter's buying of lumber has been done. Stocks of common and face brick and hollow tile are reported below normal, with little or no accumulation in warehouses or yards due to the keeping up of demand resulting from continued mild weather throughout December. Some cement on hand but not much.

Detroit—Ample supply of sewer pipe for present needs, demand slightly decreased. Plenty of cement in storage at nearby Michigan plants. Only one cement mill closed down. Lime available from local and also Ohio, kilns. Plenty of brick but only a moderate supply of hollow tile on hand. Sufficient dimension lumber. Prompt asphalt deliveries.

Chicago—Brick stocks lowering with increasing demand, a condition unusual for this time of the year. Sewer pipe stocks below normal with small demand. Fair quantity of hollow tile on hand. Not much call for reinforcing steel; stocks normal with deliveries taking from one to two days.

New Orleans—No market for asphalt or crushed stone. Orders on yellow pine mills way in excess of production. Stocks of other materials plentiful but demand poor. No creosoted wood paving blocks on hand.

Birmingham—Mill output of steel rails sold for first half of 1923. Cast-iron pipe demand greater than mills can supply. Sewer pipe plentiful and demand strong. Sand shipped in from outside city; supply ample but small.

Atlanta—Plenty of pine lumber and common brick. Hollow tile deliveries take from four to six days; sewer pipe, six to eight days. About thirty or forty cars of asphalt; twenty-five to thirty cars of lime; fifteen to twenty cars of cement and three or four carloads of structural steel, on sidings.

New York—Brick dealers piling up reserve stocks in local storage spaces. Hudson River brick supply hampered by ice. Burned brick on hand in New York and New England district reduced about 33⅓ per cent, in month. No improvement in car supply. No actual shortage of other construction materials.

Philadelphia—Stocks short on sewer pipe and hollow tile, orders held up on account of freight congestion. Small quantities of wood blocks and paving stones on hand with demand active. Shortages of cement and common brick reported. About thirty cars of lime in yards. Lumber deliveries poor with stocks limited; water shipments, however, show improvement over rail.

Freight Loadings Touch New Seasonal High Mark

Freight loadings for the week ending Dec. 23 totaled 834,591 cars, according to the American Railway Association. This represents the heaviest week's loading ever recorded during this season of the year. The record exceeds totals for the corresponding period last year, by 167,986 cars and shows a gain of 186,185 over the same week in 1920.

The following table shows car loadings by weeks since the peak, Oct. 28, 1922, during the last three years:

Week	1922	1921	1920
Dec. 23..........	834,591	666,605	648,406
Dec. 16..........	888,082	726,074	802,271
Dec. 9..........	919,828	741,341	837,953
Dec. 2..........	845,219	741,849	882,604
Nov. 25..........	955,495	673,465	803,701
Nov. 18..........	969,094	790,363	889,138
Nov. 11..........	953,909	755,777	927,586
Nov. 4	994,827	837,576	915,615
Oct. 28	1,014,480	951,384	981,247

Freight cars awaiting repairs on Dec. 15, totaled 213,837, or 9.4 per cent of the total number on all lines. This represents a reduction of 12,451, compared with the number in need of repairs on Dec. 1, at which time there were 226,288 cars or 9.9 per cent.

Locomotives in bad order on Dec. 15, reached a total of 17,883, which was 27.7 per cent of the total number on all lines. This represents a decrease of 126 compared with the number in need of repair on Dec. 1, at which time there were 18,009 or 27.9 per cent.

Highway Costs in Canada

The average cost per mile for highway construction in the Province of Quebec, Canada, was $10,854 in 1922, according to statistics issued by the Minister of Roads, Dec. 22, 1922. The average cost in New Brunswick and Nova Scotia was $11,800 per mile. The Province of Ontario paid on an average of $23,700 per mile for good roads, during the year. In one instance, thirty-seven miles of highway between Toronto and Ottawa cost $2,400,000. The Minister states that at present Quebec possesses 800 miles of road-and that by the end of 1923, 2,208 miles will have been completed. Cost of maintainance on these roads will average about $300 per mile.

U. S. Court Defines Lawful Trade Associations

Consent Decree in Gypsum Case Lists Lawful Activities and Forbids Specific Violations

In his decree dissolving the Gypsum Industries Association, Judge John C. Knox of the United States District Court at New York has set forth the lawful and unlawful activities of trade associations under the Sherman anti-trust law.

Judge Knox considers it legitimate for trade associations (a) to promote the use of the products of their industries by legitimate and lawful means including research, publicity, and similar activities, (b) to deal with engineering and trade problems pertinent to their industries for the purpose of advancing the use of their products, (c) to promote educational work pertinent to the industry through fellowships in schools and colleges for research, experimental and research work in institutions of learning, scientific bureaus and societies, and to provide for lectures and papers on subjects pertaining to the industry, (d) to maintain a bureau to furnish traffic information upon specific request in each case from published freight tariffs lawfully issued by carriers and to assist the industry in transportation questions before federal and state commissions and other bodies dealing with questions of transportation and with common carriers, (e) to deal with improved methods of plant and mine operation including sanitation, safety, accident prevention, labor, plant and mine development, housing conditions, insurance and methods of accounting, and (f) to maintain a credit bureau for the sole purpose of furnishing credit information.

In Violation of the Law

The following activities are declared to be in violation of the law: (a) Agreement to fix prices to be charged for products, (b) performance by agreement of any act which would result in maintenance of uniform prices, (c) agreement to advance or decrease prices for products, (d) agreement to advise or communicate with one another as to proposed advances or decreases in prices or agreement to circulate among themselves in any way information concerning or relating to proposed advances or decreases or to the prices charged or to be charged, (e) performance by agreement of acts that will result in advising or communicating with one another as to proposed advances or decreases in prices, (f) agreement to restrict or control production or performance through agreement of any act that will restrict or control production such as the withdrawal of salesmen from a certain territory over stipulated periods, (g) agreement as to territory in which any or all producers may sell or otherwise dispose of their products, (h) agreement to effect discrimination whether in prices or otherwise in favor of or against purchasers of products because such purchaser is a mail-order house, purchasing agency, co-operative buying association or so-called dealer or for any other reason, or performance by agreement of any act to effect such discrimination except that each producer may independently of other producers select his own customers and dispose of his own products on such terms as he may choose, (i) agreement to use a published credit list and credit information to blacklist an undesirable purchaser or for the purpose of putting the name of the purchaser on such list with the intent of the manufacturer who submits the name reserving the purchaser's business for himself, (j) agreement to fix terms, differentials, discounts or prices to be followed by dealer, jobber or other middleman upon his resale or the uniform discounts which should be subtracted by each manufacturer as an inducement for cash payment, (k) agreement to follow any price list published by themselves or by any newspaper, trade paper or periodical as a fixed price, (l) agreement to enforce any arbitrary freight rates in excess of those lawfully made, (m) agreement that certain individual manufacturers engage in the manufacture of a certain product of a definite composition and that other manufacturers desist from manufacturing a similar product, and (n) assisting others to do any or all of the matters here enjoined.

The decree further states that nothing contained in it shall be construed to restrain or interfere with the action of any manufacturer with respect to his own business properties or affairs, or from furnishing necessary information to his own customers in connection with bona fide sales of such products, or from doing individually any of the acts described done in good faith to meet competition when this action or the furnishing of this information is not performed in concert as the result of agreement among manufacturers.

Public Roads Bureau Urges Highway Development

Curtailing of Transportation Service More Costly Than Building and Maintaining of Roads

Thomas H. MacDonald, chief of the United States Bureau of Public Roads, in a recent address on the functioning of federal-aid in the development of highway transportation, before the eighth annual convention of the American Association of State Highway Officials, stated the following:

It is about time that we recognize in this country the fact that the development of adequate highways is not a problem for the farmer, nor is it a problem alone for the city man. It is one of the fundamental transportation problems in every locality, and the use of the roads in every locality will reflect the life and activities of the people in the locality. This is demonstrated beyond dispute by the traffic census which we are now carrying forward. Despite any conditions political or otherwise, highway improvement in this country must go forward on an increased scale because it will cost more to do without the transportation service which can be supplied through the building of highways than it will cost to build and maintain them.

Here is an example taken from an industrial section. The recent traffic counts in Connecticut and Massachusetts, taken in October which is an average traffic month, give an average for each of four stations of 1,140 tons of commodities per day of nine hours. Adding one-third as a very conservative estimate for the full day, we have 1,520 gross tons daily commodity movement.

The agricultural tonnage is not large, neither is that of a number of the other activities, but the manufacturing tonnage is the big and important item. The section is devoted largely to manufacturing, and we find reflected the life and activities of the section in the highway commodity movements. Seventy-three per cent of the commodity movement consists of the products of manufacture, the balance being divided between the products of agriculture, mines and forests. From figures which have been published by the Iowa Experiment Station, assuming gasoline to cost 24c. per gal., the cost of the fuel alone for moving this tonnage per mile per day would be $26.44 over an ordinary dirt road, assuming the impossible, that such traffic could be carried over a dirt road. The cost of fuel for moving the same tonnage over a paved road would be $11.70, a difference of $14.74 per day. On the basis of 300 days per year the actual saving in fuel alone moving this tonnage, which comes from the actual weighing of the actual movements, would be $4,022. The paved highway costs approximately $40,000. The average interest at 5 per cent would be $1,000, which, deducted from the actual saving on fuel, would leave a balance which would retire the cost of the road in about eleven years. The maintenance costs are not figured in either case, but a greater maintenance charge could be deducted than the roads are actually costing, and still the balance of the saving would be sufficient to retire the cost within what we believe to be a reasonable period for the service of the road without extensive repairs.

Business Briefs

Bank debits for the week ending Jan. 3 totaled $11,223,963,000, the highest since the Federal Reserve Board started to collect these figures (August, 1918). The week's business was 49 per cent heavier than that of the preceding week. The increase in New York was 65 per cent, in Cleveland 90, Cincinnati 72, St. Louis 63. The chief reason for the great volume is end-of-year settlements.

Call money rate advanced to 4½@5, from 4 per cent. Rise due to deficit in actual reserves of Clearing House banks and to Government withdrawal of $52,000,000, effective Jan. 9.

Time loans, 4½@4¾ per cent for 60@90 days or six months; market dull.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of January 4; the next, on February 1.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb	$3.14	$3.95	$4.40	$3.02½	$3.15	$3.85	$3.25	—$3.70	$3.50
Structural rivets, 100 lb	3.85	4.60	5.25	3.75	4.00	4.80	4.75	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb	3.04	3.85	3.15	2.92½	3.05	3.62½	3.35	—3.70	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	54%	52.50%	45%	59½%	57-5%	41%	39.2@51.8%	40%	—22.50
Cast-iron pipe, 6 in. and over, ton	+55.20	+48.32	+57.50	+53.67	+56.66	+66.11	+55.50	+55.50	55.00
Concreting Material:									
Cement without bags, bbl	2.60@2.70	2.54	2.25	2.05	2.29	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd	1.00	1.32	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd	1.75	2.00	1.65	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	59.00	36.00	+50.00	52.00	+42.75	+50.50	35.00	+25.00	90.00
Lime, finishing, hydrated, ton	16.80@17.10	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	2.75@3.13½	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	10.00	10.90	11.00	18@19	12.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0859	.115	....	+.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1230	.0859	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal	—.90	—.95	+1.09	.98	1.01	+1.13	1.04	.86	1.02
Common Labor:									
Common labor, union, hour	.60	.35	.30@.50	......	......	.50@.55	56¼	.50@.60	......
Common labor, non-union, hour	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.50	....	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.47). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $22.50; 6-in., $108.

Changes Since Last Week

Average advance of $2 per ton in cast-iron pipe quotations throughout the country, following rise in pig iron, scrap and coke prices. Steel prices also tending upward. Structural shapes and reinforcing bars firm at $2 per 100 lb., Pittsburgh. No price shading in bars; mills sold up for first quarter delivery. Tendency to shade quotations in structurals, disappeared from market. Mills filled up on orders for shapes; deferred deliveries on new business. Big tonnage buyers purchasing for first half requirements, indicating belief that market will go no lower.

Pine lumber advanced $2 in Dallas; Douglas fir, $2 in Minneapolis and $1.50 per M. ft. b.m. in Seattle. Sharp rise in fir timbers also reported in Denver, due to car shortage and curtailment of operations.

Raw linseed oil in 5-bbl lots, quoted at 90c. as against 93c. per gal., f.o.b., New York. Prices advanced 2c. in Dallas, however, and 5c. per gal. in Denver, during week. Market generally weaker with tendency to shade prices.

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DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

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Indicting A Whole Industry

FOR the last two months the Department of Justice at Washington, with a keen sense of publicity, has been unfolding bit by bit its campaign against the conduct of the construction operations of the war. Public opinion is divided in its judgment of this campaign; to some it is merely partisan politics, the continuation of the congressional investigations to discredit the Wilson administration; others regard it as a proper showing up of profiteering which, through a popular misconception of the cost-plus contract and its consequences, is commonly thought to have been greatest in construction. The political strategy here exhibited may be only of academic interest to engineers and contractors, as such, but the direct charges of negligence, corruption and even treason against individual engineers and contractors implicate the whole construction industry and that industry cannot afford to shift the burden onto the shoulders of the men directly accused of misdoing.

Up to date the Attorney General's charges are in two parts; first, a series of suits to recover from the contractors on certain of the national cantonments sums totaling over $50,000,000 alleged to have been paid out by the government in excess of the fair and reasonable cost of those camps, due to the "fraud and deceit practiced" by the contractors, and second, a criminal indictment against seven men associated with the Emergency Construction Committee of the Council of National Defense for conspiracy to control the construction program of the war to their own benefit and the benefit of their friends, clients and prospective clients, thereby obstructing the war and defrauding the government—which comes about as near treason as any one not a lawyer would care to define it.

Obviously it is impossible here to specify all of the charges of the suits and of the indictments or to defend the accused by set phrase; that is their obligation when the cases come to trial. But it is possible briefly to reconstruct the scene of the operations which are denounced, to point out the controlling elements in the situation as it was in 1917 and to indicate the interest of the whole construction industry in the events which then occurred.

When war was declared on April 6, 1917, this country was not prepared; that is a matter of history. And in no way was it less prepared than in a definite policy as to the numbers of and means of raising an army. It was not until six weeks later that the national army by conscription was decided upon and not until well into June that it was appreciated that, by September, sixteen camps to house nearly a million men would have to be built. Here was a construction job unprecedented in magnitude and far beyond the capabilities of the regular army as then constituted.

Those who were in Washington at the time know what happened. The confusion in designing the camps and in devising contracts to build them became worse confounded. The Quartermaster Department—the existing agency for domestic camp construction—had certain designs evolved from the late Mexican campaign; these were changed overnight by advice of the allied military commissions then arriving in Washington and again the next night by advice of the Medical Corps. Three regular quartermaster officers were struggling with a construction problem of staggering proportions. The Corps of Engineers, already occupied with the stupendous job of preparing for the engineering conduct of the war in France, was seeking control of the camp construction, or if not seeking such control was a receptive candidate. And meanwhile no progress was being made toward building the camps.

At this juncture the Council of National Defense began to function. An extra-departmental body, legalized but of vaguely specified powers, it had attached to it a number of civilian advisors, among whom was a committee of engineers, architects and contractors, all experienced in large construction. This committee became associated with the General Staff in an advisory capacity, and from that association the so-called civilian control was born. It resulted in a civilian recruited Cantonment Division, a part of the army reporting directly to the Secretary of War, and the Emergency Construction Committee whose members are now being accused. All this, of course, was done by order of the Secretary of War.

It was immediately apparent that no existing form of army contract could be applied to this emergency work. There are those now, five years after the event, who claim this not to be a fact but they forget or ignore the conditions. No plans existed for these cities —to house 40,000 men each—on which a contractor could bid nor would any reputable contractor have gambled on his ability to guess at unit prices through a period when labor and material were being driven daily upward by the scarcity demand. Force account construction meant building up from the bottom a whole contracting organization, time for which did not exist, and probably also conscription of labor, which was a national policy the President evidently did not want to consider. The only way out seemed to be some form of fee or percentage payment to selected contractors who were competent and prepared with organizations to push through so gigantic a task. The formulation of such a contract was assumed, with the apparent acquiescence of the War Department, by the Council of National Defense. Its competent construction committee devised the so-called "cost plus limited fee" contract as the only way to get the camps built and the War Department approved it, at the same time imposing on the committee the duty of selecting the contractors to do the work, also subject to the approval of the department.

This was unprecedented procedure, but the war itself was unprecedented and to those who were trying to conduct it observance of precedent pointed only toward one thing—an enemy victory. For it must be remembered that even as these preparations were being made Ambassador Page was writing confidentially from London that in all probability the Allies had lost the war and the future was in our hands. Troops had to be housed by September.

In the procedure thus briefly outlined lies the source of the criminal indictments. The men who made up this committee, together with Benedict Crowell, then assistant secretary of war in charge of construction, are charged not only with urging the semi-civilian control of the war construction but of deliberately conceiving the scheme of getting control and putting it through to their own benefit and to the loss of the government. In other words, according to the charges, in two weeks in May a group of men, not before associated together, not only combined to perform these illegal acts but managed to make dupes of the General Staff of the Army and the Secretary of War.

It is inconceivable, however, that now even the most bureaucratic or politically minded official could urge the criminal prosecution of those responsible for this procedure merely because it broke precedent. The charges are that it also resulted in terrific and unnecessary waste and delay and undue profit to some individuals. And here is where the recovery suits come in. One difficulty in considering this immediately arises, that of defining "undue" and "unnecessary." There is no standard by which the proper limits of waste, delay and profit can be measured. There is, moreover, no way of telling whether any humanly possible system would have resulted in lower costs or less waste, though the experience of many years of construction makes it virtually certain that no system could have procured the finished camps sooner. The construction of those camps was the outstanding achievement of the war so far as speed was concerned and in the summer of 1917 speed was king.

Excessive contractor profits are charged, but these charges are for the most part generalities. The atmosphere of both complaints and indictment exudes profiteering; the text itself rarely specifies. *The fact is that the cost plus limited fee contract limited profits on large scale work more than did any other contract made in the war.* It was a cost-plus contract with a decreasing scale and a fixed maximum profit of $250,000, which made the contractors' fees on the cantonments fall below 2½ per cent gross and much lower when taxes were deducted. There are charges of other profits, from salaries, subcontracts, equipment rental, etc., but added altogether it is certain that in actual money received the contractor would make much more on a lump sum contract of similar size in normal times. And yet these same contractors are being sued for from $4,000,000 to $6,000,000, as much in some cases as the total value of their contract.

Wastes beyond all necessity are charged. These range all the way from deliberate destruction of material to encouragement of labor soldiering. Waste there was; it would be silly to deny it. It was tremendous, outrageous, universal. But war never is economical and this was war, just as much on the scrub flats of Long Island as in the forest of Argonne. Specific cases by the hundreds could be pointed out where a waste could have been avoided. Any one who could, at the time, have devised some system whereby the accumulation of those wastes could be avoided would have been the superman looked for in vain. Waste at such a time is a defect of human nature. Lump sum bids, could they have been obtained, would have saved much of the waste, *but the camps would never have been built.*

Favoritism is charged. There were only a limited number of contractors in the country capable of undertaking the work. Most of them were awarded contracts. All of them had friends somewhere among the groups responsible for the awards. The way to have avoided that would have been to put some ice-cream manufacturer from Honolulu in charge of construction. He would not have had friends in the construction industry.

The system which grew out of the confusion of those early days was not ideal. So few things in this world are. But it was a real attempt to solve a problem which had to be solved immediately. In looking back from these calmer days there appear many faults but they are the kind one sees from the light of hindsight. Even the much abused cost-plus contract, to which are justly laid many of the evils of waste and high cost, has rarely been competently criticized *for the emergency that then existed.* Publicly it has been defended by some of the leading men in the profession and this very defense has led to one of the most outrageous attacks in the indictment. One clause of the indictment reads:

> At Washington, D. C., in aid of inducing and procuring the continuance of the system of cost-plus contracts awarded without competitive bidding, said defendant Starrett about March 12, 1918, named and procured to be appointed by defendant Crowell as acting secretary of war, a committee of which committee certain members were interested in such contracts and systems, ostensibly to investigate and report upon the merits of said plan or system, which committee assembled on March 14, 1918, and reported on March 15, 1918, by adopting substantially as their report extended written statements and arguments made to them by said defendant Starrett and one Richard C. Marshall, Jr., then at the head of the Construction Division of the army, to which report, as though it were a report of a thorough and impartial investigation, wide publicity was given.

Who were the men who thus connived at perpetuation of this treasonable contract?

The presidents of three national engineering societies—Arthur N. Talbot of the civils, Charles T. Main of the mechanicals and E. W. Rice of the electricals, and president John Lawrence Mauran of the American Institute of Architects, president F. L. Cranford of the General Contractors Association of New York, president R. G. Rhett of the Chamber of Commerce of the United States, John R. Alpine of the American Federation of Labor and Oscar A. Reum of the Building Construction Employers Association. Later Francis Blossom, of Sanderson & Porter, C. A. Morse, chief engineer of the Rock Island, and W. S. Davies, then president of the accountants national society, formed another committee which paid similar testimony to the applicability of the contract for the emergency, and is likewise attacked in the indictment.

Are these men who would defraud the government?

As to the charges of personal corruption alleged in the indictment, they remain to be proved. We are asked to believe that the men accused after a lifetime of honest and fair dealing turned thieves at a time when menace of national disaster aroused even in the meanest the highest of motives and purpose. Violation of statutes are cited in the indictment but as alleged they are mere technicalities carrying no conviction to any but the inquisitorial mind. Possibly these men are guilty of some infraction of rule or law but they are not of the breed of which criminal profiteers are made.

WE HAVE thus violated the usual rule not to discuss cases before the courts because we believe that these suits and indictments have implications far beyond the personal affair of those concerned. They affect the whole construction industry. The men accused are among the most prominent in that industry. Those unnamed who must have participated in the alleged benefits had those benefits accrued are equally prominent and more numerous. The large body of representative engineers who made up the Construction Division are at best made out to be the simple dupes of these arch criminals who sway cabinet officers and control general staffs. And lastly the consulting committees condemned as accomplices after the fact were some of them the accredited representatives of the professional societies and all of them the most respected of our associates. It is a monstrous charge of iniquity that has been made against the best men in the engineering and architectural professions and in the industry. But the indicted men, and even those not indicted but maligned, are caught in the meshes of the law, so far embodied in a few officials in Washington. There is no redress save in the courts and the courts are notoriously slow. Meanwhile, they are branded before the country according to the respective indictments as wasters and incompetents or as criminals. Their eventual clearing can never redress the damage that will have been done. The least that can be demanded, if there be sense of justice in the department of that name, is to bring these cases to early trial—particularly in view of the widespread belief that the indictments are for political effect and that there is no intention of bringing them before the courts.

More than a century ago Burke said he knew of no way of bringing an indictment against a whole country. The Attorney General of the United States is better informed; he has found a way to indict a whole industry.

An Engineering Ambassador

AT THE dinner last week of the American Engineering Council some four score American engineers had the unique pleasure of listening to the first speech ever delivered by a foreign ambassador who is by profession an engineer. Prince Caetani, the diplomatic representative of the new Fascisti government in Italy, belied neither his training nor his present calling in his clear expression of the place the engineer plays or should play in international comity. The expedition now moving across the Franco-German border into the industrial heart of Germany is a plain token of what engineering means in the relations of nations. Is there any doubt that those relations would be better understood if discussed from the engineering viewpoint by engineers who in spite of difference of tongue talk the same language? That is the lesson the Italian ambassador sought to teach in his maiden speech. May he be but the first of a long line.

Defining Activated Sludge Anew

TWO schools have risen championing two principal theories as to the how and why of activated-sludge action. One holds that biological or living organisms do the work while the other claims much for chemistry and physics, mainly through colloids. Dr. Buswell, on p. 119, from comparatively simple tests together with the reasoning from previous investigations propounds a new statement which in a way is a combination of the biological and colloidal theories. Much as garbage disposal is handled by feeding to hogs so the organisms—no one variety—ingest, digest and assimilate organic matter in sewage into the living material of the "synthetic gelatinous matrix" in which bacteria are imbedded and on which larger forms of life crawl and feed. The organisms use chemistry in the digestive process and perhaps in the ingestive process. This synthetic biological attribute of sludge seems to be logical. Dr. Buswell's quantity measure of the surface by the Sedgwick-Rafter biological tests long in use is novel but nevertheless affords a real yardstick, and it is yardsticks we need to evaluate the various factors in the sludge "digestion" operation. Knowing how much surface will handle a given quantity of sewage throws the problem into the realm of practice, for we arrive then at the conclusion that in activated-sludge tanks we have simply taken the old slate beds of Dunbar and passed from flat fixed planes to suspended points. As in most operations where the forces of nature are used, a middle ground may be found the most advantageous. In other words, instead of unfixed suspended points we may find it well worth while to explore the possibilities of the second dimension by utilizing lines on which the gelatinous matrices may be fixed and by which the sewage may pass carrying the small amount of oxygen required for the life of organisms.

The Coal Report

THE crux of the preliminary report submitted by the President's coal commission will be found in the following sentences: "Already in our study we have come to see that underlying these immediate causes of scarcity and high prices—labor difficulties and transportation deficiency—are other causes; namely, the irregularity of demand and the overdevelopment of the mining industry. . . . While it might be expected that in an overdeveloped industry aggressive competition would have driven out mines with high producing costs and forced prices to the consumer down to a minimum, so many such complex factors have operated to prevent the free play of economic forces that a very detailed and comprehensive investigation is required before a valid conclusion can be reached." Only two remedies exist for such interference; first, a return to free competition; second, further interference. How slim is the chance that the commission will turn to the first of these may be inferred from this paragraph of its report:

> The commission believes that the public interest in coal raises fundamental questions of the relation of this industry to the nation and of the degree to which private right must yield to public welfare. It may be that both private property in an exhaustible resource and labor in a public service industry must submit to certain modificatious of their private rights, receiving in return certain guarantees and privileges not accorded to purely private business or persons in private employ.

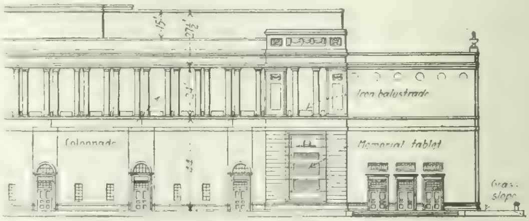
The issue here defined applies with equal force to every industry in which the normal interplay of economic interests has been found to menace the general welfare. The commission is exploring a fundamental subject and should its final conclusions support the doctrine implied in this suggestion they will carry widespread significance for the essential industries.

Illinois Stadium; a Double-Deck Steel-Frame Structure

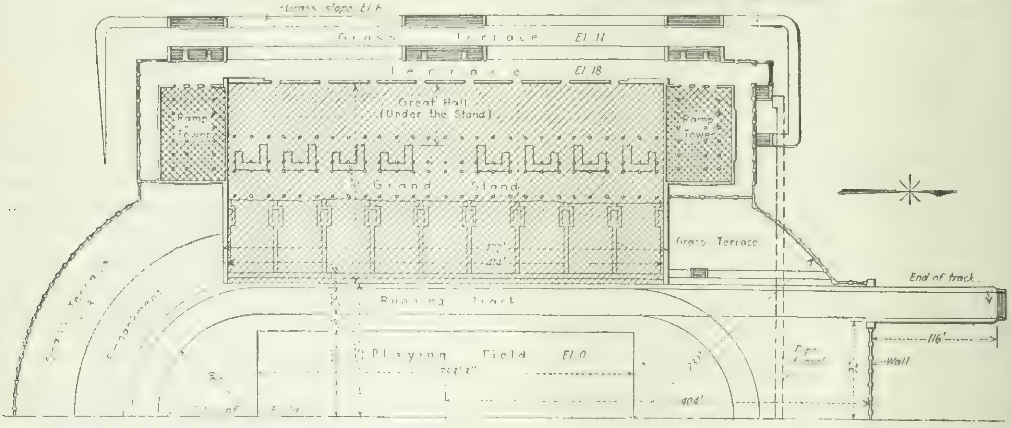
Steel and Concrete Double-Decked Side Stands Hold 60,000 Persons—Steel Trusses Carry Stands Over Large Halls for Indoor Athletics—Drainage of Arena

CONCENTRATION OF SPECTATORS in large but relatively short grandstands by means of a double-deck construction, which provides seating accommodations for 60,000 persons, is a special feature of the stadium now being built for the University of Illinois at Urbana, Ill. The reason for this design is that the main use of the stadium will be for football and it was considered that for this game side stands will afford a much better view than would be afforded by end stands supplementing the seating capacity of smaller side stands. Provision is made, however, for additional seating accomodations at the ends when required.

Since this stadium is to constitute a memorial to the students who took part in the World War it is to have more than usually elaborate architectural treatment. Colonnades surmounting the grandstands are to be a prominent feature as memorials, each of the 200 stone columns bearing the name of a man who gave his life in the war. The architectural design provides lofty walls inclosing the space beneath the grandstand and thus gives an opportunity to develop the interior for indoor athletic activities and other purposes. With this in view the structural design includes trusses which carry the decks of the grandstands and leave a wide space clear of columns.



Part Elevation of East Stand



Half Plan

FIG. 1—WAR MEMORIAL STADIUM FOR UNIVERSITY OF ILLINOIS

General Design—In plan there will be an arena 650 x 250 ft., having a football field 160 ft. wide flanked on each side by a 16-ft. safety zone for players and a 25-ft. running track, with 4-ft. clearance between the track and the grandstand, as shown in Fig. 1. These running tracks are to be connected by loops at the ends of the field, forming a quarter-mile track, but they will also be continued beyond the loop at the north end to form two straightaway tracks 220 yd. long. On each side will be a grandstand 414 ft. long and 193 ft. wide, having at each end a rectangular tower for ramps giving access to the balcony. The lower or main stand will be served by eight ramps leading from the great hall to the portals.

Steel framing was adopted for the main portion of the grandstand and for the balcony; it will not be encased in concrete but simply protected by paint, as there is no fire hazard. Reinforced concrete will be used for the decks, floors and ramps and for the framing of the front third of the grandstand. The general structural design and steel details are shown in Figs. 2 and 3. Red brick and stone trim will be used for the exterior walls, and the memorial columns will be of Bedford stone. Under each stand will be a main hall, 50 x 414 ft., a series of heavy trusses being provided in the steel framing to keep this clear of columns (see Fig. 3). These halls will be entered directly from the outside terraces. In the adjacent space provision is made for locker and toilet rooms and other facilities, while separate sets of training quarters for the visiting and home teams will be located in the lower part of two of the four corner towers.

At the top of each side structure will be the colonnade. The south end of the arena will be closed by a semicircular earth embankment, on which a masonry amphitheater may be built at some later time. A straight embankment closes the north end, except at the running track, and a tunnel 4½ ft. square under this end provides for pipe connections from the northwest tower, in which the heating plant is located,

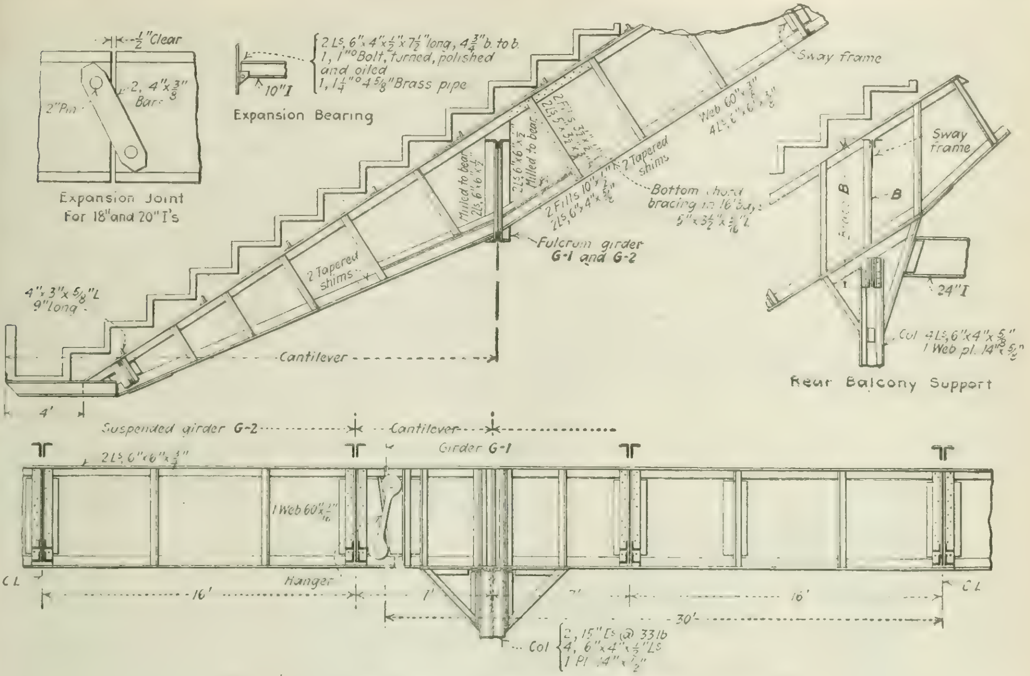


FIG. 2—STEEL DETAILS OF BALCONY

to the training quarters in the northeast tower.

For a required seating capacity of 60,000, a double-deck type of grandstand was adopted in order to limit the length to 414 ft., since football will be the principal sport and in order to provide the best view of this game is was considered desirable to mass the spectators in a space little longer than the 300-ft. playing field or gridiron. Thus the stands extend only 57 ft. beyond the goal lines. Temporary or permanent seats at the ends of the arena can be provided later to increase the capacity to 100,000. The lower deck of each grandstand has 70 rows of seats, with the top seat 62 ft. above the arena. In the balcony or upper deck there are 39 rows of seats, with front and rear rows at elevations of 58 ft. 7 in. and 110 ft. 9 in. respectively.

Expansion Joints—Careful study was given to the arrangement of expansion joints throughout the structure. There will be transverse joints 46 ft. apart, with no longitudinal joint in the balcony and two

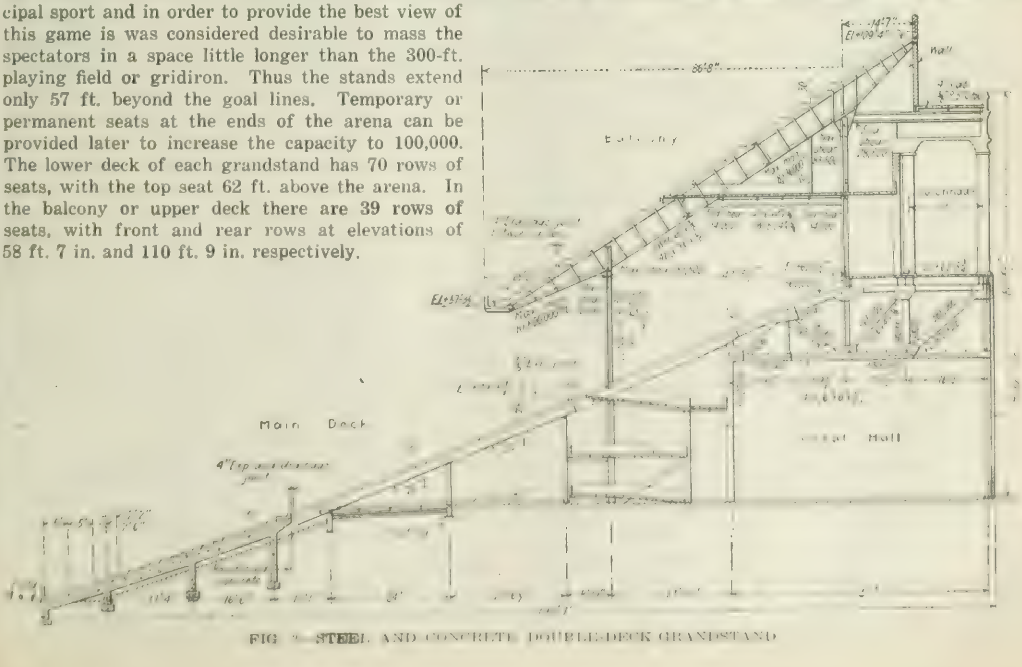


FIG. 3—STEEL AND CONCRETE DOUBLE-DECK GRANDSTAND

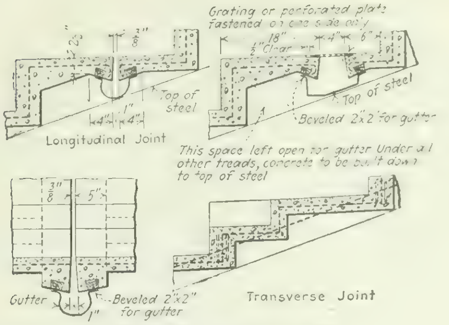

Grating or perforated plate fastened on one side only
3/8"
18"
1/2" Clear
4"
6"
Top of steel
Top of steel
1"
4"
4"
Beveled 2x2 for gutter
Longitudinal Joint
This space left open for gutter. Under all other treads, concrete to be built down to top of steel
3/8"
5"
Gutter
1"
Beveled 2"x2" for gutter
Transverse Joint

FIG. 4—EXPANSION JOINTS

joints in the lower deck. These joints, which are shown in Fig. 4, are carried through from the foundations to the top of the structure, so that the only resistance to expansion and contraction is that offered by the columns. Horizontal and vertical offsets had to be made at several points in order to carry the joints inconspicuously through portals, ramps and the exterior walls. No filler will be used in the joints. Sliding joints were necessary only in a few cases, and as they occur where the loads are small their details can be arranged to prevent cracking or spalling.

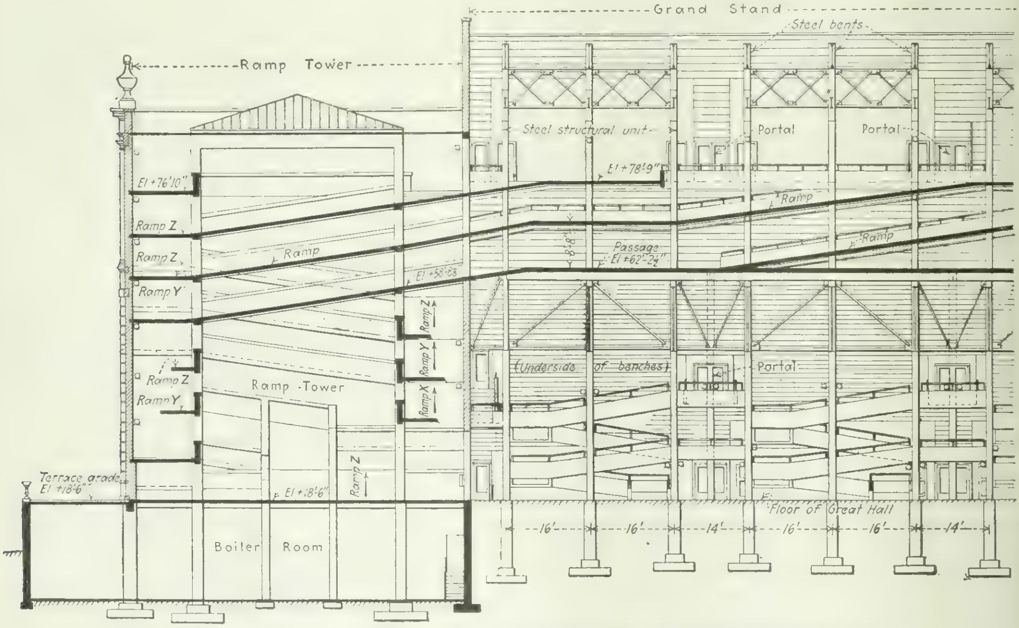


FIG. 6—RAMP ARRANGEMENT AND PART LONGITUDINAL SECTION OF GREAT HALL

Structural Design—In the lower deck the steel framing is arranged in independent units corresponding to the divisions made by the expansion joints. Each unit consists of three bents spaced 16 ft. c. to c. and connected by longitudinal diagonal bracing, as shown in Figs. 5 and 6. Adjacent units are spaced 14 ft. c. to c. of bents, with 7-ft. cantilever ends for the deck framing; thus giving a spacing of 46 ft. between transverse expansion joints. Steel trusses which span the main interior halls will support the rear row of balcony columns in the colonnade and a portion of the main deck (see Fig. 3).

For the balcony, there will be one front row of columns, passing through the main deck at the entrance tunnels and extending to separate footings, as indicated in Fig. 5. In alternate bays these columns carry 60-ft. girders with 7-ft. cantilever ends, these cantilevers carrying 32-ft. suspended girders in the other alternate bays. The deck has its expansion joints over the columns, as shown. Inclined girders or floor beams have a cantilever projection of 25 ft. beyond the longitudinal girders on the front columns and 14 ft. behind the rear columns (see Fig. 3). By this arrangement there is only one row of columns to obstruct the line of sight and the columns in the row are 46 ft. apart.

It will be noted by Fig. 3 that the upper end of the balcony rises some 15 ft. above the parapet over the colonnade along the main front of the building, the steel frame being masked by a high masonry wall placed about 14 ft. back from the main wall. This arrangement was used to provide great width for the grandstand without excessive height for the front wall of the building. A roof will be provided over the upper end of the balcony.

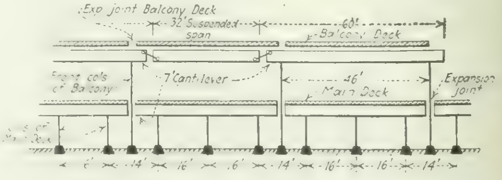


FIG. 5—LONGITUDINAL GRANDSTAND-FRAME JOINTING
Section of balcony is taken just behind balcony columns and section of main deck just in front of these columns.

In the deck construction the joists or risers are designed as continuous beams between the expansion joints, the panels being so proportioned as to give a practically uniform section from end to end. Throughout the design advantage was taken of the opportunity to use cantilever ends on the reinforced-concrete deck, on the longitudinal balcony girders and on the inclined transverse girders or floor beams of both decks.

Concrete Portion of Grandstand—In the lower part of the grandstand a reinforced-concrete construction is used, as shown in Figs. 3 and 7. Four lines of footings and columns carry girders on which the deck is formed, with a cantilever projection at the upper end where a longitudinal expansion joint separates the decks on the concrete and steel framing. In the first two benches, 5 ft. wide, the slab thickness is 3½ in., but in the 26-in. seat benches it is 2½ in. A drainage gutter in the bottom bench has a 4-in. outlet for each 46-ft. length of the stand. The excavation below grade has a slope of 3½ in. per foot and is practically parallel with the slope of the girders.

Benches and Ramps—The bench and seat construction is as shown in Fig. 8. For the benches a uniform tread or width of 26 in. is used, with a slope of ¾ in. for drainage. The thickness of concrete tread is 2½ in. Steel reinforcement consists of two rods in the top and bottom of each riser or joist and a sheet of welded wire fabric of 4 x 8-in. mesh extending through the risers and treads. The risers range in height from 8 to 11¼ in. in the main deck and from 15¾ to 17 in. in the balcony. Wood brackets anchored to the riser carry the seat, which consists of three lines of 3 x 2-in. sticks with chamfered edges, the seat projecting 4 in. in advance of the face of the riser.

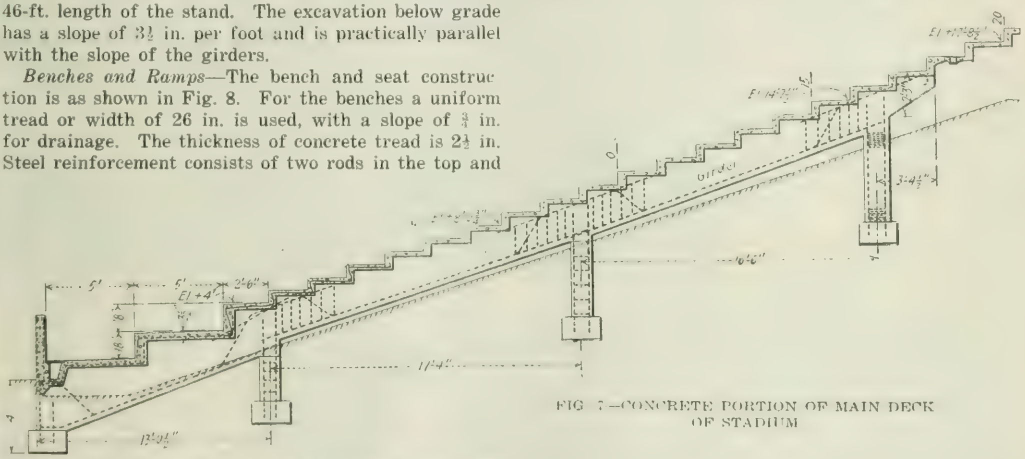


FIG. 7—CONCRETE PORTION OF MAIN DECK OF STADIUM

A complete system of ramps for access to all parts of the grandstand is a feature of the design. Its general arrangement is shown in Fig. 6. In each of the four ramp towers, 92 x 62 ft., there will be three superimposed rectangular ramps around an open well, level landings being provided at the corners. Longitudinal ramps from these towers lead into the main building and connect with runways and lateral ramps to the seat entrances of the balcóny. The lower row of portals in the main deck is served by practically level runways from the great halls of the side structures, while ramps from the level of these halls serve the upper rows of portals on this deck. The ramps and runways are of concrete, mainly 10 ft. wide, with grades of 10 to 14 per cent.

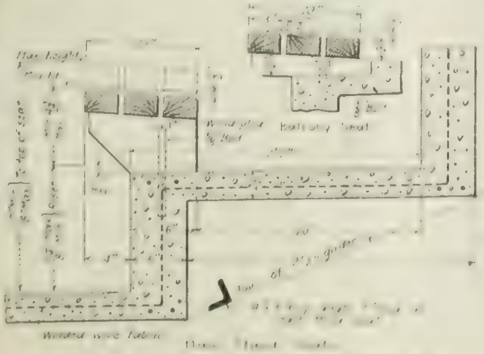


FIG. 8—BENCH AND SEAT CONSTRUCTION

Foundations and Drainage—A good foundation for spread footings is found on the clay subsoil at a depth of about 4 ft. The footings are proportioned for a dead load of 3,000 lb. per square foot and this may be increased to about 6,000 lb. by the maximum live load.

As the level of the field or arena is 10 ft. below average ground level and 18 ft. below the finished outside grade a thorough system of drainage is provided. Laterals of 4-in. tile laid with open joints are spaced 20 ft. c. to c. under the entire surface of the arena, including the running tracks. These laterals connect with 6-in. drains discharging into catchbasins which are spaced about 100 ft. apart along each side of the field and which serve also to carry off surface drainage. The catchbasins are connected to a 12-in. storm sewer from which a 2,000-ft. length of 24-in. sewer leads to the storm-water system of the city of Champaign.

The design for the University of Illinois stadium was made by Holabird & Roche, architects, Chicago, and the structural design was worked out under the direction of H. J. Burt, consulting engineer for the architects. The cost of the structure complete will be about $1,800,000. The contract for all the work except the steel work and the mechanical trades was let in September, 1922, to English Bros., Champaign, Ill. The contract for the fabrication and erection of the structural steel framing was let to the Fort Pitt Bridge Works, Pittsburgh, Pa., at approximately $180,000. There will be about 22,000 cu. yd. of concrete, 2,585 tons of steel and 4,800,000 brick. Work is now in progress and it is expected to have the structure ready for use by October, 1923.

Caution Plates on Motor Trucks Aid Load Control

By David C. Fenner
Manager, Public Works Department, International Motor Co

Extract from a paper presented at the joint session of the North Central Division of the National Highway Traffic Association and the Michigan State Good Roads Association

MANUFACTURERS have suggested that state motor vehicle commissioners should refuse a state motor vehicle license for any truck which is not equipped with a manufacturer's caution plate properly stamped with the actual weight of the chassis, body and load capacity. They are now proposing to go a step further and indicate on this plate the maximum gross load for the front axle, the maximum allowable gross load for the rear axle, the maximum allowable speed and the distance in which the vehicle loaded to capacity can be stopped with each set of brakes operated independently with the vehicle running at the above maximum speed on a hard, dry, level roadway.

The information on this caution plate will give the owner the data he needs for painting the weight and carrying capacity on the sides of the vehicle to comply with the local state law. It will also enable the local enforcement officer to check up the distribution of weight between the axles, the maximum speed, and the condition of the braking system. A similar plate for use on home made trucks can be issued by the state motor vehicle department. The information contained on this plate will prevent the operation of improper trucks and force the proper operation of good trucks. It will put the penalty for poorly adjusted brakes and steering connections directly on the operator where it belongs.

Investigations conducted in some states show that light- and medium-capacity vehicles are overloaded to a greater extent and in greater numbers than heavy-capacity vehicles. This indicates the importance of restricting loads per inch width of tire per wheel and per axle. We must recognize the four classes of tire, pneumatic, cushion, solid rubber, and metal, for regulating speed and determining license fees according to wheel load.

The motor vehicle industry stands solidly behind the rigid enforcement of the provisions of the Proposed Uniform Vehicle Law and the existing state laws. It condemns overloading and overspeeding unreservedly and will co-operate actively in every movement to regulate loads and speeds of motor trucks on the highway.

Garbage and Refuse Used for Land Filling at Ottawa

By George H. Wilson
Secretary Engineering Department, Ottawa, Ont.

OTTAWA, CANADA, like Seattle, some five years ago, discarded its incinerator. Since then it has disposed of its garbage on the low spots in the outlying portions of the city. Seattle refers to its system as the "sanitary fill." Ottawa uses the term "land making."

In 1909 the city erected an incinerator of the Heenan-Froude type. Within a year it was evident that one incinerator would not burn the refuse of a city of 83,000. The city decided to build a second incinerator, but the people living around every location suggested started a rebellion. Council chose the easiest way out. It began to dump in the low land immediately around its incinerator. Part of the refuse was burned, part dumped. In 1917 it became evident that dumping could not be carried on without offense. By the judicious use of ashes, earth and disinfectants of tar-derivative type all offensive odors have been kept down.

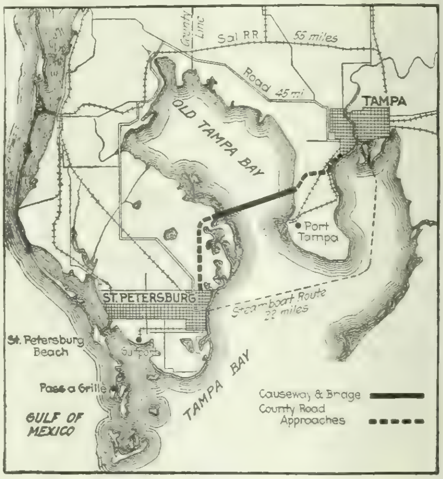
The engineering department, which is under A. F. Macallum, commissioner of works, began a definite policy of "dumping." The incinerator was shut down, and a number of low areas within a comparatively short haul were selected. Some of these spots belonged to the city; others were owned by land companies, who were glad to have gullies or low spots filled in. In one case a city street in the suburbs, which fronted on marshland, was brought to grade—a 4-ft. fill for a distance of over half a mile—entirely with refuse. To have raised this street to grade with stone or earth would have cost many thousands of dollars.

Today the "land making" policy is generally accepted by the citizens as being both wise and profitable.

Six-Mile Causeway To Cross Tampa Bay

BY BUILDING a causeway and bridge across Old Tampa Bay, the Bay Construction Co. of St. Petersburg, Fla., will provide a 19-mile route between St. Petersburg and Tampa (which lies on another branch of Tampa Bay) in place of a present highway route of 45 miles.

About 17,000 ft. of the 6-mile bay crossing will be sand-fill causeway across the shallow, protected waters of the bay, while 14,500 ft. will be reinforced-concrete bridge, including the 75-ft. bascule draw near the eastern end. The roadway over the crossing is planned to be 24 ft. wide, the pavement over the fill being 8 in. thick. A single line of track is to be laid down at the time of construction for future installation of trolley service, but the road is intended to serve automobile traffic essentially.



NEW ST. PETERSBURG-TAMPA ROUTE

Makes distance between the two cities 19 mi., saving 26 mi. over present road connection. Includes 3¼ mi. of causeway and 2¾ mi. reinforced-concrete bridge with draw.

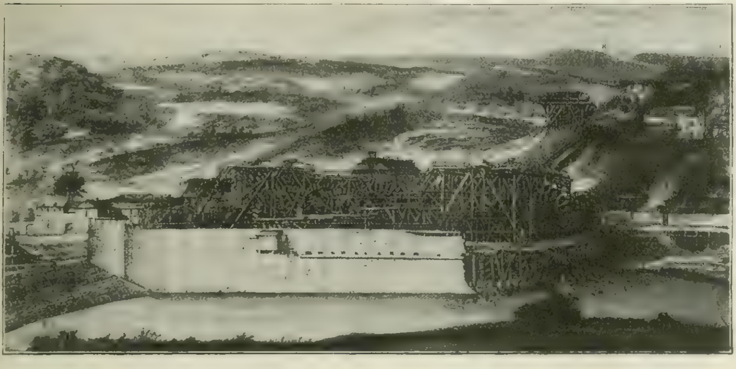
An interesting feature of the project is that it is proposed to light the crossing so effectively as to make it unnecessary for automobiles to use headlights at night.

The project was conceived by George S. Gandy, Sr., formerly of Philadelphia, and is named the Gandy Bridge after him. He secured a charter from the Florida Legislature, and organized the company which is to build it. W. G. Thompson, former state highway engineer of New Jersey, has been engaged as chief engineer of the company, and will be in charge of the designing and building of the bay crossing.

250-Year Old Marly Waterwheels for Versailles Fountains

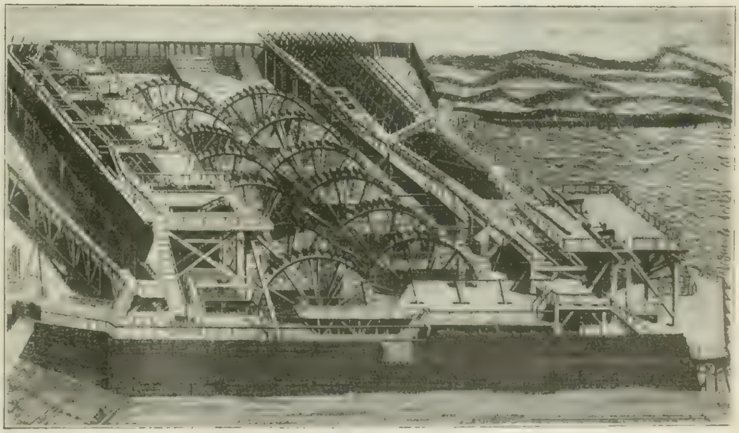
Water Pumped to Aqueduct 4,000 Ft. Away, 500 ft. Higher—Gravity Fall to Fountains—200 Pumps, 15 Mi. Cast-Iron Pipe

AT MARLY on the Seine near Paris between 1664 and 1685 Louis XIV had built by engineers whose names are now forgotten a most remarkable pumping plant to supply water for the fountains at Versailles. Kingly jealousy was the genesis of the idea of building the pumps. The king of Spain had famous fountains at one of his palaces which were supplied by gravity from a hillside reservoir. Louis XIV had no hill but he determined to outdo the fountains in Spain and set his engineers to the task.



MARLY WATERWHEELS ON THE SEINE

Water for the Versailles fountains was raised 500-ft. in three lifts and then delivered into an aqueduct at the point "T" in the upper right-hand of the view. Pump rods transmitted power up the hill to the two sub-stations. Historians remark on the terrible clanking of these rods.



WHEELS FOR THE WALKING BEAM PUMPS (LEFT) AND FOR THE PUMP RODS (RIGHT)

Undershot wheels driving about 200 pumps were 30-ft. in diameter and had paddles, against which the water impinged, 6-ft. wide. The rods carrying power to the substations are shown in the center background.

This installation, the forerunner of the larger size pumping equipment by means of water power, consisted of undershot waterwheels operating walking-beam pumps whose tops are shown at the left in the view. Water was pumped to the aqueduct shown at the top of one of the pictures, 4,000 ft. away and at a difference in level of 500 ft. This elevation was reached in three stages, the motive power for the upper stages being transmitted by rods. The multi-stage development was essential because pressures due to 500-ft. head could not be confined in the flanged cast-iron pipe of that day. From the aqueduct the water flowed by gravity to the fountain. Altogether about 200 pumps were used and 15 miles of pipe lines. The waterwheels were 30 ft. in diameter and had paddles 6 ft. wide.

The machine here shown was in use until the time of Napoleon I. About 1803 it was replaced by a steam engine designed by James Watt. The steam-driven pumps in turn were replaced by hydraulic machinery now in use.

The pipe founder has always been interested in the fact that the cast-iron flanged pipe used in this system is still in use and in good condition. It was cast in meter lengths and bolted.

Many English books on hydraulics refer to the Marly installation but few present illustrations. The colored woodcuts from which these halftones were reproduced by utilizing color screens were picked up in a curio shop in Besançon by Major Paul M. LaBach, engineer, water services, Chicago, Rock Island & Pacific R.R., and are probably at least 150 years old. In a visit to Versailles Major LaBach was fortunate enough to see repairs on one of the 250-year-old pipe lines to one of the fountains. The pipe which had been broken out appeared to be of gray cast iron in good condition.

Tests of Knees for Continuous Frame Concrete Bridges

Results Show Efficiency of Detail of Specially Designed Highway Bridges Used on Bronx Parkway Roads

By Arthur G. Hayden

Senior Assistant Engineer in Charge of Design, Bronx Parkway Commission, Bronxville, N. Y.

In CONNECTION with the development of the design for the continuous-frame reinforced-concrete highway bridge described in *Engineering News-Record*, Jan. 11, 1923, p. 73, for the Bronx Parkway Commission, several interesting tests were conducted in the engineering laboratory of Columbia University. In the first studies for Swain St. bridge, the first of the bridges of this type, the intrados was much flatter than in the accepted design, the required clearance over the driveway curbs being afterwards reduced in order to obtain a more graceful structure with greater rise from springing to crown. The original design necessitated a thin section across the knee on account of the grade of Swain St. and made these points the critical points of the design.

It is well understood that the stresses in a curved beam are different than in a straight beam. Applying the formula for curved beams to a right-angle bend subjected to bending, the computed stress at the root of the bend is infinite. This presumes Hooke's law to hold true, which in the nature of things cannot be the case and thus the curved-beam formula does not apply.

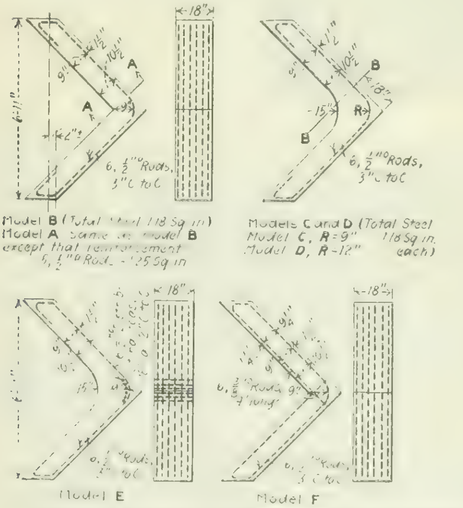

18"
A
A
B
B
R
9"
10½"
15"
6, ½" Rods, 3" c to c
6, ½" Rods, 3" c to c
Model B (Total steel 1.18 Sq in)
Model A same as model B except that reinforcement 6, ½" Rods - 1.25 Sq in
Models C and D (Total Steel 1.18 Sq in. each)
Model C, R=9"
Model D, R=12"
Model E
Model F

FIG. 1—DETAILS OF TYPES OF CONCRETE KNEES TESTED

Data of tests of reinforced-concrete knees were needed which would indicate the efficiency of such a detail in terms of the applied bending moment. The writer corresponded with several authorities, but could not find that tests had been made of this detail in its simplest form, but in structures where other effects were present. L. G. Holleran, deputy chief engineer of the Bronx Parkway Commission, recommended to Jay Downer, engineer and secretary, that tests be made. The recommendation was approved and an appropriation made.

The general result of the tests is interesting, in view of the fact that several authorities in reinforced-concrete design predicted failure at the knees at much lower loads than those actually sustained. The number of tests permitted were too few to be of great theoretical value—little more than a determination of the proper factor of safety to be used in proportioning the sections at the knees being hoped for. An attempt was made, however, to determine the effect of certain secondary elements of design, but for the most part only negative results were obtained, and further tests are needed.

Six models were made in all—three with square corners (A, B and F) and three with filleted corners (C, D and E). Some authorities predicted that the square cornered models would fail at very low loads across the knee on account of the peculiar conditions of stress that would develop around the bend. It was expected by some that the filleted models would also develop weakness at the knee; but this did not occur, so that the tests of the filleted models gave negative results. The reinforcing rods in five of the models had 9-in. bend radius around the bend and one had 12-in. bend radius; one model (E) had distributing rods on the inside of the bend. But in none of the models did the concrete crush under the steel at the bend, so that the value of the distributing rods as well as the effect of varying the bend radius of the main reinforcing rods is not apparent. One model (F) had compressive reinforcement in addition to the tensile reinforcement, but the value of this cannot be determined by comparing the results of the tests of model F with the other models of the same type, because of the great difference in the quality of concrete. Model F was cast without inspection (on election day morning) and the model itself, as well as the test cylinder belonging to it, showed an inferior grade of concrete. This explains the low ultimate load for model F as compared with model A. Though negative results were obtained as to the effect of such details, the general result of the tests is interesting.

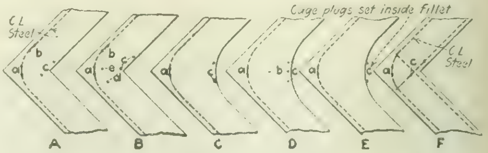


FIG. 2—LOCATION OF STRAIN GAGE PLUGS ON TEST PIECES

The models were cast in the field by the commission's forces, five being cast in succession without interruption. Model F was cast on a different day. One concrete test cylinder, 8 in. in diameter, 18 in. long, was cast with each model for the purpose of determining the properties of the concrete in the models. A small shovelful of concrete was used from each batch poured into the model. Each cylinder bore the same letter as the model to which it belonged.

Specimens of the steel used in the models were tested and showed a yield-point of about 45,000 lb. per sq.in. and ultimate strength of about 75,000 lb. per sq.in.

The load, applied to the ends of the arms of the models by the testing machine, was localized, as shown in the sketch of model B, by means of narrow shims. The models were white-washed so as to facilitate the detection of tension cracks and, as the load was increased, each model was scrutinized through a magnifying glass for the developments of cracks. As these appeared, they were traced with black crayon so as to appear in the photographs.

Strain-gage readings were taken on the tension steel at the middle of the bend in the knees and on the concrete on the inside of the bend and deflection readings between the extremities of the two arms. The location of the strain gage plugs is shown in Fig. 6.

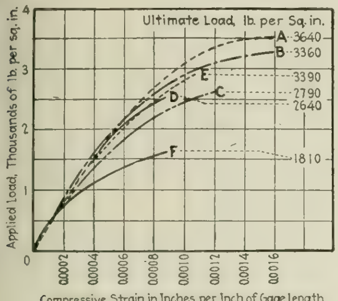


FIG. 3—ELASTIC CURVES FOR TEST CYLINDERS

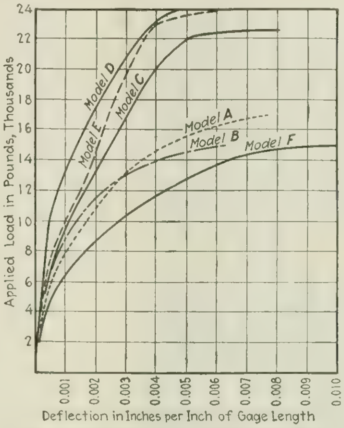


FIG. 4—DEFLECTION BETWEEN ENDS OF LEGS

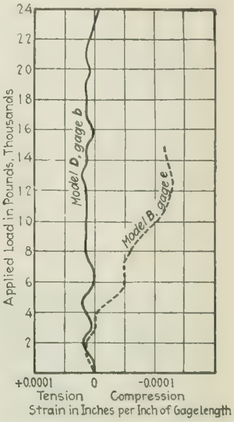


FIG. 7—DIAGONAL STRAINS IN CONCRETE AT KNEE

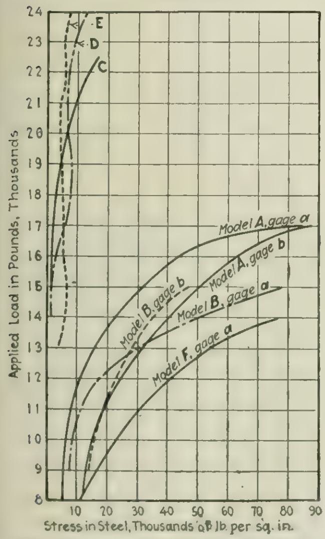


FIG. 5—STRESSES IN TENSION STEEL
Computed stresses above yield-point (45,000 lb. sq.in.) based on constant modulus of elasticity = 29,000,000.

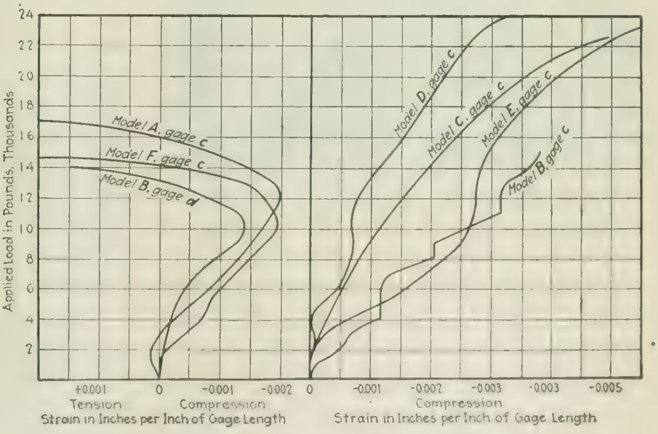


FIG. 6—LONGITUDINAL STRAINS IN CONCRETE AT BEND OF KNEE

It should be noted that in model B, the concrete strain curve for gage "d" has quite a different characteristic than the curve for gage "c"; and that it is, therefore, unfortunate that the "c" gage readings for models A and F combine the two effects which cannot be separated. The higher steel stress and lower ultimate load of model F as compared with model A of the same type is explained by the poor grade of concrete in this model as before mentioned. The higher steel stress (above 13,000 lb. load) and lower ultimate load of model B, as compared with model A of the same type, is explained by the fact that the reinforcing steel was inaccurately placed; the effective depth of the steel across the knee being less than 8 in. instead of 9 in. as called for on the plan. This model also developed tension cracks across the knee earlier than models A and F.

Examination of the tension cracks at the knees of models A, B and F indicates that the neutral axis at the root of the bend is very near the root—less than 2 in., and that the compression in the concrete at the root of the bend must be very high; but the concrete is confined by compressive forces in several directions and compressive failure within the root is prevented until the structure as a whole is destroyed. Fig. 5 shows that the stress in the steel at the middle of the bend of the filleted models (C, D and E) is very small.

The only pronounced compression failure was in model A and that at very high applied load. Critical stresses do not develop across the knee earlier than on a right section immediately in front of the knee, so

TABLE SHOWING COMPUTED STRESSES IN TEST KNEES

	A	B	F	C	D	E
Load at first tension-crack (lb.)	7,000		6,900	13,000	13,000	13,000
Load "b" (lb.)	16,000	14,000	12,000	20,000	23,000	23,000
Ultimate load (lb.)	19,300	16,000	15,900	23,300	25,600	25,800
Computed steel stress at load "b" (lb. per sq.in.)	48,700	45,800	41,400	40,000	45,600	45,600
Computed concrete stress at load "b" (lb. per sq.in.)	2,710	2,540	1,930	1,940	2,230	2,230

The transverse shear on the right section is in all cases equal to 960 lb. + 0.7 the applied load.

that such a detail may be designed for the bending moment on the right section as for an ordinary cantilever beam provided the same effective depth is maintained around the bend.

In the accompanying table the stresses for models A, B and F are computed on a right section at the knee as indicated by line A-A in the sketch for model B; and for models C, D and E on a right section near the knee as indicated by line B-B on the sketch for models C and D. The computed stresses take account of the direct compression as well as the bending moment, but the direct compressive stresses are small in comparison with the bending stresses. The ratio of modulus of elasticity in the steel to that in the concrete was computed each time from the elastic curve for the test cylinders as shown in Chart A, and varied from 8 to 10. The only exception was made in the case of model F. The surface of test cylinder F was defective, an area of 2 x 4 in. being unfilled for a depth of ½ in., and the results of the test were not considered to be reliable, so a ratio of moduli of 10 was assumed in computing the stresses in model F.

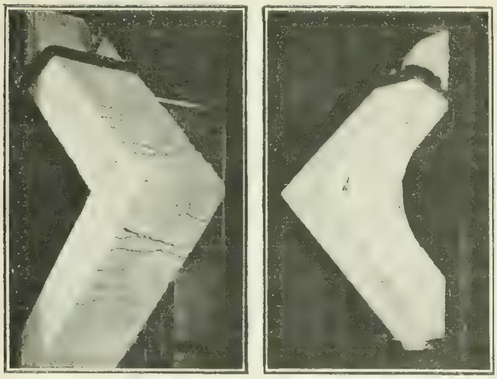


FIG. 8—TYPICAL KNEES AFTER TESTING
(At left) Knee A at 19,200 lb. load. (At right) Knee C at 20,000 lb.

Straight-line variation of stresses was assumed in computation, therefore the computed stresses are not the actual stresses, but do give an idea of the capacity of the knees.

The condition of the knees at the loads for which the stresses are computed is shown in the typical photographs.

The models, test cylinders and steel specimens were tested in the engineering laboratory of Columbia University under the direction of Professors A. H. Beyer, W. J. Krefeldt, G. E. Orthey and J. S. Peck of the laboratory staff, to whom should be given credit for the conduct of the tests.

Portland Water-Works Improvements Completed and Projected

New Headworks Bring Section 1 of Steel Conduits to Designed Capacity—Third Steel Pipe Line and Storage Projected

By W. P. Hardesty
Civil Engineer, Portland, Ore.

NATURAL growth of the city and environs calling for increased supply, practical experience showing limitations of formula for computing delivery of water through pipes, construction of new diversion headworks with some novel features and plans for increased supply have been among the recent developments connected with the water supply of Portland, Oregon.

The water supply of Portland has long stood in the first rank among all the cities of the world as regards purity and constancy of supply. The water is obtained from the Bull Run Reserve, set apart by the federal government 30 years ago. Monthly analyses of the supply show only 25 p.p.m. of dissolved solids, mostly magnesium and calcium salts. No bacteria have ever been found.

Portland's duplicate gravity supply mains, reaching from the diversion at Bull Run River to the reservoir system on Mt. Tabor (in East Portland), are each over 24 miles long. Controlling summits divide the conduits into three sections, each with its independent hydraulic grade line. The first section is 10 miles long and actual use has demonstrated that it is inferior in delivery capacity to the two following ones, nearer the city, though all had been carefully figured out to the same formula and coefficient. This inferior capacity appears to be due to the much greater number of short bends in the pipe, occasioned by the rougher topography of the first section. The same results appear in the original 42-in. riveted and in the second 52-in. lockbar steel pipe.

The above noted defect in Section No. 1 of the pipe line, coupled with need of other betterments at the headworks, have resulted in some radical changes, recently completed, which have increased the head and delivery of the first section of the two conduits. A third conduit is to be built. Studies for storage have been made.

New Diversion Headworks—The old diversion, in use since 1895, served well its purpose for many years. The diversion was effected without any dam by direct entry of water into a head-canal leading to the regulating house. But of recent years the *entire* low-water flow of the river has been required, and this is difficult without a dam. Much sand and gravel also washed in during flood stages, at which times the work of clearing the screens of trash was considerable.

The new headworks are located about 100 yd. above the old ones. They include a concrete dam, sluice and diversion gates; a canal and a screen-house. The dam is 170 ft. long and 30 ft. high, being a gravity type Ogee rollway, keyed-in to the bedrock.

On the south side of the dam is the intake, set back from the current and protected by a floating boom. Here a pair of 48 x 72-in. sluice gates permit draining water off to bottom of the dam. At the entrance of the diversion canal (leading off at right angles to the river and protected by rack screens) is a set of three 48 x 72-in. sluice-type diversion gates. These provide for drawing off the water at the desired levels between the surface and bottom, so that only *suspended* matter is carried.

The screenhouse is equipped with two sets of ½-in. mesh Link-Belt traveling screens, each 7 ft. wide and moving at a rate of 10 ft. per minute through a water depth of 20 ft. Cleansing is effected by a series of water jets, applied both at right and oblique angles under an 80-lb. gravity pressure supplied by a 4-in. pipe that taps a branch stream high above the main cañon.

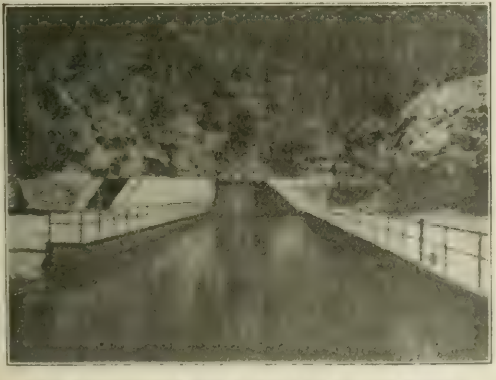
From the screenhouse, connecting pipes lead to the 42-in. and 52-in. mains supplying the city. Provision is made throughout the new works for attachment to a third main, to be constructed in the near future.

All these structures are built of concrete, using about 10,000 cu.yd. The dam and most of the other works are plain concrete, and the remainder are reinforced. No sand in deposits is available in the vicinity, so sand was shipped from Portland to the end of the electric railway and thence hauled over the difficult road to the work. Rock for crushing was obtained at and near the dam site.

The contractor for the works recently completed was the Hauser Construction Co., of Portland. The total cost to the city was about $270,000.

By the new diversion an initial head of about 30 ft. is added for Section No. 1 of the pipe line, before mentioned, thus making its capacity equal to that of the remaining sections, besides which a better utilization and control of the water has been provided.

Storage Development—Bull Run River has its source in Bull Run Lake, on the west slope of the Cascade Range, twenty miles above the headworks just described. The entire drainage area of the river is rugged and picturesque—all but inaccessible save for one or two trails. The mean annual precipitation ranges from 90 in. at the headworks to 150 in. at the lake. The low-water flow at a point slightly above the headworks, from records kept since 1895, ranges from 70 to 100 sec.-ft., while there is a recorded maximum of over 20,000 sec.-ft. The first pipe line had a capacity of about 22.5 and the second one of about 43 m.g.d. These easily carry the natural low-water supply.



NEW HEADWORKS FOR PORTLAND WATER SUPPLY
Looking up canal toward diversion gates. Sluice gates at left. Overfall of dam not yet built but one wing wall has been completed

Increased population has rendered storage necessary. The most readily utilizable means is the lake itself. Bull Run Lake has an area of about 500 acres and a drainage area of about 4 sq mi. At the outlet end the water disappears in the rocks and does not reappear until one mile down the cañon.

A beginning in storage has been made in the past year by using types of construction naturally adapted to local conditions, as all outside materials, appliances and supplies have to be brought in over an 11-mi. pack trail. By the expenditure of $40,000 a material addition to the summer supply of Portland has been made.

WATER-WORKS DIVERSION DAM ON BULL RUN
Concrete overfall and wing walls. Sluice gates at right

The Bull Run gathering ground, 102 sq.mi. in area, is the only undefiled source at present controlled by the City of Portland. The average annual runoff is about 750 sec.-ft., sufficient for a city of several million people if all utilized. With an eye to the future, many preliminary surveys and computations have already been made looking to the increasing utilization of this supply. Besides the lake there are other less natural sites along the river itself, besides some side cañons leading out from flatter basins above. Natural dam sites abound because of the frequent narrow rock cañons, but with many the natural storage available is limited. Altogether thirteen different additional storage projects of from 2,000 to 19,000 acre-ft. have been considered. The complete storage cost is estimated at $15,000,000.

Additional Supply Main—The two pipe lines already mentioned have a delivery capacity of 65,500 m.g.d. To provide for the immediate growth of the city, plans have been prepared for a third main. The two existing mains occupy about all the available ground along their route, including bridge room. An additional reason for a separate location is the desirability of so segregating the supply lines that possible breaks or stoppages from whatever cause, including slides and washouts, collapse or burning of bridges, should not throw all the lines out of commission. The new main will consequently have an entirely separate location.

The size of pipe will be 60 in. if of riveted steel, and probably only 58 in. if the lockbar type be chosen, and the capacity will be 60 m.g.d. The estimated cost is $2,000,000. It is planned to award contracts for the new line in the spring of 1923, with two years for completion. The sum of $1,000,000 has been set aside for a start, and also $2,500,000 for extensions and betterments in the city itself.

For data from which this article has been prepared the writer is indebted to F. M. Randlett, chief engineer of the Water Bureau of Portland

Hydrologic Record of the Mississippi Floods from 1882 to 1922

Official Statement of Gage Heights From Cairo to the Gulf in All the High Waters of the Past 40 Years —Record of the Present Status of Levee Construction

By Edward N. Chisolm
Captain, Corps of Engineers, U. S. A.; Secretary, Mississippi River Commission, St. Louis, Mo.

The 1922 flood on the Mississippi River began in February and had its origin from a moderate rise in the Ohio River. On Feb. 16 at Cairo, Ill., beginning with a stage of 18.3 ft. on the Cairo gage, there was a continuous rise until March 25, when a stage of 53.6 ft. was reached, when the river receded to 49.9 ft. on April 9 and 10. The second rise began on April 9 and continued until April 25, when a stage of 53.5 ft. was recorded, which was 0.1 ft. lower than the crest of March 25.

In addition to the flood water entering the Mississippi from the Ohio on March 1, a disturbance developed over the lower river valley and rains of more or less intensity resulted, together with 6 to 7 in. of snow in northern Arkansas and Missouri. This resulted in a rise of the lower tributaries of the river about the time the waters of the Ohio were reaching this portion of the river. During the first week of April all tributaries north of the Missouri reached flood stages. At Muscatine, Iowa, the crest was reached on April 24; gage read 17 ft.; discharge observations showed 288,572 sec.-ft. This condition, along with several other disturbances, had a tendency to prolong the flood.

From observations made during the flood it was noted that the time interval between the two crests was 30 days at Cairo, Ill., 30 days at Mhoon Landing, Miss., a distance by river of 273 miles; 27 days at Sunflower Landing, Miss., a distance of 81 miles; and only 11 days at Arkansas City, a distance of 83 miles.

High water in the Arkansas River culminated at Little Rock, Ark., on April 16, and in White River at Clarendon, on April 19 and 20, caused the Mississippi to rise slowly at Arkansas City until April 22, seventeen days after the crest of the first rise in the Mississippi had passed Sunflower Landing.

The crests of the two rises did not differ by more

TABLE I. GAGE READINGS ON MISSISSIPPI TRIBUTARIES, 1882-1922

(Date of crest at Cairo is given and readings at other stations correspond to these dates, allowing proper time interval for travel to Cairo. Max. of rise given in parentheses)

Year	Date at Cairo	Cairo Gage Reading	St. Louis Gage Reading (3 Days Earlier	Ohio River, Paducah, Gage Reading (1 Day Earlier)	Ohio River, Evansville, Gage Reading (3 Days Earlier)	Ohio River, Cincinnati, Gage Reading (5 Days Earlier)	Ohio River, Pittsburgh, Gage Reading (9 Days Earlier)	Tennessee River Florence, Gage Reading, (3 Days Earlier)	Cumberland River, Nashville, Gage Reading (3 Days Earlier)	Wabash River Mount Carmel Gage Reading (3 Days Earlier
		Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.
1882	Feb. 26	51.87	27.10 (July 5, **32.39**)	49.78 (Feb. 26, **49.95**)	44.60 (Feb. 24, **44.90**)	58.58 (Feb. 21, **58.58**)	10.90 (Jan. 28, **21.50**)	13.60 (Jan. 22, **29.60**)	35.60 (Jan. 22, **55 30**)	No record
1883	Feb. 27	52.17	25.50 (June 26, **34.80**)	50.60 (Feb. 25, **50.70**)	46.20 (Feb. 19, **47.80**)	54.00 (Feb. 15, **66.33**)	19.80 (Feb. 8, **26.80**)	7.80 (Jan. 28, **23.30**)	16.70 (Feb. 14, **41.60**)	No record
1884	Feb. 22-24	51.79	14.70 (Apr. 9, 10, **28.10**)	53.95 (Feb. 23, **54.25**)	48.80 (Feb. 19, **48.80**)	65.50 (Feb. 14, **71.06**)	17.80 (Feb. 6, **31.90**)	22.00 (Mar. 14, **25.20**)	42.40 (Mar. 15, **48. 30**)	No record
1886	Apr. 19	51.02	20.80 (May. 13, **27.00**)	50.00 (Apr. 17. **50.40**)	42.90 (Apr. 14, **43.40**)	49.00 (Apr. 9, **55.75**)	14.10 (Apr. 7, **22.20**	18.70 (Apr. 8, **28.10**)	29.20 (Apr. 10, **49.30**)	14.10 (May 22, **19.80**
1893	May 9	49.33	29.30 (May 3, **31.60**)	42.30 (Feb. 27, **44.30**)	40.20 (Feb. 24, **41.80**)	47.80 (Feb. 21, **54.58**)	8.90 (Feb. 8, **23.10**)	14.80 (Feb. 17, **21.40**)	16.80 (Feb. 22, **40.80**)	24.20 (May 8, **24.50**
1897	Mar. 25, 26	51.72	18.80 (May 2, **30.95**)	50.90 (Mar. 24, 25, **50.90**)	39.90 (Mar. 2, 3, **43.60**)	40.30 (Feb. 26, **61.10**)	9.40 (Feb. 24, **28.90**)	27.50 (Mar. 19, **32.20**)	47.20 (Mar. 20, **49. 25**)	21.10 (Mar. 13, **26.40**
1898	Apr. 6	49.78	20.20 (May 25, **27.20**	47.10 (Apr. 6, **47.30**	44.80 (Apr. 2, **44.80**)	55.40 (Mar. 28, **61.10**)	11.40 (Mar. 24, **28.50**)	10.90 (Jan. 20, **13.80**)	19.80 (Jan. 23, **38.80**)	25.60 (Mar. 30, **27.00**
1903	Mar. 16, 17	50.57	24.50 (June 10, **38.00**)	47.60 (Mar. 15, **47.60**)	42.00 (Mar. 11, **42.40**)	49.20 (Mar. 5, **53.20**)	9.50 (Mar. 1, **28.90**)	16.80 (Mar. 6, **18.82**)	37.40 (Mar. 9, **40.60**)	22.20 (Mar. 12, **22.30**
1907	Jan. 27	50.33	26.10 (July 25, **28.00**)	45.00 (Jan. 28, **45.70**)	46.20 (Jan. 24, **46.20**)	64.50 (Jan. 21, **65.10**)	20.10 (Mar. 15. **35.50**)	4.90 (Mar. 5, **14.50**)	28.20 (Mar. 3, **38.90**)	23.50 (Jan. 28, **24.50**
1912	Apr. 6, 7	53.95	29.85 (Apr. 5, **30.80**)	49.40 (Apr. 8, **49.90**)	42.10 (Mar. 31, **42.60**)	46.80 (Mar. 27, **53.20**)	9.40 (Mar. 22, **28.10**)	19.58 (Apr. 3, **19.58**)	45.30 (Apr. 8, **46.60**)	22.40 (Apr. 7, **23.20**
1913 (First rise)	Jan. 28	48.89	9.70 (Jan. 25, **9.70**)	47.50 (Jan. 25, **47.60**)	44.70 (Jan. 20, **46.70**)	45.50 (Jan. 15, **62.20**)	14.70 (Jan. 9, **31.30**)	12.70 (Jan. 28, **17.00**)	33.50 (Jan. 14, **48.40**)	22.90 (Jan. 30, **24.30**
1913 (Second rise)	Apr. 7	54.69	21.60 (Apr. 16, 17, **27.20**)	54.10 (Apr. 7, **54.30**)	48.20 (Apr. 5, **48.30**)	69.50 (Apr. 1, **69.80**)	7.90 (Mar. 28, **30.40**)	Feb. 1. 17.60 (Mar. 21, **18.47**)	44.00 (Apr. 2, **44.90**)	26.40 (Mar. 30, **31.00**
1916	Feb. 4,	53.21	31.40 (Jan. 31, **31.40**)	43.8 (Jan. 18, **45.7**)	38.7 (Jan. 18, **43.6**)	35.3 (Apr. 1, **53.5**)	8.5 (Mar. 29, **21.8**)	9.0 (July 12, **20.46**)	20.4 (Jan. 5, **42.40**)	22.4 (Feb. 6, **26.5**
1920	Mar. 31	51.40	24.7 (Apr. 24, May 22, **28.0**)	44.5 (Mar. 28, **45.3**	41.3 (Mar. 25, **42.8**)	43.5 (Mar. 22, **54.6**)	12.6 (Mar. 14, **24.5**)	11.2 (Apr. 10, **23.5**)	14.7 (Jan. 30, **44.10**)	16.7 (Apr. 28, **23.6**
1922	Mar. 26	53.60	21.5 (Apr. 19, **33.95**)	48.8 (Mar. 24, **48.8**)	42.5 (Mar. 21, **42.9**)	47.2 (Mar. 18, **52.1**)	15.0 (Mar. 16, **18.3**)	12.8 (Mar. 11, **21.0**)	27.80 (Mar. 16, **45.1**)	24.1 (Apr. 23, **26.0**
	1913	**54 69**	**1884 41.39**	**1913 54.3**	**1884 48.8**	**1884 71.06**	**1907 35.5**	**1897 32.20**	**1882 55.30**	**1913 31.0**

A—Maximum gage readings prior to 1922.

TABLE II—CONDITION OF MISSISSIPPI LEVEE SYSTEM, 1922

Levee District	In System Miles	Built Miles	Contents 1921 Cu. Yd.	Built Since by United States Cu. Yd.	Built Since by Local Authorities Cu. Yd.	Total Built Since 1921 Cu. Yd.	Lost or Abandoned During the Year Cu. Yd.	Contents, 1922 Cu. Yd.	Required to Complete Cu. Yd.	Estimated Final Contents Cu. Yd.	Per Cent Now Built	Approximate Area Protected Sq. Mi.
Rock Island to New Boston, Ill.	25	25	1,956,884	283,968		283,968		2,240,852	1,029,500	3,270,352	68.5	44
Muscatine to mouth of Iowa River, Iowa	20	20	1,238,143	174,026	327,190	501,216	..	1,739,359	227,000	1,966,359	88.5	34
Mouth of Iowa River to Burlington, Iowa	28	28	1,330,500	.	....	....	23,786	1,306,714	873,786	2,180,500	59.9	70
Mouth of Des Moines River to LaGrange, Mo.	5	5	285,655		.....		7,000	278,655	7,000	285,655	97.6	12
Warsaw to Quincy, Ill.	17	17	1,553,063	199,377	......	199,377	...	1,752,440	33,000	1,785,440	98.2	46
Quincy to Hamburg Bay, Ill.	53	53	4,875,549	813,265	....	813,265	.....	5,688,814	2,275,000	7,963,814	71.4	172
LaGrange to mouth of Missouri River, Mo.	23	20	1,298,763	168,445	....	168,445	....	1,467,208	451,000	1,918,208	76.5	45
Head of Chouteau Island to Prairie du Pont, Ill.	21	21	2,632,235		....	......	....	2,632,235	....	2,632,235	100.0	96
Prairie du Pont to Grand Tower, Ill.	16	16	445,153	44,587	....	44,587	35,000	454,740	35,000	489,740	92.9	45
Grand Tower to Gale, Ill.	22	22	1,386,866	120,419	..	120,419	85,000	1,422,285	26,500	1,448,785	98.2	45
Upper St. Francis	87	78.30	9,347,947	1,418,826	12,079	1,430,905	...	10,778,852	3,515,987	14,294,839	75.4	700
Lower St. Francis	218	218	50,829,199	2,768,717	63,324	2,832,041		53,661,240	10,214,760	63,876,000	84.0	3,500
White River	74	74	18,043,663	1,007,716	23,927	1,031,643		19,075,306	9,435,694	28,511,000	66.9	910
Reelfoot	21	21	3,033,665	209,688	.	209,688		3,243,353	784,647	4,028,000	80.5	310
Upper Yazoo	97	97	41,436,756		941,200	941,200		42,377,956		42,377,956	100.0	3,281
Lower Yazoo	206.30	185.20	60,046,984	3,431,197		3,431,197	114,000	63,364,181	23,680,596	87,044,777	72.8	3,367
Upper Tensas	241	241	62,287,961	3,082,511	1,172,304	4,254,815	779,194	65,763,582	22,183,322	87,946,904	74.8	3,000
Lower Tensas	158.81	151.66	34,276,288	1,997,822	48,400	2,046,222	725,654	35,596,856	9,400,686	44,997,542	79.1	2,080
Atchafalaya	127.51	127.51	30,221,690	2,315,944	392,097	2,708,041	538,459	32,391,272	6,618,316	39,009,588	83.0	6,035
Lafourche	82.06	82.06	15,960,262	539,985	201,870	741,855	252,823	16,449,294	689,024	17,138,318	96.0	2,020
Barataria	71.98	71.98	5,421,211	160,998	11,087	172,085	129,183	5,464,113	641,750	6,105,863	89.5	
Pontchartrain	125.87	125.87	26,402,894	1,225,151	135,580	1,360,731	573,467	27,190,158	4,971,454	32,161,612	84.5	1,816
Lake Borgne	78.42	78.42	6,122,443	89,957	3,222	93,179	133,681	6,081,941	812,607	6,894,548	88.2	
Total	1,818.95	1,779	380,433,774	20,052,599	3,332,280	23,384,879	3,397,247	400,421,406	97,906,629	498,328,035	80.4	27,628

TABLE IV—MAXIMUM DISCHARGE OF GREAT MISSISSIPPI FLOODS

Location	1912 Sec.-Ft.	1913 Sec.-Ft.	1916 Sec.-Ft.	1920 Sec.-Ft.	1922 Sec.-Ft.
Mississippi River at Helena	2,041,000	1,932,000	1,706,000	1,598,000	1,612,000
Arkansas River at Little Rock	235,000	90,000	458,000	55,000	280,000
White River at Clarendon	151,000	138,000	320,000	125,000	149,000
Total above mouth of Arkansas River	2,427,000	2,160,000	2,484,000	1,778,000	2,041,000
Mississippi River at Arkansas City	2,007,000	1,782,000	1,889,000	1,513,000	1,768,000
Between Arkansas City and Trippe	(1)	138,000	336,000	5,000	(2)
Total passing latitude of Arkansas City	....	1,920,000	2,225,000	1,518,000	1,768,000
Decrease due to reservoir effect	....	240,000	259,000	260,000	273,000

[1] Not measured.
[2] Closed

than 0.2 ft. at any of the regular gages from Cairo to Mhoon Landing. The stages at Helena and Sunflower Landing were respectively 0.7 and 0.6 ft. higher at the second crest than at the first, and the stages from the Mouth of White River to Vicksburg were from 0.2 to 0.3 ft. higher at the first crest than at the second. Below Vicksburg the crests were materially affected by crevasses and by the return flow of the water which had escaped through the break in the Weecama levee.

Table I shows the stages of the main tributaries above Cairo just preceding the maximum stages at Cairo for the great floods beginning with that of 1882. In this table the date of crest at Cairo is given and the readings at other stations corresponded to these Cairo dates allowing the proper time interval for travel to Cairo; the interval in days for each station is given

TABLE V—MAXIMUM STAGES IN MISSISSIPPI REFERRED TO GULF LEVEL

	1912 Ft.	1913 Ft.	1916 Ft.	1920 Ft.	1922 Ft.
Maximum stage, feet above mean Gulf level:					
White River	165.21	164.21	165.36	161.96	165.66
Arkansas City	152.08	151.90	153.15	150.75	154.85
Difference	13.13	12.31	12.21	11.21	10.81
Slope per mile	0.292	0.274	0.271	0.249	0.240

TABLE III—PROVISIONAL MISSISSIPPI LEVEE GRADES ADOPTED IN 1914

Name of Gage Station	Miles Below Cairo	High Water of 1922 Date	High Water of 1922 Gauge Reading Feet	Previous Highest Water Height Feet	Previous Highest Water Year	High Water of 1922 Compared With Previous Highest Feet	Provisional Levee Grade Feet	High Water of 1922 Referred to Provisional Levee Grade Feet
Cairo, Ill.	0.0	Mar. 26	53.6	54.69	1913	—1.09	58.0	—4.4
Columbus, Ky.	21.6	Apr. 26	49.0	49.30	1913	—.30	52.7	—3.7
New Madrid, Mo.	71.0	Apr. 26	41.7	44.61	1913	—2.91	47.6	—5.9
Cottonwood Point, Mo.	124.[illegible]	Mar. 28-30	38.5	42.30	1913	—3.80	46.0	—7.5
Fulton, Tenn.	175.4	Apr. 29	39.2	44.07	1913	—4.87	47.0	—7.8
Memphis, Tenn.	227.0	Apr. 1, 2	42.5	46.55	1913	—4.05	51.5	—9.0
Mhoon Landing, Miss.	273.2	May 1, 2	45.1	45.28	1913	—.18	50.0	—4.9
Helena, Ark.	307.1	May 3	53.2	55.20	1913	—2.00	58.5	—5.3
Sunflower Landing, Miss.	353.7	May 2	51.0	51.60	1916	—.60	56.0	—5.0
Mouth of White River, Ark.	391.7	Apr. 21-24	56.8	56.50	1916	+.30	61.9	—5.1
Arkansas City, Ark.	436.7	Apr. 22, 27	58.1	56.40	1916	+1.70	60.5	—2.4
Greenville, Miss.	480.2	Apr. 27	52.0	50.76	1912	+1.24	55.8	—3.8
Lake Providence, La.	54[illegible].0	Apr. 27	49.6	48.80	1916	+.80	53.7	—4.1
Vicksburg, Miss.	601.8	Apr. 2[illegible]	54.8	53.85	1916	+.95	58.0	—3.2
St. Joseph, La.	662.4	Apr. 26	52.2	50.80	1916	+1.40	54.0	—1.8
Natchez, Miss.	705.7	Apr. 26	55.3	53.50	1916	+1.80	57.[illegible]	—2.7
Red River Landing, La.	772.6	May 15, 16	55.3	53.20	1912	+2.10	57.5	—2.2
Bayou Sara, La.	806.9	May 16	49.4	47.37	1912	+2.03	51.5	—2.1
Baton Rouge, La.	841.0	May 16	45.7	43.82	1912	+1.88	48.1	—2.4
Plaquemine, La.	861.0	May 16	41.1	39.38	1912	+1.72	43.7	—2.6
Donaldsonville, La.	892.8	May 16	36.0	35.10	1912	+.90	39.0	—3.0
College Point, La.	911.3	Apr. 27, 28	30.9	30.18	1912	+.72	34.4	—3.5
Carrollton, La.	[illegible]	Apr. 2[illegible]	21.3	21.05	1912	+.2[illegible]	2[illegible].2	—3.[illegible]
Fort Jackson, La.	1,046.8	Apr. 26	9.6	8.80	1916	+.80	11.0	—1.4

TABLE VI—DURATION OF FLOODS ABOVE BANKFULL STAGE

	Gage at bank-full stage. Ft.	1882 Days	1897 Days	1903 Days	1907 Days	1912 Days	1913 Days	1916 Days	1920 Days	1922 Days
Cairo	44	63	51	21	28	48	49	66	67	62
Columbus	43	13	35	14	10	38	42	36	38	51
New Madrid	40	(1)	7	0	0	23	20	10	1	35
Cottonwood	36	53	36	19	14	39	38	36	24	48
Fulton	34	63	48	20	14	44	44	40	30	51
Memphis	34	54	51	33	29	58	59	56	50	57
Mhoon	35	47	79	51	51	66	64	70	70	66
Helena	41	85	63	77	54	63	62	65	64	62
Sunflower	36	(1)	73	84	93	86	73	97	85	72
White River	44	82	68	79	82	84	70	93	75	69
Arkansas City	44	54	54	75	75	78	65	85	73	66
Greenville	39	96	51	72	69	66	60	68	68	62
Lake Providence	37	39	60	75	88	79	71	90	73	66
Vicksburg	42	99	67	80	82	70	78	96	90	73
St. Joseph	40	97	61	72	64	70	70	85	78	69
Natchez	46	28	63	52	23	63	56	57	69	64
Red River	43	81	69	73	51	76	74	84	80	76
Baton Rouge	37	0	48	44	8	62	39	50	67	66
Donaldsonville	24	(1)	81	88	123	91	96	113	109	90
Carrollton	11	210	102	146	199	132	131	176	153	104

(1)No record

in the heading. The day and maximum reading for each rise are given in parentheses. On the bottom line of the table, the highest known water prior to 1922 is given.

Table II shows the present condition of the levee system along the river from Rock Island, Ill., to Head of the Passes, La.; also levee operations during the past year. Under column "Estimated final contents," these estimates are based on grades and sections provisionally established by the Mississippi River Commission in April, 1914; 720.6 miles of levee have been completed to full commission grade and section.

The provisional levee grades adopted by the commission in 1914 were based upon the estimated stages for the 1912 flood confined. Table III is a tabulated statement of the maximum stages during the 1922 flood and a comparison with the previous highest records at all gage stations from Cairo to Carrollton; also a comparison of the highest stages of the 1922 flood with the 1914 provisional levee grades.

The 1922 flood stages were well below the previous highest at all gage stations above White River, but from White River to Carrollton they exceeded all previous records.

TABLE VII—DURATION OF FLOODS ABOVE A 50-FT. STAGE

Year	Cairo, Days	Helena, Days	Sunflower, Days	White River, Days	Arkansas City, Days	Greenville, Days	Vicksburg, Days	St. Joseph, Days	Natchez, Days	Red River Landing, Days
1882	9									
1883	14									
1884	13									
1886	8									
1890				11						
1892					1					
1893					6					
1897	19	9		30	14		37			9
1898				12	12					
1903	8	10		29	25		22		13	9
1906					1					
1907	4	5		15	16					
1909					4					
1912	22	29	11	53	49	4	10		31	47
1913	19	24	16	38	30	7	24		22	20
1916	12	19	12	43	43	11	35	10	37	35
1917				19	21					
1920	7	4		46	48		39		45	23
1922	53	45	31	55	56	36	52	33	51	53

The increased height of the flood line below the Mouth of White River can be attributed only to the closure of the gap between the Arkansas River levees and the Mississippi River levees at Cypress Creek.

Table IV shows maximum discharge for each of the great floods since 1912 in the Mississippi River at Helena, and Arkansas City, also the corresponding discharges for the Arkansas River at Little Rock and White River at Clarendon, allowing six days for flow from Little Rock, and two days for flow from Clarendon to Arkansas City. The discharges tabulated for Little Rock and Clarendon for the years 1912, 1913, and 1922 were scaled from discharge curves for those stations. Table IV also shows that the amount of water per second entering the basin at and above the mouth of the Arkansas River was less at the crest of the 1922 flood than at the crests of the 1912, 1913, and 1916 floods. The effect of the Arkansas and White Rivers on flood heights in the Mississippi is further illustrated by Table V, which gives the maximum stages in the Mississippi River referred to mean Gulf level, at White River, and Arkansas City; also to the total fall and the slope per mile between the two gages for all the floods included in Table IV. Table V also shows that the slope per mile was 18.4 per cent less in the flood of 1922, than it was in that of 1912. Table VI gives the gage reading corresponding to a bankfull stage at the regular gages from Cairo to Carrollton (omitting Bayou Sara and College Point), also the number of days during which the principal floods since 1882 remained above the bankfull stage at each of the gages tabulated. Incidentally this table shows that the lengths of periods of overflow have not, as a rule, been increased by levee building.

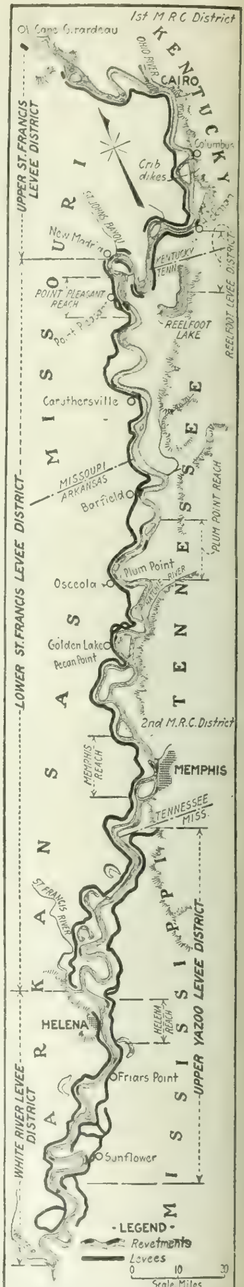


FIG. 1. FIRST AND SECOND MISSISSIPPI RIVER DISTRICTS SHOWING EXISTING LEVEES

Table VII gives the number of days during which the stage exceeded 50 ft. at the regular gages below Cairo for all the floods covered by the commission's records.

This table also shows that the duration of the stages above 50 ft. in the 1922 flood was greater than for any previous flood.

During the high water of 1922 the maximum stages at the mouth of White River, Ark., and at all gages below that point exceeded the previous highest known stages. At Red River Landing, La., the highest stage was 2.1 ft. higher than the previous highest in 1912. The highest stage at Vicksburg was 0.95 ft. above the previous highest in 1916, and was above 50 ft. on the Vicksburg gage for 52 days. Many crevasses occurred between Rock Island and Gale, Ill., none of which were through levees that were built to provisional grade and standard cross-section. Table VIII shows the effect of the high water of 1922 on the levee system.

The maximum observed discharges at six stations on the Mississippi River from Columbus, Ky., to Carroll-

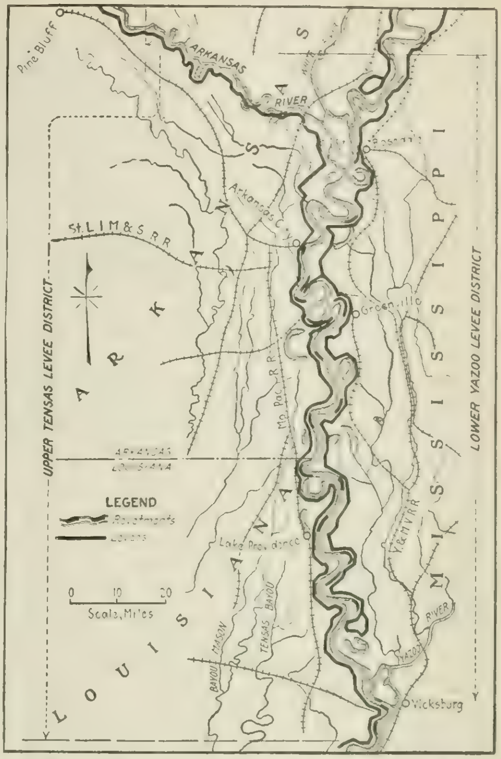


FIG. 2. THIRD MISSISSIPPI RIVER DISTRICT FROM THE WHITE RIVER TO VICKSBURG

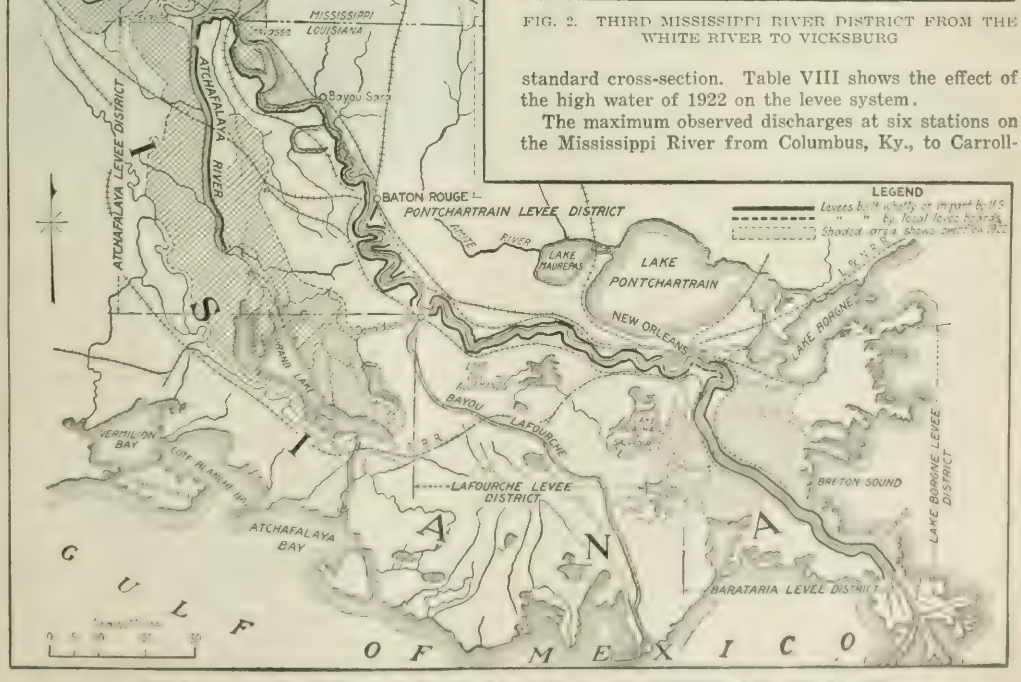


FIG. 3. THE FOURTH MISSISSIPPI RIVER DISTRICT FROM VICKSBURG TO THE PASSES

TABLE IX—MAXIMUM OBSERVED DISCHARGES ON THE MISSISSIPPI, 1858-1922

Year	Columbus, Ky. 22 Miles Below Cairo Gage Ft.	Columbus, Ky. 22 Miles Below Cairo Discharge Cu.Ft.	Helena, Ark., 307 Miles Below Cairo Gage Ft.	Helena, Ark., 307 Miles Below Cairo Discharge Cu.Ft.	Arkansas City, Ark., 437 Miles Below Cairo Gage Ft.	Arkansas City, Ark., 437 Miles Below Cairo Discharge Cu.Ft.	Vicksburg, Miss., 602 Miles Below Cairo Gage Ft.	Vicksburg, Miss., 602 Miles Below Cairo Discharge Cu.Ft.	Red River Landing, La., 773 Miles Below Cairo Gage Ft.	Red River Landing, La., 773 Miles Below Cairo Discharge Cu.Ft.	Carrollton, La., 964 Miles Below Cairo Gage Ft.	Carrollton, La., 964 Miles Below Cairo Discharge Cu.Ft.
1858	42.7	1,403,000					46.9	1,244,000	....			
1882	43.6	1,603,000	46.5	1,562,000					48.3	1,595,000		
1883											15.4	1,086,000
1884			20.0	466,000	20.6	552,000	17.9	461,000	46.0	1,292,000	14.2	892,000
1893	43.8	1,528,000	47.5	1,594,000	50.0	1,667,000			47.6	1,236,000	17.2	1,129,000
1897	42.5	1,462,000	49.0	1,486,000	51.4	1,646,000	52.0	1,777,000	50.2	1,290,000	18.6	1,353,000
1898	42.5	1,517,000	48.8	1,425,000	51.1	1,514,000	49.4	1,456,000	44.3	1,134,000	15.6	1,096,000
1903	44.5	1,483,000	50.9	1,686,000	50.4	1,743,000	51.4	1,614,000	50.0	1,206,154	19.0	1,337,602
1904	43.9	1,502,000	47.6	1,412,000	49.0	1,403,000	46.6	1,382,000	43.7	1,018,000	15.8	1,097,935
1907	43.2	1,543,333	49.9	1,691,170	51.9	1,608,120	49.6	1,721,211	46.9	1,291,448	18.6	1,254,452
1912	48.5	2,015,213	54.1	2,040,660	55.0	2,006,601	51.6	1,780,407	53.2	1,499,402	20.4	1,357,739
1913	49.3	2,014,849	55.0	1,931,802	55.1	1,782,084	52.2	1,783,130	50.6	1,306,364	19.2	1,195,746
1916	48.3	1,774,996	52.6	1,705,639	56.4	1,889,222	53.4	1,801,315	52.4	1,327,060	20.0	1,338,969
1920	46.9	1,527,430	50.0	1,598,080	54.0	1,513,089	50.6	1,648,798	49.6	1,109,536	17.6	1,097,074
1922	48.9	1,501,347	52.3	1,612,125	56.0	1,761,376	54.6	1,825,555	53.7	1,354,786	21.2	1,358,311

TABLE VIII—EFFECT OF FLOOD OF 1922 ON LEVEE SYSTEM

Levee District	Length Of Levee Destroyed Linear Ft.	Area of Land Overflowed Sq.Miles	Length Of Levee Protected By Sacks, Capping, Etc. Miles	Area of Land Saved From Overflow By Levees Sq.Miles
Rock Island to New Boston, Ill.			¼	44
Muscatine to mouth of Iowa River, Iowa				34
Mouth of Iowa River to Burlington, Iowa	238	26		34
Mouth of Des Moines River to La Grange, Mo.	100	12		46
Warsaw to Quincy, Ill.				
Quincy to Hamburg Bay, Ill.				172
La Grange to mouth of Missouri River, Mo.				50
Head of Chouteau Island to Prairie du Pont, Ill.				96
St. Louis to Cape Girardeau, Mo.[1]	3,159	34		
Prairie du Pont to Grand Tower, Ill.	400	31		14
Grand Tower to Gale, Ill.[2]	2,457	75		
Upper St. Francis		262		438
Lower St. Francis		500		3,000
White River	[3]400	[4]465		445
Reelfoot				310
Upper Yazoo				3,281
Lower Yazoo		[5]1,227	45.0	2,140
Upper Tensas				3,000
Lower Tensas	4,500	470	28.5	1,610
Atchafalaya		[6]450	49.0	5,585
Lafourche			57	2,020
Barataria	1,000	230	8.1	1,790
Pontchartrain			7.91	1,816
Lake Borgne	1,100	450	75	1,366
	13,354	4,232		27,291

[1] Perry County levee districts Nos. 1, 2, and 3. These districts were protected by a levee built by local authorities which was practically overtopped throughout its entire length.

[2] Includes Preston levee district in which breaks occurred in a levee built by local authorities.

[3] Break in White River Levee. Not government levee. Laconia Circle.

[4] Includes 446 sq.mi. flooded from backwater and 19 sq.mi. flooded in Laconia Circle.

[5] Backwater.

[6] Overflowed by backwater from the Atchafalaya River.

ton, La., during the period 1858 to 1922 are shown in Table IX.

During the high water of April, 1922, crevasses occurred in a number of local levee districts between Cape Girardeau, Mo., and Rock Island, Ill. No breaks were in levees that had been constructed under supervision of the Mississippi River Commission, except in one district where the levee is claimed to have been dynamited.

High water protection of levees was carried on in a number of places along the river from Fort Jackson to Rock Island, as described in *Engineering News-Record*, May 18, 1922.

The following crevasses occurred in the levees below Cairo during the high water of 1922:

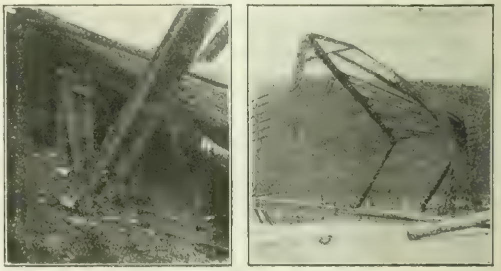
Name	Miles Below Cairo	Date of Break	Length, Ft.	Discharge Per Second Cu.Ft.	Date Measured
Weecama	693 Right 693 Right	April 26 April 26	3,669	623,006 286,029	May 10 May 19
Poydras	985 Left	April 27	1,100	450,000	Estimated
Myrtle Grove	1,008 Right	April 22	1,000		

Automobile Pushes Bridge Off Abutment

By Charles Haydock
Philadelphia, Pa.

An illustration of the potential destructiveness of motor cars running at high speed is found in the wrecking of a bridge near Tyrone, Pa., noted in *Engineering News-Record* of Nov. 23, p. 905.

A concrete road along the Little Juniata River between Tyrone and Altoona crosses the river on a skew of about 45 deg. by an old through Pratt bridge of seven 17-ft. panels, approached by curves of about 100 ft. radius. The inclined end posts are built up of two 7-in. channels, a 12 x ½-in. cover plate, and batten plates below. At 4 a.m. on Nov. 5, a Mitchell runabout failed to make the approach and struck the outer end post. The truss was forced off the abutment, and when the end post struck the abutment or the ground it was broken and doubled back on itself, the bottom-chord members tearing away from the end pin (first view). Nearly all the members of this truss are damaged beyond repair. The portal and sway bracing are badly warped. The opposite truss, however, is in fairly good condition, only one post being seriously bent.



LITTLE JUNIATA BRIDGE AFTER CAR STRUCK POST
Curved approach responsible. One truss pushed off abutment, the end post breaking when it struck in the fall; other truss little damaged.

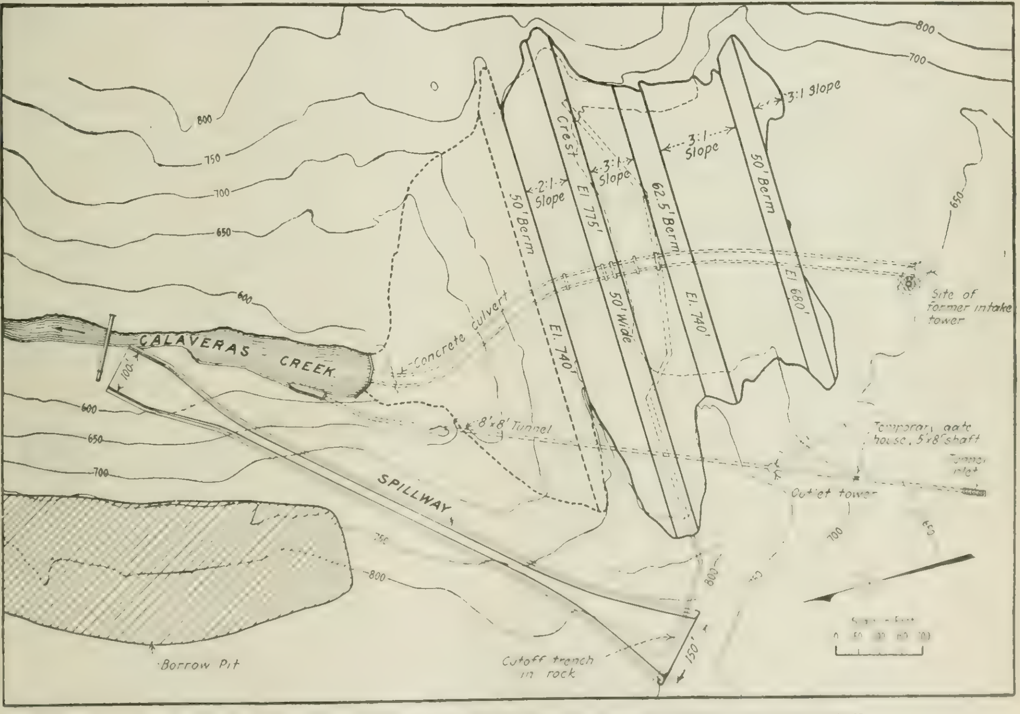
Prior to the accident the end pins, bearing plates, etc., were in very bad condition due to lack of maintenance. The bridge floor, of creosoted wood block, held together in the collapse except along the line of the end floorbeam, which parted from the stringers when the truss dropped. The joints between stringers and floorbeam showed considerable corrosion.

A few nights after this, another car in attempting to cross this bridge made the turn safely, crashed through the barricade, broke the red light and entered the bridge, sliding off into the river bed between two of the posts where the hand rail had been removed.

Calaveras Dam Raised With Dry Fill and Puddled Core

Additional Material Now Being Added Brings Total Height to 175 Ft.—Concrete Spillway and New Outlet Tunnel Provided

THE long deferred addition to Calaveras Dam that will bring the total height up to 175 ft., began in earnest last September when a contract was awarded to Palmer & McBryde for placing an additional 800,000 cu.yd. in the structure. The dam is owned by the Spring Valley Water Company of San Francisco and is located about 40 miles southeast of that city. In addition to the contract work the company will, with its own forces, tap into the new outlet tunnel with a shaft and a concrete intake tower above it and will also construct a concrete spillway at the west end of the dam. The accident that occurred on this dam during construction when some 800,000 cu.yd. on the upstream face slipped into the reservoir was described in *Engineering News-Record* Dec. 26, 1918, p. 1158. Plans for continuing the construction and increasing the available water supply were outlined briefly in the issues of Sept. 29, 1921, p. 540, and May 4, 1922, p. 751.

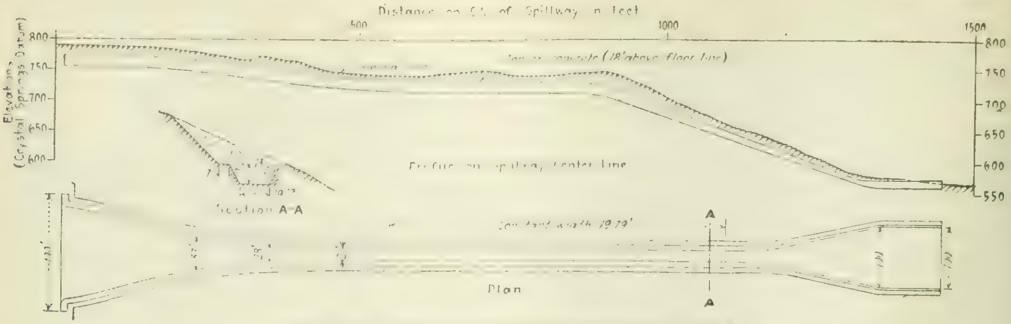


PLAN OF CALAVERAS DAM SHOWING LOCATION OF NEW OUTLET AND SPILLWAY

Material for the additional height is being excavated by an electrically operated shovel with a 2½-cu.yd. bucket from the west bank of the stream above the ultimate level of the crest. Delivery from this borrow pit is by 12-cu.yd. dump cars hauled by locomotive to trestles on the dam. Before the main part of this fill was started, a cut-off trench, shown in the accompanying cross-section, was excavated to hard, impervious clay. This excavation varied in depth up to a maximum of 40 ft. and represents the thickness of loose material left by the slip of 1918. Beneath this trench is material which originally was sluiced into place to form a core and which has now thoroughly solidified and hardened.

The trench for the most part follows the toe of the fill made in 1920. After filling the trench with puddled clay, a core fill of impervious clay thoroughly soaked down as the work progressed was carried up the upstream face of the 1920 fill, as shown in the cross-section. Material for filling the trench and also for making the core fill above it was taken from pockets left at the upstream toe of the dam by the 1918 slip and filled with saturated clay from the core. A good deal of this material was excavated from one large pocket whence a grab bucket loaded into dump cars at the foot of an inclined track built down the slope of the dam.

The section marked "sluiced core" in the accompanying drawing will be formed after the dry fills on both sides have been carried up to heights that will permit of sluicing fines by means of hydraulic giants down the faces of both fills into this central basin. If the clay and other fines that can be brought into the core by this sluicing process are insufficient, additional clay will be hauled in and dumped over the edge of the fills whence it will be carried to the desired position by the sluicing process. This plan of reconstruction is much along the lines suggested soon after the slip and described in *Engineering News-Record* Dec. 26, 1918, p. 1163. The present contract will bring the crest of the dam to El. 775 as shown in the cross-section.

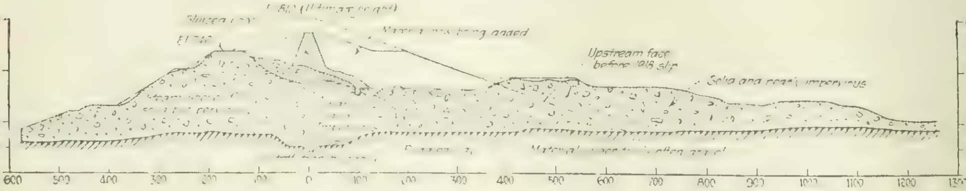

Distance on C.L. of Spillway in Feet
500
1000
1500
Elevations (Crystal Springs Datum)
800
750
700
650
600
550
(18' above floor line)
Profile on spillway, center line
Section A-A
A
Plan

PLAN AND PROFILE OF CONCRETE-LINED SPILLWAY

After the 1918 slip the main conduit was choked with debris and the conduit marked "8 x 8-ft. tunnel" on the accompanying plan was built on rush schedule to provide an emergency relief from possible high water. This new outlet has been temporarily controlled by gate valves operated through a 5 x 8-ft. shaft. Present plans call for a concrete intake tower above ground and a shaft below ground connecting with the new tunnel, while three short tunnels will connect the shaft and reservoir at three levels below the base of the tower, thus affording means of drawing water into the outlet under all conditions of water storage.

The tower will be of standard design, 40 ft. high and 19 ft. in outside diameter at the base, with reinforced-concrete walls ranging up to 30 in. in thickness. The shaft beneath this tower will have a 42-in. concrete lining and an inside diameter of 12 ft. A novel method of mucking this shaft was made possible by the fact that the tunnel beneath it was already in service when the shaft was sunk. A 12-in. well-casing was first sunk on the center line of the shaft and the main shaft was driven around this, scraping the muck into the well as the material was broken up. The shaft traversed serpentine rock which was readily broken up. The water in the tunnel carried out the material, so the mucking process was carried on speedily at low cost.

The location chosen for the spillway was around the west end of the dam. On this side the bank has a steep slope above the top of the dam so that any considerable width of excavation would entail handling excessive quantities. To meet this situation a spillway was designed with a capacity of 20,000 sec.-ft. which will have, through the major portion of its length, constant depth and varying width. The desired capacity will be secured by using a wide intake which narrows and pitches down on a sharp grade as it approaches the slope of the hill where a minimum width is desirable to reduce the necessary excavation. The grade will be as much as 35 ft. per hundred toward the lower end and velocities will range from about 2½ ft. per second at the intake to 97½ ft. per second in the "chute" or lower section. The discharge from the spillway will be into a spillway pool, however, from which the flow is not to exceed about 12 ft. per second.



CROSS-SECTION OF CALAVERAS DAM SHOWING NEW WORK

The work on Calaveras Dam is now being done under the direction of George A. Elliott, chief engineer, and T. W. Espy, construction engineer, of the Spring Valley Water Co., from whom the data were obtained.

Municipal Coal and Wood Yard Legal in Minnesota

The Minnesota Supreme Court (Central Lumber Co. *vs.* City of Waseca *et al.*, 188 Northwestern Reporter; 275) has decided that the establishment of a municipal fuel yard and a tax levy for its operation is constitutional. The decision, in part, is as follows:

> The question is whether the establishment of a municipal coal and wood yard is a public purpose. The constitutional validity of the charter is presumed. It is to be assumed that in framing their charter the people were informed of conditions, such as the sources of supply, the ability and disposition of dealers to care for local demands, and other relevant factors affecting the situation, and found that public necessities and conveniences were such that the establishment of a municipal fuel yard was a public purpose. They have the responsibility of their finding and the wisdom or folly of the policy which they authorize. Their determination of public purpose is not final. It is accorded weight, but finally the court must determine as a judicial question whether the purpose for which taxes are exacted is public.
>
> Economic and industrial conditions are not stable. Times change. Many municipal activities, the propriety of which is not now questioned, were at one time thought, and rightly enough so, of a private character. The constitutional provision that taxes can be levied only for public purposes remains, but conditions which go to make a purpose public change.
>
> In our judgment the establishment of a municipal fuel yard is a public purpose.

Microbiology and Theory of Activated Sludge

Discussion of Colloidal vs. Biological Explanation of Phenomenon—Counts of Micro-Organisms Made to Determine Effective Surface

By Dr. A. M. Buswell and H. L. Long
Chief and Assistant Biologist, respectively, Illinois State Water Survey, Urbana, Ill.

IN REVIEWING the expressions of opinion with regard to the theory underlying the activated-sludge process of sewage disposal one comes to the conclusion that two main lines of action are held responsible for the results obtained. That the mechanism of the reaction is sometimes described as that of adsorption of the colloidally dispersed matter by sludge already present in the sewage is evident from the following statement quoted from well known authorities.[1]

"The sludge embodied in sewage and consisting of suspended organic solids, including those of a colloidal nature when agitated with air for a sufficient period, assumes a flocculent appearance very similar to small pieces of sponge. Aerobic and facultative aerobic bacteria gather in these flocculi in immense numbers, some having been strained from the sewage and others having developed by natural growth."

In other words, the usual suspended particles in sewage grow by the accretion of material colloidally dispersed, thus producing activated sludge. Other writers refer to the "scrubbing action" of suspended particles and compare the action of activated sludge to that of coagulated alum.[2] The process is often referred to as one of oxidation, assuming that oxidation is a necessary step in the purification of sewage. Another definition states that activated sludge must be of "a character to absorb colloidal matter," and still another author[3] refers to the "clotting" of the colloids in the sewage. Such expressions seem to indicate what might be called the colloidal or mechanical theory for the mechanism of the action of activated sludge, similar in many respects to the Hampton doctrine of the action of sewage filters.

The other theory which one meets, and which in reality seems to have been the first to be proposed, is what might be called the biological theory and resembles Dunbar's theory of sewage filters. Those emphasizing this viewpoint of the action of activated sludge call attention to the analogy[4] between the action of slate beds, contact beds and sprinkling filters and the action of activated sludge. The sludge is referred to by these writers, not as a clotted, agglomerated or coagulated sludge produced by the mechanical growths of suspended particles in the sewage, but as biological growths arising from the germination and propagation of micro-organisms whose spores are always present in sewage. The term "cultivated sludge"[5] used by one author contrasts perhaps as strongly as any with the term "coagulated" or "agglomerated" sludge, used by those favoring the colloidal theory.

Of the authors who favor the biological theory, we find that some[6] refer to nitrification and nitrifying organisms as requisites for the success of this method of sewage treatment, while others refer to the sludge as being composed of a variety of micro-organisms. Mumford's[7] *M7* seems to have been the only specific organism mentioned as having ability to produce the purification of sewage. This organism, it will be remembered, required for its best activity appreciable amounts of iron.

If one examines particles of activated sludge under the microscope he is immediately impressed with the fact that there is practically no adsorbed, precipitated or coagulated amorphous matter in these sludge particles, but that they are composed entirely of active growing microscopic organisms of varieties ranging from true bacteria up through the giant bacteria, with occasionally moulds and yeasts, and including, as well, a variety of free swimming and attached protozoa[8]. These communities of micro-organisms must obtain food and this food must be supplied from the colloidal organic matter in the sewage. From what we know of the metabolism of micro-organisms it is probable that the unicellular forms are absorbing through their membrane such soluble forms of organic matter as are able to pass through this membrane, and that they are also secreting enzymes which are capable of peptizing or liquifying colloidal particles too large to be directly absorbed. Protozoa, on the other hand, can easily be seen to approach and ingest visible particles of organic matter.

Action Like Hog Feeding—This biological theory of the action of activated sludge might be summarized and emphasized by proposing what seems to be a rather striking analogy, namely, that the purification of sewage effected by microscopic communities appearing as flocs is entirely similar to that of garbage disposal by feeding it to hogs. It does not seem probable that colloidal or mechanical precipitation play any greater part in the metabolism of micro-organisms than they do in the digestion of the larger animals. One serious objection to the colloidal theory of coagulation is that the colloidal particles in sewage and the activated-sludge particles are, so far as we are able to determine, both negatively charged. Since adsorption of colloids is most effective between oppositely charged particles it should not be applied to the conditions of the activated-sludge particles without reservation.

Discussion of the theory at this time may seem academic and impractical. Since, however, these two theories would suggest rather different lines of attack on the general problem, we have chosen to review and compare them.

If the action is largely colloidal and mechanical, then we will need to study particularly the colloid chemistry of the sewage. If, on the other hand, it is biological, we will need to study the biology of the sludge, and should have for the sake of the success of the activated-sludge process a most complete knowledge of the desirable and undesirable members of these microbial communities upon which we are to rely for the purification of sewage.

Comparatively little has been published on the organisms of activated sludge. Earlier writers make especial mention of nitrifying bacteria. Bartow[9] and Smith noticed large numbers of worms (Aeolosoma Hemprichii) as well as Vorticella and Rotifera at times in the sludge. Purdy[9] counted the various protozoa in strawboard waste activated in a 3-in. glass tube and fed by the fill-and-draw method.

More recently Dienert[10] and Cambier[11] have debated the role of bacteria in the activated-sludge process. Dienert maintains that bacteria are essential since nitrification did not take place in the presence of phenol. Cambier, on the other hand, maintains that the activated-sludge process is an example of ordinary chemical catalysis. His conclusions appear to be based on three experiments: One in which chloroform was introduced with the air used for aeration, apparently on the assumption that the chloroform would be a germicide; one carried out at low temperature (10 to 12 deg. C.) on the assumption that nitrifying bacteria are not active at these temperatures, and one in which iron sulphide was added. That nitrification and purification were accomplished under these conditions Cambier interprets as proof of the catalytic theory of the reaction. He presents no definite data to show results of the solutions. In the same journal Courmont[12] reports a study of the

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A brief abstract of this paper and the new definition of activated sludge contained were presented by Dr. Buswell to the Philadelphia Convention of the American Water Works Association.

bacterial flora of activated-sludge effluent. He found seven species, one of which was B. subtilis. No obligatory anaerobes were found and in some cases B. coli was absent.

PROCESSION OF ORGANISMS AND SOLIDS FROM RAW TO MATURED ACTIVATED SLUDGE

Dorr-Peck Tank I

Date	Minute Ciliates and Flagellates	Peritrichia	Holotrichia and Heterotrichia	Hypotrichia†	Larger Flagellates	Nematoda	Beggiatoa Filaments	Standard Units Zoögleal Masses Millions per c.c.	Total Solids Mg. 1	Per Cent Solids by Volume, 1 hr. sed.
1921 Nov			(Thousand per c.c.)							
17	2,885 0	.10	.30					11		
18	215.0	.30	1.40				.20	.38	2,200	5
19 20	90.0	.60	1.90	.			.30	.37	2,700	7 7
21	17 5	3.70	2.40			10	10	48	2,930	[illegible]
22	+	6.70	1.60			20	.30	.77	3,370	9
23 24	+	2.70	1.40			.20	60	.49	4,030	11 13
25	+	8.60	3.60	1.20	...	.10	.30	1 08	4,500	15
26 27	+	14.07*	1.00	1 00	..	50	.33	54	4,900	18 29
28	+	6 50	3 00	3.80	...	70	40	10	5,300	37
29	+	12 85*	6.40	1 80		1 00	80	1 54	5,800	48
30	+	8 00	6 40	2 40	...	1 60	40	1 81	5,430	68
Dec.										
1	+	17 10	5 70	3 30		1 80	60	2 06	6,140	76
2	+	1 44	5.40	3.60		2.40	90	2.50	7,350	78
3 4	+	14.70	5 40	4 50		2 40	1 50	2 56	6,480	84 82
5	+	4 00	60	80		1 00	40	1 11	6,050	78
6	.....	3 00	4 80	2 70		3 30	1 20	1 70		
7	......	5.00	2.00	2.50		1.50	2.00	1 51	5,300	75
8	......	6.50	2 00	2 00	5.00	1 50	1 00	2 40	4,800	74
9	....	4 00	2 50	1 00	5.00	1.50	4 00	1 71	4,410	74
10	......	6.80	1.60	1 60		2.00	1.20	1.24	4,100	52
11	......									64
12	+	7.60	1.20	3.20	4.20	4.00	2 80	2 10	4,270	56
13	.....	12.00	2.20	4.00			4.50	1.84	4,260	57
14	....	15.00*		2.00	10.00	1 00	3 00	1.56	3,770	57
15	+	13.00		3 00		50	5 00	1.99	4,010	59
16	+	5.00	1 00	.50	5.00	1.00	5.50	1.55	3,120	58
17	+	1 60					.80	.82	3,060	55
18	....	....								60
19	+	6.00		1 60		80	3 20	1 41	3,180	54
20	+	5 20	40	1.60	...		4 40	1.32	2,910	56
21	+	4 80		.40			1.20	62	2,660	62
22	+	5 10		60	...		3.00	79	2,450	54
23	+	2 40	40	40	...		1.60	.51	2,640	64
24	+	5 00	40	2 60	...		.80	.71	2,800	67
25	.....									63
26	+	17 00*	50	1 50			.50	2.39	3,650	70
27	+	10.8	1.00	2 60	...	.20		.89	3,820	61
28	+	12.40*	.60	1.80	...	.40	.40	1.10	.....	81

Dorr-Peck Tank II

Date	Minute Ciliates and Flagellates	Peritrichia	Holotrichia and Heterotrichia	Hypotrichia†	Larger Flagellates	Nematoda	Beggiatoa Filaments	Standard Units Zoögleal Masses Millions per c.c.	Total Solids Mg. 1	Per Cent Solids by Volume, 1 hr. sed.
Nov.										
17	.. .								.....	.
18	120 0	.....	.30	.	. .	.10		.043	1,370	1
19 20	63.0	60	.50	.			[illegible]	098	2,360	2 2
21	75.0	1 50	70				.20	.224	1,390	2
22	12.5	2.90	.80	.10	...		.30	.132	1,410	3
23 24	+	1.10	.40				.20	231	1,370	2 3
25	+	.10	1 10			.30	.40	.205	1,120	2
26 27	....	.90	.80	.20	..	.10	20	185	1,220	2 2
28	+	1.20	50	.20		10	10	.145	1,050	2
29	+	.50	1 00	...	..	.10	10	055	900	1
30	+	.50	.30	.10	..	.10	30	119	870	0
Dec										
1	+	.60	10					024	890	..
2	+	.10	.40		.	.10	.	.026	780	..
3 4	....	.					.		790	..
5	. .			....	..				1,160	4
6	.	5 10	60	.90	..	90		725		27
7		8 00	40	2 40	..	1 20	40	1 270	3,970	60
8		3 80	70	1 30		40	10	1 912	4,570	64
9	. .	4.10	70	40	..	90	20	.540	4,610	62
10 11	+	2 80	30	.70	...	.40	50	312	4,780	74 60
12	+	13.20	.40	2.40	.. .	2.40	2 40	2.010	4,460	70
13	+	16 00	7 50	5.50	..	3 00	2 50	3 400	4,630	75
14	+	16.50	.50	2 50		[illegible]	3 50	2 012	4,550	75
15	+	9 50	50	5 00	... .	2.50	1 50	1.987	3,990	69
16	+	9 00			.	1.50	3.00	1.712	4,030	75
17 18	+	7.60	.40	.40		.80	5 60	1 500	3,450	82 82
19	+	6 00	80	5 60	..	.40	1 20	1 170	3,610	86
20	+	12.4	.40	2 00	..		4 40	2 530	3,610	88
21	+	12 40		3 60		.40	2 80	2 300	3,530	92
22	+	15 00	90	1 20		.90	3 90	1.192	3,270	83
23	+	10 40		80			2.60	.840	3,000	92
24 25	+	4.80		40			2.00	.675	2,690	89 99
26	+	3 80	2 20	2 00		.20	.20	1.025	3,570	90
27	+	4 80	1 80	2 40			.20	1.170	3,570	88
28	+	6.40	80	.80	..		.20	1.405		87

* Colony or cluster of peritrichs present

† The standard unit is used here as a measure of surface only and 0.004 mm. sq.

Of the various investigations which have been made that of Purdy[8] furnishes the most complete data on the various organisms present in the sludge. Purdy followed the usual Sedgwick-Rafter method of enumerating the microscopic organisms, reporting the zoögleal flocs in standard units of 0.004 mm. sq. Purdy used a 500 c.c. aerating vessel operated with an unmeasured excess of air on the fill-and-draw system with 24-hour aeration periods. This system served admirably the purposes of the particular investigation which showed the presence of relatively large numbers of protozoa, especially of Peritrichs. Some work of the present authors on a similar scale, and with excess of air and 24-hour fillings, gave similar results. They do not seem to correspond to results obtained when smaller amounts of air are used, nor with the results on larger experimental units.

The analytical data herewith reported refer to samples taken from the aeration chambers of a two-tank Dorr-Peck activated-sludge unit fully described elsewhere.[13] For the purposes of the present paper it will be sufficient to state that the apparatus was treating about 65,000 gal. a day in two aeration chambers having capacities of 14,400 and 12,700 gal. respectively and operated in series. Approximately 0.75 cu.ft. of air was used per gallon of which two-thirds was used in the first tank and one-third in the second. A good degree of clarification and an average methylene-blue stability of three days were obtained during the run.

Microscopic observation made during the winter of 1920-21 indicated some sort of a relation between the amount of air used, the strength of the sewage, the settling rate of the sludge and the types of organisms composing the sludge. When in the spring after a shut-down for repairs, the plant was started up without any activated-sludge as a "starter," daily microscopic observations were made to follow the changes in microbial life as the sludge built up. The daily records, which on account of the unexpected pressure of other work had to be limited to brief observations, are given below. In general it is to be noted that the Holotrichs were the first to appear in noticeable numbers but that they gave way in time to other forms. The Peritrichs (Carchesium and Vorticella) appeared only after several days of aeration. The matured sludge seemed to be composed largely of zoögleal masses with frequent colonies of Peritrichs and an occasional Hypotrich (generally Euplotes).

In September the daily qualitative study of the sludge was resumed and a careful investigation of the forms in the zoögleal masses undertaken. In November an interruption in the operation of the plant offered another opportunity to study the forms appearing during the building up of sludge. In this series of examinations, which dates from Nov. 17, quantitative estimations were made using the Sedgwick-Rafter method of enumeration, as Purdy did. Beginning with Dec. 9, $FeSO_4$ equivalent to 10 mg. per liter of Fe, was added to the influent sewage for the purpose of determining its effect on the nitrogen cycle. It appeared to be without effect on the character of the organisms found. The results of these examinations are given in the accompanying table.

In the study of the microbiology of activated sludge in its development from raw sewage there seems to be a definite succession or addition of forms, as the sludge develops. Beginning with the characteristic micro-organisms of raw sewage as it is taken into the aeration chamber, there is a predominance of the minute flagellates and ciliates, with occasional Peritrichs and Holotrichs. In a few days the minute forms diminish in number until they become a negligible quantity while Peritrichs, Holotrichs and Heterotrichs increase in number, the Peritrichs predominating throughout. As the minute forms become insignificant the zoögleal masses of the Chlamydobacteriacae and Nematodes appear, to be followed in a few days by the sudden appearance of Phyotrichs. This point then brings us to the characteristic fauna and flora of the matured activated sludge, under the particular conditions of operation employed, e.g.—aeration, rate of filling and drawing, etc.

SUMMARY OF MICROSCOPIC OBSERVATIONS MAY 3-17, 1921 DURING BUILDING-UP PERIOD OF ACTIVATED-SLUDGE TANKS I AND II

May 3		Plant started operation.
May 4	I.	A few Paramecium, paper fibers and miscellaneous vegetable cells.
May 5	I.	Paramecium, paper fibers and miscellaneous vegetable cells.
	II.	Zoögleal masses of fine bacterial filaments beginning to form.
May 6	I.	Large flocs of zoögleal masses of fine bacterial filaments.
	II.	Zoöglea, Paramecium, Colpidium.
May 7	I.	Branching zoögleal masses of fine bacterial filaments, Parmecium. Spyrogyra.
	II.	Paper fibers with much attached zoöglea. Many Paramecium, few Peritrichs (Vorticelli, dae), branched zoögleal masses of fine filaments.
May 8	I.	Branched zoögleal masses of fine filaments, Paramecium, Colpidium, one filament of Spyrogyra.
	II.	Branched zoögleal masses of fine bacterial filaments, few Holotrichs, mould hyphae and paper fibers.
May 9	I.	First appearance of Peritrichs in tank I. One filament of Spyrogyra, Zoögleal masses of filamentous bacteria.
	II.	Increase in Peritrichs.
May 10	I.	Few ciliates, 80 per cent of field consists of zoögleal masses.
	II.	Many Peritrichs.
	I.	Largely zoögleal mass of filamentous bacteria; some Hypotrichs and Peritrichs.
	II.	Largely zoögleal masses of filamentous bacteria; fewer Peritrichs.
May 12		No change in character.
May 13		Increase in Peritrichs.
May 15, 16, 17		No changes in character.

Bacterial Surface—Hering[14] long ago pointed out the importance of bacterial surface in sewage purification, though little definite data have been developed since his paper on the subject. From the tables we may obtain a notion of the order of magnitude at least of the sludge surface in the activated-sludge process. Take a case where 2,000,000 standard units of zoögleal masses were found per cubic centimeter in the aeration chamber. Each floc must have a lower surface equal at least to the upper surface estimated so that leaving out the side surfaces we would have 4,000,000 standard units of 0.004 mm. sq. each or 160 c.m. square of surface per cubic centimeter of volume. This figure does not include the surface of the protozoa or the free-swimming bacteria. If increased by 50 or 100 per cent it would probably approach more closely the correct value.

Summary—In view of previous work of other authors cited and the data of the present paper we wish to propose the following statement of the theory of the activated-sludge process: Activated-sludge flocs are composed of a *synthetic* gelatinous matrix, similar to that of Nostoc or Merismopedia, in which filamentous and unicellular bacteria are imbedded and on which various protozoa and some metazoa crawl and feed. The purification is accomplished by digestion and assimilation, by organisms of the organic matter in the sewage and its resynthesis into the living material of the flocs. This process changes organic matter from colloidal and dissolved states of dispersion to a state in which it will settle out.

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Monuments to Early Engineers of the Rock Island Ry.

Samuel B. Reed and Gen. Grenville M. Dodge Are Honored for Location and Construction Work on Pioneer Lines

IN THE recent celebration of the 70th anniversary of the Chicago, Rock Island & Pacific Ry., whose first train was run from Chicago to Joliet in 1852, a pleasant feature was the unveiling of monuments erected by the railway company in memory of two engineers who were engaged in the survey and construction of the early lines of the Rock Island system, which were pioneer lines in the development of the western part of the country. These engineers were Samuel B. Reed and General Grenville M. Dodge, both of whom were later prominent in the location and construction of the Union Pacific as the final link in the first transcontinental railway. Both became members of the American Society of Civil Engineers.

FIG. 1—SAMUEL B. REED
First location and construction engineer, Rock Island System

The Rock Island System—The beginning of the present system known as the Rock Island Lines was the incorporation in 1847 of the Rock Island & La Salle R.R., to connect navigation on the Illinois and Mississippi rivers. Later it was authorized to extend east to Chicago. Construction was commenced at that point, the track being laid with rails brought from England and delivered by lake schooners. On Oct. 10, 1852, the first train was run from Chicago to Joliet, 40 miles, thus inaugurating the new railway. In June, 1854, the first train was run from Chicago to Rock Island, on the Mississippi.

The Mississippi & Missouri Ry. was incorporated in 1853 to build westward across Iowa to the Missouri River, the city of Council Bluffs being selected as the terminal of this road and the place for the crossing of the projected line to the Pacific. But, the railway did not reach Council Bluffs until 1869. The great timber truss bridge over the Mississippi to connect the two lines was a remarkable engineering work but was the subject of strong protest by the steamboat interests. In a case where the wreck of a steamboat was charged to the new bridge Abraham Lincoln was attorney for the railway. Besides a swing span of 285 ft. there were five fixed spans of 250 ft. The noted engineer, John B. Jervis, was consulting engineer for both of these railways, which on completion formed a line from the Great Lakes to the Missouri River. At present the system of the Chicago, Rock Island & Pacific Ry. aggregates more than 8,000 miles.

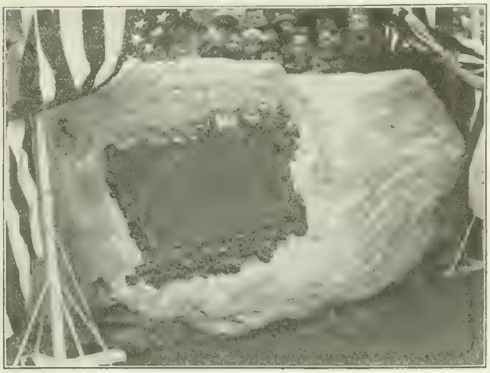


FIG. 2—MONUMENT TO SAMUEL B. REED AT JOLIET

Samuel B. Reed—Mr. Reed was born at Arlington, Vt., in 1819 and was educated at Middleport Academy. His engineering experience began in 1841 on the enlargement of the Erie Canal, following which he was with the Detroit & Pontiac Ry. until its completion in 1843, when he joined the U. S. Government expedition which explored the upper Lake Superior country. In 1846 he took charge of the extension of the Michigan Central R.R. west from Kalamazoo to Mattewan, and when that was finished he went with the Michigan Southern & Northern Indiana R.R. This latter was completed in 1852 and was the first railway to enter Chicago from the east.

In 1850, Mr. Reed was engaged as engineer for the Rock Island Ry. and then made the survey from Chicago to Joliet, the first section of the line. He was in charge of construction of the entire main line from Chicago to the Mississippi, with the exception of a few miles, and on its completion he surveyed the Washington branch, which is now a part of the Kansas City line of the Rock Island System. Later he went to the Chicago, Burlington & Quincy R.R.

In April, 1864, Mr. Dey, chief engineer of the Union Pacific R.R., appointed Mr. Reed as locating engineer for that part of the line from Green River, Wyo., to the Salt Lake basin. He reached Salt Lake City by stage in May and began his exploration of possible passes through the mountains, reporting in 1865 in favor of the Wasatch, Echo Canyon and Weber River route. He was superintendent of construction from February, 1866, to May, 1869, when connection was completed with the Central Pacific.

In later years Mr. Reed was employed on various railway works and was engaged by Mr. (later Sir) William C. Van Horne to report on the proposed western end of the Canadian Pacific Ry. He died at Joliet, Ill., on Dec. 25, 1891. A portrait of Mr. Reed is reproduced in Fig. 1. In Fig. 2 is shown the monument which was erected to him by the Chicago, Rock Island & Pacific Ry., and which was unveiled on Oct. 10, 1922.

General Grenville M. Dodge—In 1831, Grenville M. Dodge was born at Danvers, Mass. He entered Norwich University at Northfield, Vt., in 1848 and after graduating from the scientific department early in 1851 he entered Capt. Partridge's private school for practical instruction in field engineering, receiving a diploma as a military and civil engineer in July, 1851. He went west at once, to Peru, Ill., and was axeman and transitman on the surveys for the Illinois Central R.R. from La Salle to Bloomington. In March, 1852, he was engaged as rodman by Peter A. Dey, division engineer of the Rock Island R.R., and later had charge of the survey of the Peoria branch. When Mr. Dey was made chief engineer of the Mississippi & Missouri R.R., as an extension of the Rock Island Ry., he engaged Mr. Dodge as principal assistant engineer in the survey of a line between the two rivers. The route selected was from Davenport, through Des Moines to Council Bluffs, this last point being selected as the Missouri River crossing for the future Union Pacific R.R. Until 1857 he was engaged in the construction of the Mississippi & Missouri Ry., which is now a part of the Rock Island System. Construction being then suspended he continued the surveys west of the Missouri for the Union Pacific.

During the Civil War, General Dodge had extensive experience in reconstructing railways and bridges destroyed by the Confederate army. Meanwhile work on the Union Pacific R.R. had been commenced at Omaha, in 1863, and on his resignation from the army in 1866, with the rank of Major-General, he became chief engineer of this pioneer line to complete the first trans-

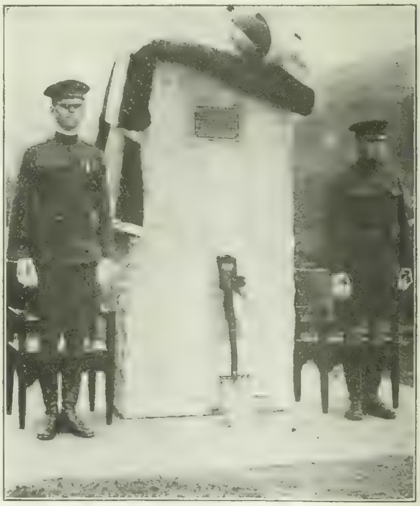


FIG. 3—MONUMENT TO GEN. GRENVILLE M. DODGE AT NORWICH UNIVERSITY, NORTHFIELD, VT.

continental railway. Under military protection against numerous attacks by the Indians, the surveys were extended to the California state line and construction was carried on until in May, 1869, it met the Central Pacific, building eastward. These surveys are said to have included some 15,000 miles of instrument line and 25,000 miles of reconnoissance.

Plans for a Missouri River bridge connecting Council Bluffs and Omaha were prepared by General Dodge in 1868, and he is said to have been responsible for the use of the pneumatic process in sinking 9-ft. cylinder piers to a depth of 60 to 90 ft. in the loose sand of the river bed. These depths are also said to have been about twice as great as those of previous foundations sunk by the pneumatic process in this country.

For the next 25 years, 1870-1895, General Dodge was active in railway construction, largely in the West and Southwest. He retired in 1896 and died in 1916 after a life of prominence in the railway and engineering development of the "Wild West." More complete records of his career are given in *Engineering News* of Jan. 20, 1916, and Oct. 28, 1909.

As part of the Rock Island Ry. celebration on Oct. 10, 1922, monuments to General Dodge were erected at Council Bluffs, Ia., and at Norwich University, the latter is shown in Fig. 3. A seat will be built later on the slab which supports the granite block. The spade shown was used in digging the hole for the memorial tree.

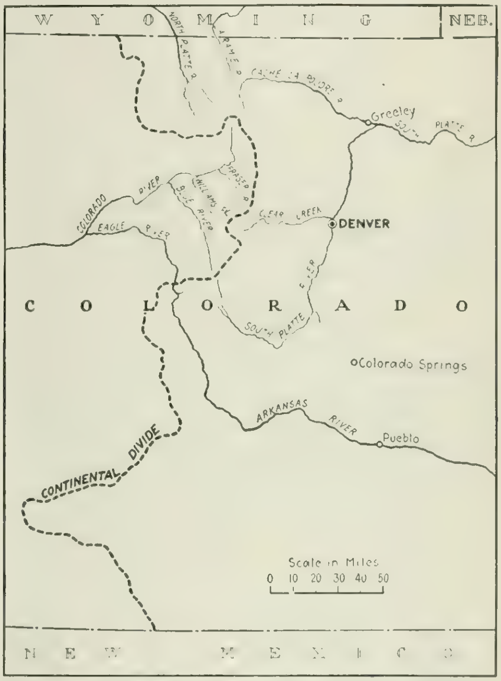
Transmountain Diversion of Water in Colorado

Need and Extent of Diversions Already Made—Physical Limitations—Colorado River Problem and Denver Water Supply

By Robert Follansbee
District Engineer, U. S. Geological Survey, Denver, Colo.

THE plan of the seven Western States through a commission and the Federal Power Commission to divide equitably the waters of that river and the fact that the bulk of the water originates in Colorado, makes transmountain diversion of water in that state an important subject to the engineering profession. To show the need for transmountain diversions, the extent to which such diversions have already been made, both from the Colorado and other mountain drainage basins, the physical limits of such diversions from the Colorado River basin, and the effect of these latter upon the flow of the Colorado at the state line, the following article is presented. The physical limitation of transmountain diversions from the Colorado River in Colorado appears to be less than 300,000 acre-ft. annually, and the effect of these will reduce the flow at the state line by only a few per cent.

More than half of the 103,658 sq.mi. comprising the area in Colorado are within the Rocky Mountain region. The eastern part of the state lies within the province of the great plains which extend from the front range of the Rockies to the Missouri River. Irrigation has been practiced in this region for many years, and the area of irrigable land is only limited by the water supply. The sources of this supply are the South Platte and Arkansas rivers and their numerous tributaries which rise on the eastern slope of the Rocky Mountains. With the present water supply the limit of irrigation on the plains has been almost reached. On the western slope of the mountains, particularly in the Colorado River



PRINCIPAL STREAMS, TRANSMOUNTAIN DIVERSION
Continental Divide in relation to Denver also shown

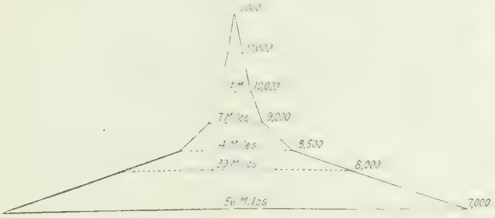
TABLE I—EXISTING TRANSMOUNTAIN DIVERSIONS IN COLORADO

First used	Ditch	Diversion From	Diversion To	Conduit Tunnel Miles	Conduit Ditch Miles	Capacity Sec.-Ft.	Drainage Area Intercepted Sq. Mi.	Average Annual Diversion Acre-ft.
		North Platte River basin						
1899	Skyline	Laramie River.........	Cache la Poudre	0	[illegible]	130	17	17,000
1902	Sand Creek system	Headwaters of Laramie River	do	0	3	100	10	2,990
1914	Laramie Poudre tunnel	Laramie River	do	2	9	800	60	5,900*
1919	Bob Creek	Headwaters of Laramie River	do	0	2		1	100
1905	Rist and McNab	Headwaters of North Platte	do	0	2.5	50	4	3,060
	Cameron Pass	do	do	0	2	10		300
		Colorado River basin						
1903	Grand River	North Fork Colorado River	Cache la Poudre	0	8	220	12	12,400
	Ewing	Eagle	Arkansas River	0	2	18	2	2,200
1910	Berthoud	Fraser	Clear Creek	087	4	13	4	600
1914	Boreas Pass	Blue	South Platte	0	1	10		400
1914	Cochetopa	Cochetopa Creek	Rio Grande	0	2	40	10	2,500
								47,400

* Laramie-Poudre tunnel is limited to an annual diversion of 15,500 acre-ft. by a recent decision of the United States Supreme Court in the Wyoming-Colorado suit. The drainage area intercepted by it includes that intercepted by the Skyline and Sand Creek system which divert water at higher elevations.

basin, which includes all of the mountainous area except 7,700 sq.mi. in the Rio Grande basin and 1,730 sq.mi. in the North Platte basin, the water supply is far in excess of the irrigable land.

For many years water has been diverted from the Colorado and North Platte drainage basins by means of open ditches. Table I gives the principal facts of each existing transmountain diversion.



TUNNEL LENGTHS INCREASE AS ELEVATION FALLS
Section through mountain range on headwaters of Fraser River.

These diversions are made chiefly by open ditch and represent practically the limit of transmountain diversion by that relatively inexpensive means.

The continued need for additional water on the eastern slope of the Rockies has caused water users to propose additional diversions of greater magnitude and cost. Table II shows the principal proposed diversions. The total may reach 300,000 acre-ft.

TABLE II—PROPOSED TRANSMOUNTAIN DIVERSIONS

Applicant	Diversion From	Diversion To	Elevation of Tunnel Feet	Length of Conduit: Tunnel, Miles	Length of Conduit: Ditch, Miles	Estimated annual Diversion, Acre-Feet
City of Denver	Fraser River	Clear Creek	9,200	6½	31	100,000
do	Williams Fk.	do	10,400	3	19	36,000
do	Blue River	Tarryall Creek	10,300	3½	92	98,000
Water users in Arkansas Valley	Eagle Rver	Arkansas River	10,200	2	15	24,000
do	Fryingpan Cr	do	11,600	2*	3	7,000
Water Supply & Storage Co.†	N. Fk. Colo. River	Cache la Poudre		0	7	10,000
Total				17	167	275,000

* Ivanhoe tunnel on abandoned Colorado Midland Ry.
† Proposed extension of Grand River ditch.

The monthly amount of water possible of diversion under each plan has been computed for the year 1916, which was practically a normal year, as shown by the 22-year record of Colorado River at Glenwood Springs and the results are given in Table III.

TABLE III—TOTAL MONTHLY DIVERSIONS FOR NORMAL YEAR

Diversion	Total Amount Diverted in Acre-Feet: May*	June	July	Aug.	Sept.	Oct
Fraser River	14,300	34,400	14,800	9,400	5,030	3,660
Williams Fork	1,980	14,500	8,500	4,670	2,240	1,760
Blue River	9,510	36,000	21,300	15,600	6,320	6,280
Eagle River	3,190	10,900	3,230	1,510	1,020	730
Fryingpan Creek	750	2,890	1,410	715	308	164
No. Fk. Colorado River	1,270	3,960	1,580	875	668	504
Total	31,000	103,000	79,900	32,800	15,600	13,100

* Partial month.

The effect of these diversions upon the discharge of the Colorado River at the state line is shown in Table IV by a comparison with the discharge of the Colorado River near Fruita (near the state line) for 1916.

The slight effect that the proposed diversions will have upon the flow of the Colorado River at the state line shows how groundless are any fears that may be entertained as to the effect of transmountain diversions upon the flow of the lower Colorado.

TABLE IV—EFFECT OF DIVERSIONS ON DISCHARGE OF COLORADO RIVER NEAR FRUITA

	Discharge in Acre-Feet: May	June	July	Aug.	Sept.	Oct.
Recorded discharge	1,410,000	1,910,000	769,000	536,000	240,000	167,000
Proposed diversion	31,000	103,000	79,900	32,800	15,600	13,100
Reduced discharge	1,380,000	1,810,000	689,000	503,000	224,000	154,000
Per cent of recorded flow	98	95	90	94	93	92

The topography of the upper Colorado basin is such that it is confidently believed the proposed plans represent closely the limit of transmountain diversions, at least for many years to come. In order to divert the 275,000 acre-ft. proposed, it will be necessary to build 17 miles of tunnel and 167 miles of ditch, an undertaking of great magnitude.

The accompanying diagram represents roughly the section through the range on the headwaters of Fraser River and is typical of similar sections on other headwater streams. This diagram shows that as the elevation of the proposed tunnels decreases their lengths increase greatly. Near the mouth of Fraser River (El. 8,500 ft.) a tunnel would be 14 miles long and would intercept the run-off from 220 sq.mi., amounting to 158,000 acre-ft. A system of collection ditches would increase this amount somewhat. On Williams Fork, if the proposed tunnel were lowered 900 ft. to El. 9,500 ft., its length would be increased from 3 to 7 miles and the run-off intercepted would be increased from 36,000 to 56,000 acre-ft. On Blue River a lowering of the proposed tunnel 800 ft. (El. 9,500 ft.) would increase its length from 3½ to 17 miles. It is impossible to state the amount of run-off that would be intercepted, because long collection ditches are needed in this basin, and the success of these is doubtful. On Eagle River a tunnel 700 ft. lower (El. 9,500 ft.) than that proposed would be 14 miles long and would intercept the run-off from 67 sq.mi., amounting to 50,000 acre-ft.

The foregoing facts show that the increased expense of the greater lengths of tunnels is out of proportion to the increased amount of water intercepted. This is due to the fact that the snowfall on the mountain range is heaviest at the top and decreases greatly with a decrease in altitude. (Follansbee, Robert, "Some Characteristics of Run-Off in the Rocky Mountains," Water Supply Paper 500-C, U. S. Geological Survey.) Investigation of the stream-flow records on Fraser River shows that at El. 9,200 ft. the annual run-off is 1,200 acre-ft. per square mile. The unit run-off from the area between that and the mouth of the river (El. 8,000 ft.) is only 644 acre-ft. per square mile or about half of that from the upper area. Exact figures can not be given for the other headwater streams but data on other mountain streams all confirm the statement that unit run-off in a drainage basin decreases rapidly with decrease in altitude.

Any proposals to divert greater amounts than those already outlined will face the adverse conditions of greatly increased cost of tunnels which will cover areas yielding a decreasing amount of additional water. These two adverse conditions of greatly increased cost and decreasing unit run-off from the additional areas reached illustrate admirably the economic law of "diminishing returns," and it is confidently believed that this law will operate against any considerable extension of diversions beyond those proposed.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

A New Book by Secretary Hoover

AMERICAN INDIVIDUALISM—By Herbert Hoover. Garden City, N. Y.: Doubleday, Page & Co. Cloth; 5x7 in.; pp. 72. $1.

This little book, which can be read in less than an hour, reveals another of the many sides of Herbert Hoover, that of social philosopher. The thesis of the book is that the social philosophy of our institutions is that of individualism, but individualism restrained by insistence upon maintaining equality of opportunity for all. The ideals of this individualistic philosophy are thus expressed by Mr. Hoover:

> That while we build our society upon the attainment of the individual, we shall safeguard to every individual an equality of opportunity to take that position in the community to which his intelligence, character, ability, and ambition entitle him; that we keep the social solution free from frozen strata of classes; that we shall stimulate effort of each individual to achievement; that through an enlarging sense of responsibility and understanding we shall assist him to this attainment; while he in turn must stand up to the emery wheel of competition.

These ideals Mr. Hoover proceeds to examine on philosophic, spiritual, economic and political grounds. The argument is particularly interesting when it relates to the economic and political phases. Mr. Hoover reviews the various curbs to individualism that have been developed as a result of our industrial progress and points out how legal inhibition has steadily tended to thwart the adverse influence of these developments. He says:

> The growth of corporate organizations, of our banking systems, of our railroads, of our electric power, of our farm co-operatives, of our trade unions, of our trade associations and of a hundred others, indeed, develops both beneficent and malign forces. The timid become frightened. But our basic social ideas march through the new things in the end. * * * Progress requires only a guardianship of the vital principles of our individualism with its safeguard of true equality of opportunity in them. * * * A great test of the soundness of a social system must be its ability to evolve out of itself those orderly shifts in its administration that enable it to apply the new tools of social, economic and intellectual progress, and to eliminate the malign forces that may grow in the application of these tools.

In his discussion of the political phases of our individualistic philosophy, Mr. Hoover lays down very precisely the dividing line between government regulation of the forces of business and government production or distribution of commodities and services. The government's duty is to safeguard equality of opportunity, which is accomplished by regulation; it must maintain the initiative of our people, which is accomplished by the government staying out of production and distribution.

Very neatly does Mr. Hoover dispose of the demagogues who find fault with our system and who live by pointing out its deficiencies. He admits that our social system, as well as any other, contains faults, but these faults are to him but the spur for renewed energy in their removal—energy which is but a demonstration of the vitality of our social ideals.

The book closes with a chapter on the future in which Mr. Hoover reiterates his faith in our social ideals—a chapter which might well become recurrent reading for all who think. Particularly, would it be good reading for those to whom this incisive sentence applies, "The perpetual howl of radicalism is that it is the sole voice of liberalism—that devotion to social progress is its field alone."

The book deserves wide circulation and serious study. It has been placed on our shelves alongside the contributions to social thinking of two other great engineers, alongside of Morrison's "New Epoch," the crystallization of thinking on the "manufacture of power," and Steinmetz's "America and the New Epoch," a most stimulating book, although it contains much with which to disagree.

The Technique of Freight Transportation

RAILROAD FREIGHT TRANSPORTATION—By L. F. Loree, President Delaware & Hudson Co., Chairman Kansas City Southern Railway Co. New York: D. Appleton & Co. Cloth; 5½x8¼ in.; pp. 771; halftones and line cuts. $5.

There is no lack of books on the various phases of railroad engineering and operation. Location, design, construction, administration, accounting, all have been discussed at length from the viewpoint of the specialist. It has remained for Mr. Loree, however, to present an exhaustive and authoritative exposition of the technique of railroad transportation, with respect to its major economic function of moving the produce of our mines, fields, and factories. Although, in carrying out this purpose, he has been compelled to treat of the several technical services involved in the maintenance and operation of the transportation machine, he has limited this treatment to those considerations which have a direct bearing upon freight transportation.

Mr. Loree handles his subject under seven main heads. The first of these deals especially with the work of the civil engineer and discusses the permanent way as an essential factor in the conduct of transportation. Track, structures, grade and alignment improvements, water and coal stations, signals, yards, and all other elements that go to make up the fixed railroad structure are discussed at length with respect to their contribution to adequate and economical transportation.

Then follow sections on shops and equipment, field and staff organization, accounts and statistics, the movement of cars, the movement of engines and trains, and finally a very full section, divided into two parts, in which is reviewed the history of railroad labor relations and the current problems involved in the human side of the industry.

All of these chapters may be read with profit by the engineer in whatever field he may be working. At times he may find irksome the detailed description of operations unrelated to his own work, but on the whole the book is easy reading and affords an exceptional outlook upon the technical problems of our second national industry, in the operation of which engineering is so vital an element.

Aside from the identity of the author as president of one railroad and chairman of another, and from his lifetime of experience as a railroad engineer and executive, the best index to the practical and authoritative character of the book is found in the following quotation from the foreword, in which Mr. Loree describes the process of its making:

> I therefore sat down to the preparation of a series of memoranda on freight transportation, pointing out some of the things that help and some that hinder the prompt and regular movement, and this in spite of a full recognition that there is a universality of duty and interest running through the whole railroad world which makes it very difficult to deal with one part of that world only. These were submitted, from month to month, to the officers of the companies of which I had charge, for discussion and consideration with reference to their own situation and practice. The methodical study of problems thus presented serves to focus thought and activity upon current duties with the happiest results. Prepared originally for the officers of my own companies, I venture to offer this material, expanded and rearranged, to the whole body of railroad officers in the hope that it may be helpful to them.

Least Squares

REVIEWED BY OSCAR S. ADAMS

Mathematician, U. S. Coast Goedetic Survey, Washington, D. C.

PRACTICAL LEAST SQUARES—By Ora Minor Leland. New York and London: McGraw-Hill Book Co. Cloth: 6 x 9 in.; pp. 237. $3.

This work is based upon a series of lectures that the author gave for several years to classes of civil engineering students at Cornell University. As the title indicates, it is the practical side of the subject that is kept in the foreground throughout. To the man who wants to use "Least Squares" as a tool in his work, this feature cannot be commended too highly. The pure mathematician may prefer the theoretical side of the subject, but the engineer and the physicist want to know how to apply the method to the problems in hand.

The introduction gives a clear discussion of the various classes of errors, and passes from the assumption of the arithmetic mean to the method of least squares. All people who deal with the measurement of physical quantities have need to note carefully this classification of the errors that may enter into observations, as well as to master the most practical method of dealing with accidental errors. This introduction is therefore important and the subject is well treated in a style that is easily followed.

After a short chapter on "direct observations of one quantity" we pass to "indirect observations of a function of the unknown quantities." Incidentally the subject of weighting of observations is developed and illustrated by examples.

The formation and solution of normal equations are important features that must be thoroughly mastered by those who wish to apply the method to practical problems. A very well written chapter is therefore devoted to the subject of the solution of such sets of equations.

The two chapters treating of "observations of dependent quantities; conditioned observations" are devoted largely to the adjustment of triangulation. This is a phase of the subject in which the author has had a great deal of experience and hence he is well qualified to present the matter in a clear and concise manner. There is no other field that illustrates in such a striking manner the practical utility of the method of least squares for reconciling the various discordant results due to the accidental errors of observation. Such complicated inter-relations arise due to the geometric equations of conditions that such a tool is absolutely necessary for the practical elimination of the discrepancies.

Engineers may well profit by these two chapters written in a readable style by an acknowledged authority on the subject. To other readers, this phase of the applications should be of interest because it furnishes such an excellent field for illustrating the general principles of the method of adjustment of observations.

To the physicists, the chapter "empircal formulas" will be more directly of interest and use. After the type of the curve is decided upon the method of least squares gives the most satisfactory scheme for determining the necessary constants.

The subject of precision is taken up toward the end of the book since for practical applications this part is less important that the method of using "least squares" for adjustment purposes. This phase of the subject is more theoretical and hence not much more is given than the required formulas. In the four appendices, some account is given of the theory upon which the subject is founded; this part will of course be of least interest to the practical man.

The whole work is written in the lecture style and is well illustrated by examples that are solved in the text. The subject matter might possibly have been better arranged for reference work, but the rather full index will serve as an aid in locating any desired topic. As a text-book, it has the disadvantage of being devoid of problems to be solved by the student. No greater help can be found for mastering a mathematical subject than the solution by the student of problems illustrating the principles that have been established. As a practical text for the non-mathematical worker it must be given a high place and it deserves careful consideration by the pure mathematician as well.

Short Essays on Industrial Economics

SOME PROBLEMS IN CURRENT ECONOMICS—By M. C. Rorty, M.E., E.E., President National Bureau of Economic Research. Assistant Vice-President American Telephone and Telegraph Co. New York: A. W. Shaw Co. Cloth; 5 x 8 in.; pp. 142. $1.25.

In five brief esays Mr. Rorty has presented a series of studies on the economic, financial, and statistical aspects of modern industry. He makes no claim to thoroughness from the standpoint of the trained economist and has sought to base the various discussions upon fact rather than upon opinion or personal judgment. The author has provided a check upon his dicta concerning controversial subjects by submitting his text to friends, representative of the Socialist and labor viewpoints. Their comments and criticisms have been printed as footnotes to the text with which they take issue, a procedure that is exceedingly helpful to the reader in contrasting the diverse opinions.

The essays deal with industrial history, social and industrial organization, production and distribution, some pertinent statistics, in which the author discusses the relations between physical production, wages, and the distribution of the national income, and finally an outline of present day conditions ending with a constructive program for industrial development.

The author's viewpoint may best be understood from the following quotation from his preface:

After nearly twenty years' experience as engineer and executive, the necessities of the writer's employment compelled him, as a very practical matter, to undertake a study of economic fact and theory. In nearly every case the initial study of theory was incidental to the pressing demands of some practical problem. * * * This peculiar background for the several essays while explaining certain omissions may also, it is hoped, give the volume some degree of special usefulness to the practical man who feels the need for a general knowledge of economics, but lacks the time necessary for the reading of more technical and extensive treatises.

A Practical Book on Mosquito Control

MOSQUITO ERADICATION—By W. E. Hardenburg, Sanitary Engineer, Certified Member American Association of Engineers. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 248; 146 half tones and line drawings. $3.

In writing this book the author's aim was to outline concisely the best practice in mosquito control, avoiding a bulky volume but omitting nothing of value. Thomas J. Headlee, entomologist, New Jersey Experiment Station, who has examined the volume for *Engineering News-Record*, gives his opinion of the volume as follows:

> The book appears to be a pretty good digest of the principal facts relating to mosquito control as practiced in the United States, and should prove a useful handbook for persons engaged in the practical work itself, especially where that work is concerned with malarial mosquito control problems. The weakest part of the work is its consideration of the salt marsh mosquito control problems. That portion of the book devoted to educational and publicity matters is perhaps its best executed section. Of course, there are minor mistakes such as one finds in all books, but there do not appear to be enough of them to merit serious condemnation.

The opening chapter, The Toll of the Mosquito, deals with the insect as a vehicle for the transmission of malaria, yellow fever, dengue and filariasis. The economic significance of the insect both as a disease spreader and as an annoyance is discussed, particular attention being given to malaria as a labor problem. The entomology of the mosquito is taken up in a chapter entitled Some Disease Bearing American Mosquitos. Control measures are next considered, first by means of a review of a number of specific campaigns—in the Canal Zone, on the St. Louis & Southwestern R.R., and at and near American camps during the recent war. Chapters follow on initiating anti-mosquito campaigns and on administering the work when under way. These lead up to the engineering and allied aspects of the subject—inland and salt marsh drainage (40 and 20 pages, respectively), oiling, fish control, screening and various other measures, combative and protective, the latter including mass treatment by quinine of malaria-infected populations. The final chapter, Rural Mosquito and Malaria Control, takes up the need of a survey, the protection of homes in swamps, rice-field problems and rural community measures. Appendixes contain a table to assist in identifying certain common American mosquitos, an approved anti-mosquito ordinance, a leaflet for educational campaigns, and a bibliography.

Of the numerous earlier volumes on the mosquito control problem noticed in these columns the only one we remember as having been written from the engineering viewpoint is "Mosquito Control in Panama," by Joseph A. Le Prince and Dr. A. J. Orenstein (see *Engineering News*, Oct. 19, 1916). As its title indicates, that volume was restricted in scope. Mr. Hardenburg's book is comprehensive but concise and promises to be of much usefulness to the growing number of engineers and others concerned in mosquito control.

Bishop's Structural Drafting Revised

REVIEWED BY R. FLEMING

American Bridge Co., New York City

STRUCTURAL DRAFTING AND THE DESIGN OF DETAILS—By Carlton Thomas Bishop, C. E., Assistant Professor of Structural Engineering, Sheffield Scientific School of Yale University; formerly Draftsman for the American Bridge Company and Chief Draftsman for the Hay Foundry & Iron Works. Second Edition Revised. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 11 x 9 in.; pp. 352; illustrated. $5. (25s. net.)

In reviewing the first edition of this book (*Engineering News-Record*, June 17, 1920, p. 1215) the present writer made the prediction that the general excellence of its contents would make it a standard in the field of structural drafting for some time to come. That this has been the case is verified by the favorable reception and large sales accorded to the book.

The revisions in the second edition consist mainly in changing the weights, dimensions and properties of I-beams and channels to conform to the revised standards adopted in 1920, of the Association of American Steel Manufacturers; also the weights, dimensions and properties of Bethlehem I-beams and girder beams to conform to the standards of the Bethlehem Steel Co., effective Oct. 1, 1922. The diagram and the formula used in determining the net sections of tension members have been modified to facilitate finding the rivet-hole areas to be deducted. The paragraphs on Shear (p. 202) and on Members which Resist Bending and Direct Stress (p. 215) have been partially rewritten for greater clearness. It is noted that some statements (pp. 121, 219, 266) which the reviewer criticized have been corrected.

Revisions could well have been made in a few figures embodying details that are becoming obsolete. The author and the reviewer evidently still differ regarding notation expressing moments: "pound-feet" or "foot-pounds," "pound-inches" or "inch-pounds." The reviewer still thinks that a few short additions could profitably be made: rolled steel slabs, angle clips at ends of members, drafting-room errors could each have two or three paragraphs.

The book as it stands is a credit to both author and publisher and will doubtless long continue to be the leading authority on the subject of which it treats.

For Large Industrial Concerns

STORES AND MATERIALS CONTROL: Including Procurement by Manufacture and by Purchase—By Madison Cartmell, A.B. Consulting Industrial Engineer, Assoc. M. A.S.M.E., Member National Association of Cost Accountants. New York: Ronald Press Co. Cloth; 6 x 9 in.; pp. 459; line cuts. $4.50 net.

Construction companies, except the very largest, will get little but general principles from this volume which offers, however, a most comprehensive manual of directions and working forms for manufacturers and large industrial concerns having a continuous heavy stock of materials to procure and store. The book gives about equal space to procurement and to control, there being 217 pages on control including storing and 40 pages on procurement by manufacture and 120 pages on procurement by purchase.

Essentially the book is a manual. It explains in detail proceedings, records and accounting. Forms are suggested for records and accounts of all kinds, and there are control charts of various sorts. From all these the large construction organization can draw suggestions, but they are prepared specifically for the manufacturer.

The Study of Labor Problems

AN INTRODUCTION TO THE STUDY OF LABOR PROBLEMS —By Gordon S. Watkins, Ph D., Associate Professor of Economics, University of Illinois. (Crowell's Society Service Series.) New York: Thomas Y. Crowell Co. Cloth; 6 x 9 in.; pp. 664. $3 net; postage extra.

Here is an effort to present in one fair-sized volume a review of the basic facts and a survey of the current trends that have to do with the human side of industrial relations. Prof. Watkins has divided his work into three parts. The first describes the nature and relates to the growth of labor problems from the earliest of social relations through the complications that arose with the industrial age in Europe to their later development in the United States. This part is brief and necessarily sketchy, but it is helpful because of its very simplicity.

The second part analyzes the problem. Here are discussed the various factors that enter into it, such as the standard of living, wages, hours of labor, women and children in industry, human waste, unemployment, labor turnover, immigration and industrial unrest. In his analysis Prof. Watkins is in general fair and constructive, although in spots he sets forth ideals and aspirations as though they had already become realities and might be attained or realized by fiat or enactment.

In Part III are considered the agencies and methods of readjustment. It touches upon organizations both of labor and of employers, the adjustment of industrial disputes through legislation and through the internal organization of industry, personnel administration, industrial education and training, co-operative movements, socialism, labor legislation and social insurance. Although Prof. Watkins disclaims reliance upon any panacea for healing economic strife, it is evident that he has high hopes of what he calls "a greater degree of democratic control." To what extent he would be willing to place the control of industrial property and resources in the hands of irresponsible and oft-times transient employees he does not make clear. It is evident, however, that as regards the controversial aspects of the labor problem, the author is disposed to smile encouragement to the employee and to frown admonition upon the employer. This is best illustrated perhaps by contrasting his conclusions as to labor unionism with those concerning employers' associations:

> Unionism is a product of industrial conditions, and is therefore inevitable and necessary. If the lessons of history teach anything, it is that labor organizations cannot be crushed and that if suppression were possible it would not be desirable either industrially or socially. Unionism is indispensable to the protection of the workers' interests against the selfish and unsocial attitude and practices of unscrupulous employers. Labor organizations, however, when allowed to function uncontrolled by society may be a power for harm. It becomes necessary, therefore, for society to legalize the peaceful functions of unionism and to punish violent and illegal activity. Such punishment, however, must be based upon adequate and impartial investigation of fact and not upon the perjured evidence and testimony of anti-union forces.
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> To gain public approval and confidence, associations of employers must adopt a three-fold policy: (1) Every effort must be made to prevent monopolistic control of prices, whether secured by the associated employers independently or acting in collusion with labor organizations. (2) Their activities with regard to industrial relations must be constructive rather than destructive, that is, they must recognize the necessity and justification of organization and collective bargaining on the part of the workers and accord to the latter the same rights and privileges which they claim for themselves. (3) They must recognize that industry, business and commerce should be administered for public service and not for the aggrandizement of private interest; that production is a partnership, in the management of which consumers and employees should have a voice. Functioning to these ends employers' associations will become an institution fundamental to the maintenance of industrial peace and the promotion of social progress.

Prof. Watkins' book is not essentially controversial, and the display of personal sympathies in no wise detracts from its worth as a compact and comprehensive summary of the field of industrial relations. As a work for convenient reference it will fill a place of unquestioned importance.

Modern American Locomotives

LOCOMOTIVE CYCLOPEDIA OF AMERICAN PRACTICE: Definitions and Typical Illustrations of Locomotives, Their Parts and Equipment; Descriptions and Illustrations of the Tools and Methods Employed in Their Construction and Repair; Locomotives Built in America for Industrial Operations and for Foreign Railroads—Sixth Edition, 1922. Compiled and Edited for the American Railway Master Mechanics Association, Division V, Mechanical (Formerly American Railway Master Mechanics Association). Editor, Roy V. Wright, Managing Editor of the *Railway Age* and Editor of the *Railway Mechanical Engineer*; Managing Editor, Charles N. Winter, Managing Editor of the *Car Builders' Cyclopedia* and Associate Editor of the *Railway Age*. Advisory Committee: A. W. Gibbs, Chief Mechanical Engineer, Pennsylvania Railroad; F. J. Carty, Mechanical Engineer, Boston & Albany; G. S. Goodwin, Mechanical Engineer, Chicago, Rock Island & Pacific; F. H. Hardin, Chief Engineer Motive Power and Rolling Stock. New York Central Lines. New York: Simmons-Boardman Publishing Co. Cloth; 9 x 12 in.; pp. 1,155; 2,740 illustrations. Cloth $8. Leather $12.

As a detailed and comprehensive book on the modern locomotive and its innumerable parts and appliances, this book has great value and interest, but it must be explained that it does not deal with locomotive design or history. A good share of the credit for initiating and preparing an encyclopedia of the locomotive must be given to the American Railway Master Mechanics Association (now merged with the American Railway Association), for in 1905 it authorized the *Railway Gazette* to publish an "illustrated dictionary," under the supervision of a committee of the Association. Each of the six editions has been prepared with the assistance of an advisory committee composed of railway mechanical officers. Much individual information is given by builders of locomotives and manufacturers of appliances.

In this edition a new system of classification of subjects has been introduced. A 90-page dictionary of terms is followed by about 100 pages of general descriptions of steam locomotives of various classes. Then come descriptions and drawings of practically every part and appliance used in the construction and equipment of a locomotive and its tender. This portion includes special chapters on such subjects as locomotive tests and inspection, feed water treatment, brakes, heating apparatus and electric headlights. There are also numerous specifications, as for forgings, axles, wheels, tires, springs and iron and steel castings. Drawings of train-control apparatus are given, although there is no descriptive text relative to train-control systems.

Electrification (about 56 pages) includes descriptions of different types of locomotives and control systems, electrical appliances, and several main-line electric installations. A section on foreign and industrial locomotives takes up only American engines exported to numerous countries. Industrial locomotives include fireless, compressed air, geared, rack and electric engines. Materials of construction (with specifications), safety appliances and tool equipment for locomotives are subjects of separate chapters. A section on shop work is of special interest since it includes methods of scheduling and routing the repair work of a locomotive as well as a study of machine-tool performance and detailed descriptions of a variety of machine tools used in railway shops.

Profuse illustration is a feature of the book and both its halftones and line engravings are excellent, with clear and legible lettering on the drawings. The quality of the paper is a great aid to this result. Many of the halftone views are accompanied only by brief lists of general dimensions, but they are of interest in showing varied designs of engines of the same type as well as engines of numerous different types. Accessories include an index, table of contents, index of trade names and directory of manufacturers of materials and appliances.

Testing Paints, Varnishes and Colors

REVIEWED BY ROBERT JOB

Vice-President Milton Hersey Co., Ltd., Montreal; Chemist, Lehigh Valley Railroad; Chemist, Grand Trunk Railroad and Canadian National Railways; Assistant Chemist, Canadian Pacific Railway

PHYSICAL AND CHEMICAL EXAMINATION OF PAINTS, VARNISHES AND COLORS.—By Henry A. Gardner, Director Scientific Section, Educational Bureau, Paint Manufacturers' Association of the United States; National Varnish Manufacturers' Association, Co-operating. Washington, D. C.: P. H. Butler, Sales Agent, 1845 B St., N. W. Cloth; 6 x 9 in.; pp. 219; various circulars of the U. S. Bureau of Standards; halftones and line cuts. $9.

During recent years much experimental work has been done on the chemical and more particularly the physical testing of paints, varnishes, japan driers and various paint oils and thinners. The American Society for Testing Materials has taken an active part in this work through its Committee D1., and the same has been true of the United States Government through various branches, particularly the Bureau of Standards. Also the Paint Manufacturers' Association of the United States through its Scientific Section has been doing excellent work. Mr. Gardner, who has been closely identified with these investigations, has here collected some of the more important of these data, with the object of placing conveniently in the hands of paint manufacturers and testing engineers methods of analysis and of physical test for the various paint materials, and he has also collected in the latter part of the book the recent specifications of the United States Federal Specifications Board pertaining to these materials.

Taken as a whole, Mr. Gardner's work will be a most useful addition to the reference library of the manufacturer and paint technologist, as well as to the laboratory work-bench. The methods have been carefully developed, and various useful forms of apparatus are described which have been designed by Mr. Gardner and his associates, and this work will unquestionably assist in further progress.

Some omissions may be noted: The physical testing of japan driers is more important as a means of practical valuation than the chemical analysis; also wood turpentine of various grades is widely used. Some grades are of very good quality and satisfactory for general shop use. Other grades, however, are so objectionable that they cannot be used without causing discomfort and difficulty. The chemical analysis is often within the usually accepted limits, but some standard as to odor might well be adopted.

The standard specifications of the Federal Specifications Board are of great value. Occasionally they are rather complex, and as a result of further work they can no doubt be simplified. For example, the specifications for Water-Resisting Spar Varnish seem cumbersome, and as a matter of practice the reviewer finds that they cannot be depended upon to ensure getting varnish which when applied to railway cars exposed to great variations of temperature will give the eighteen months' service which should be readily secured from high-grade varnish of proper quality. This, however, merely means that further development is needed, and Mr. Gardner rightly points out the vital importance of the physical testing of varnishes as contrasted with mere chemical analysis.

Mr. Gardner's work should be in the hands of everyone interested in manufacturing or testing paint materials.

German Tests of Various Woods

REVIEWED BY HERMANN VON SCHRENK

Consulting Timber Engineer, St. Louis, Mo.

DIE BISHERIGEN ERGEBNISSE DER HOLZPRÜFUNGEN IN DER MATERIALPRÜFUNGSANTALT AN DER TECHNISCHEN HOCHSCHULE STUTTGART—Von R. Baumann. Berlin: Julius Springer (for the Vereins deutscher Ingenieure). Paper; 8 x 11 in.; pp. 139; 87 diagrams and 13 double-page plates devoted largely to the microscopic structure of woods.

This paper deals largely with the results obtained during the war period in making tests for the development of wood parts for airplane and motor-truck service. Various samples submitted commercially were tested in an all-dry condition. The samples included the usual coniferous woods available in Germany, such as pine, spruce, and larch; North American Douglas fir, hemlock, white pine; South American Kauri pine; and among hardwoods, all the European varieties and numerous foreign woods, such as teak, gahoon, mahogany and jarrah.

After an introduction giving detailed descriptions of the methods of testing, which included compression, torsion, hardness and glue tests, the author describes the various strength properties of the woods in detail, discussing among other factors the influence of direction of cutting, comparative value of heart and sapwood, moisture, influence of knots, direction of grain, influence of defects, of moisture, of frost, of age, and of treatment with oils and other preservatives. Detailed descriptions of the species considered are given.

For American engineers the paper is of interest largely because of the methods employed in making the investigations, although there are tables dealing with strength factors of American woods. There are in addition certain definite remarks which confirm many American investigations. Mr. Bauman finds that under equal conditions sapwood is as strong as heartwood. He also confirms the findings of the U. S. Forest Service that density is a vital factor in determining the strength of coniferous woods, calling particular attention to the relation of the harder summer wood in the following words: "In considering the strength, therefore, it is essential in similar pieces to consider not the width but the relation between the hard and soft portions of the annual ring."

The only defect of an otherwise excellent paper is a lack of conclusions in various chapters.

PUBLICATIONS RECEIVED

New Books and Revised Editions

AMERICAN RAILROADS: Government Control and Reconstruction Policies By William J. Cunningham, A.M., James J. Hill Professor of Transportation, Graduate School of Business Administration, Harvard University. New York, Chicago and London: A. W. Shaw Co. Cloth; 6 x 8 in., pp. 109. $3.

COST ACCOUNTING PROCEDURE—By William B. Castenholz, A.B., C.P.A., Director Department of Higher Accountancy, La Salle Extension University. Chicago: La Salle Extension University. Cloth; 6 x 9 in.; pp. 333; illustrated $3.50

Underlying principles and their application discussed and accounting methods presented; based chiefly on production orders.

THE LAW OF CITY PLANNING AND ZONING—By Frank Backus Williams, A.M., LL.B., of the New York Bar. [The Citizen's Library of Economics, Politics and Sociology, New Series]. New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 738. $5.

MECHANICAL WORLD YEAR BOOK, 1923. Manchester, England: Emmott & Co.. Limited. Cloth; 4 x 6 in.; pp. 348. 1½s.

THE PLANNING OF THE MODERN CITY: A Review of the Principles Governing City Planning—By Nelson P. Lewis, M. Am. Soc. C. E., M. Am. City Planning Inst., formerly Chief Engineer of the Board of Estimate and Apportionment of New York City. With the Assistance of Harold M. Lewis, M. Am. Soc. C. E. Second Edition Revised. New York: John Wiley & Sons. London: Chapman & Hall. Cloth: 6 x 9 in.; pp. 457; 87 plates and 62 figures and diagrams in the text. $5.

PRACTICAL MECHANICS AND STRENGTH OF MATERIALS—By Charles Wilbur Leigh, B.S., Associate Professor of Mechanics at the Armour Institute of Technology. New York and London: McGraw-Hill Book Co. Cloth, 5 x 8 in.; pp. 293; illustrated. $2.25.

Designed for night and vocational schools, short college courses in mechanics and men engaged in practical construction work; in each chapter on Strength of Materials there is first given the "principles of mechanics that are necessary." A working knowledge of algebra, geometry and trigonometry is considered sufficient for those using the book.

PRATIQUE DU CALCUL DU BÉTON ARMÉ Par G. Magnel, Chargé de Béton Armé a L'Université de Gand, Chef des Travaux au Labatoire de Résitance des Matériaux. I Partie. Gand, France: Van Rysselberghe & Rombaut. Paper; 6 x 9 in.; pp. 159; line cuts.

RAPID ARITHMETIC: Quick and Special Methods in Arithmetical Calculation Together with a Collection of Puzzles and Curiosities of Numbers. By T. O'Connor Sloane, Ph.D., LL.D., Author of Arithmetic of Electricity, Standard Electrical Dictionary, etc. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 189. $1.50.

STANDARD SPECIFICATIONS FOR STEEL HIGHWAY BRIDGES—Ottawa, Ont.: Canadian Engineering Standards Association, West Block. Stiff Paper; 6 x 9 in.; pp. 75; line cuts. 25c.

A TREATISE ON THE LAW OF SURVEYING AND BOUNDARIES—By Frank Emerson Clark of the Minnesota Bar. Indianapolis, Ind.: The Bobbs-Merrill Co. Cloth; 6 x 9 in.; pp. 631; illustrated. $5.

THE WORLD ALMANAC AND BOOK OF FACTS, 1923—Edited by Robert Hunt Lyman. New York: Press Publishing Co. Paper; 6 x 9 in.; pp. 888. 35c.; 50c. postpaid.

New matter added to the wide range of facts previously included increases the value of this highly useful annual, which continues to be offered at a nominal price.

Reports and Pamphlets in Various Fields

AMERICAN SOCIETY FOR TESTING MATERIALS: Proceedings, 1922. Philadelphia: As above, 1315 Spruce St. Two volumes. Cloth; 6 x 9 in.; pp. 1,023 and (technical papers) 591; illustrated. $6 per volume.

CANADIAN RAILWAY STATISTICS, 1921. Ottawa, Ont.: Dominion Bureau of Statistics. Paper; 6 x 9 in.; pp. 236.

CAUSTIC MAGNESIA CEMENT. Washington, D. C.: Bureau of Standards. Paper; 7 x 10 in.; pp. 14. 5c. from Superintendent of Documents, Washington, D. C.

CITY MAPPING: The Making of Topographical Maps of Cities and Towns, the First Essential in Town Planning—By Douglas H. Nelles, Ottawa, Ont.: Geodetic Survey of Canada. Paper: 6 x 9 in.; pp. 40.

DAILY RIVER STAGES at River Gage Stations on the Principal Rivers of the United States, 1921—By H. C. Frankenfield Meteorologist. Washington, D. C.: U. S. Weather Bureau. Paper; 9 x 12 in.; pp. 277.

EFFECT OF NICKEL-CHROMIUM ON CAST-IRON—By Richard Moldenke, E.M., Ph.D., Watchung, N. J. Reprinted from *Transactions* Am. Inst. Min. and Met. Engrs. Bethlehem, Pa.: Bethlehem Steel Co Paper; 6 x 9 in.; pp. 23

An extended series of cast-iron test bars was poured from crucible-melted iron. The findings indicate that standard bars having medium total carbon, low phosphorus, silicon about 1.75 per cent, and nickel and chromium 0.15 each, will bear a transverse load some 600 lb. greater than one without the alloying elements.

FEDERAL POWER COMMISSION: Report for 1921-22. Washington, D. C.: Paper; 6 x 9 in.; pp. 316.

Summarizes work of year; includes federal water-power act and amendments, orders and decisions of commission, applications for permits and terms of permits issued.

HYDRO-ELECTRIC DEPARTMENT OF TASMANIA: Report for 1921-22. J. H. Butters, Chief Engineer and General Manager, Hobart, Tasmania. Paper; 8 x 13 in.; pp. 54; illustrated.

INDUSTRIAL DEVELOPMENT OF KANSAS—By P. F. Walker, M.M.E., Professor of Industrial Engineering and Dean of the School of Engineering, University of Kansas. Part I: Text; paper; 6 x 9 in.; pp. 53; folding plates. Part II: Industrial Map Section; paper with cloth back; 12 x 12 in. Lawrence, Kan.: Engineering Experiment Station.

A survey of industrial opportunities.

INTERIOR BUILDING CONSTRUCTION: Report on Metal Lath and Gypsum Plaster on Wood Support, Jointly Submitted by Associated Metal Lath Manufacturers, Chicago, Ill., and National Lumber Manufacturers' Association, Chicago and Washington, D. C. Chicago: Underwriters Laboratories, National Board of Fire Underwriters. Paper; 6 x 9 in.; pp. 120; illustrated.

Reports on various tests of above-mentioned fire retardant, with classification recommendations.

INTERSTATE COMMERCE COMMISSION: Report for 1921-22. Washington, D. C. Cloth; 6 x 9 in.; pp. 239.

A LIST OF ALLOYS—By William Campbell, Professor of Metallurgy, School of Mines, Columbia University. Reprinted from *Proceedings* American Society for Testing Materials. Philadelphia: C. L. Warwick, Secretary, 1315 Spruce St. Paper; 6 x 9 in.; pp. 32. $1; 85c. for five or more copies.

A list of some 1,500 different alloys, giving name and chemical composition, grouped in seventeen different classes, from brasses to fusible metals, heat resisting alloys and non-corrosive metals. The list is more complete than any previously published.

MAGNETIC DECLINATION IN THE UNITED STATES FOR JAN. 1, 1920—By Daniel L. Hazard, Assistant Chief, Division of Terrestial Magnetism. Washington, D. C.: U. S. Coast and Geodetic Survey. Paper; 6 x 9 in.; pp. 30; folding maps. Free on application.

An isogonic chart for 1920, containing not only the isogonic lines (lines of equal magnetic declination) but also the lines of equal annual change of declination, is supplemented by a brief summary of the phenomena of magnetic declination, and by brief but thorough instructions for making azimuth observations on Polaris or on the sun. Tables are given for use in the calculations for azimuth.

NATIONAL CONFERENCE ON CITY PLANNING: Proceedings, 1922. Flavell Shurtleff, Secretary, 130 E. 22nd St., New York City. Cloth; 6 x 9 in.; pp. 214; pp. 225.

Among other papers are: "The Design of the Street System in Relation to Vehicular Traffic," by E. P. Goodrich, consulting engineer, New York City, and "The Fundamentals of Transit Planning for Cities," by Daniel L. Turner, consulting engineer, New York City.

NEW YORK STATE BRIDGE AND TUNNEL COMMISSION: Report for 1921. Albany, N. Y. Paper; 6 x 9 in.; pp. 80; illustrated.

SOUTHERN APPALACHIAN WATER POWER CONFERENCE—Proceedings of First Annual Meeting, Asheville, N. C., June 20-22, 1922. Knoxville, Tenn.: J. A. Switzer, Secretary. Paper; 6 x 9 in.; pp. 143.

STATISTICS OF RAILWAYS IN THE UNITED STATES, 1920. Washington, D. C.: Interstate Commerce Commission. Cloth; 9 x 12 in.; pp. 471.

A STUDY OF COAL MINE HAULAGE IN ILLINOIS—By H. H. Stoek, Professor of Mining Engineering; J. R. Fleming, Research Associate in Mining Engineering; A. J. Hoskin, Research Assistant Professor of Mining Engineering. Urbana, Ill.: Engineering Experiment Station. Paper; 6 x 9 in.; pp. 136; line cuts, halftones.

SURFACE WATER SUPPLY OF CANADA: Arctic and Western Hudson Bay Drainage (and Mississippi Drainage in Canada) in Alberta, Saskatchewan, Manitoba and Western Canada. Climatic Year 1919-20—By C. H. Atwood, A.M.E.I.C., District Chief Engineer, Winnipeg, Manitoba, and Arthur L. Ford, District Chief Engineer, Calgary, Alberta. Ottawa, Ont.: Dominion Water Power Branch. Paper; 6 x 9 in.; pp. 343; folding map.

SYSTEM OF ACCOUNTS: Prescribed for Licensees under the Federal Water Power Act—First issue approved Nov. 20, 1922. Washington, D. C.: Federal Power Commission. Paper; 6 x 9 in.; pp. 39.

THE TECHNOLOGY OF SLATE—By Oliver Bowles. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 132; illustrated. One copy free; 20c. from Superintendent of Documents.

On slate quarrying and waste utilization.

TESTS OF DRAINAGE PUMPING PLANTS IN THE SOUTHERN STATES—By W. B. Gregory, Irrigation Engineer. Washington, D. C.: Bureau of Public Roads. Paper; 6 x 9 in.; pp. 54; halftones and line cuts.

Reviews types of pumps in use in section named; discusses suction and discharge pipes and sources of power and operating costs; gives test results.

UNITED STATES GEODETIC SURVEY: Report for 1921-22. Washington, D. C. Cloth; 6 x 9 in.; pp. 148; illustrated.

UNITED STATES SHIPPING BOARD: Report for 1922. Washington, D. C. Paper: 6 x 9 in.; pp. 306.

THE VISCOSITY OF RAW MATERIAL SLURRY USED IN THE MANUFACTURE OF PORTLAND CEMENT—Compiled by J. W. Christelow, B.Sc., A.I.C., and E. Bowes. London: The British Portland Cement Research Association, 6 Lloyds Ave., E. C. 3. Paper; 6 x 10 in.; pp. 23.

WATER POWER SURVEY OF SURRY AND WILKES COUNTIES—By Thorndike Saville, Hydraulic Engineer. Raleigh. N. C.: North Carolina Geological and Economic Survey. Paper; 7 x 10 in.; pp. 41; folding maps.

The first of a series of reports on water powers of counties made by the co-operation of the State and the respective county commissioners.

Letters to the Editor

Protecting Bridges from Automobiles

Sir—Your comment on the new danger to highway truss bridges through being struck by automobiles, as expressed in *Engineering News-Record* of Dec. 21, p. 1054, suggests the advisability of equipping such bridges with skid beams or guard rails carried along the inner face of each truss. In this way the automobile would be prevented from striking an individual member and the force of its blow would be distributed. Even if the skid beams were bent or broken by a car striking them at a sharp angle they would still protect the truss members from direct impact. This method would seem to afford a high degree of protection at low cost.

Such skid beams have been used on important railway bridges to prevent derailed cars from striking the truss members. I have also seen home-made skids applied to one truss of a highway bridge where the approach was at an angle with the bridge. In this case the condition of the skid (a single horizontal angle) showed that it has served its purpose.

Careless or reckless driving and steering of automobiles and motor trucks is a practical condition to be considered by the highway engineer. A certain stretch of road has a series of concrete culverts with heavy pipe handrailing on each side of the road. Although these structures are of recent construction, every one of them has both handrails bent outward and distorted. Since none of them were carried away it is probable that they were struck glancing blows, perhaps as a speeder tried to pass another vehicle.

Chicago, Dec. 23, 1922. Bridge Guard.

Tar Paint and Galvanized vs. Black Steel

Sir—Permit me to add a little from experience on the subject of painting galvanized steel. The Cheesman-Elliot Co. in your issue of Dec. 14 says, "Why Galvanize?" Here is one reason why: A neighbor of mine put up a steel garage of painted corrugated steel. At the same time I put up a galvanized steel garage and painted only the roof and the laps on the sides. In a year or two my neighbor had to renew the roof, as it was all riddled with holes. He has not very much left now but rust, after 4 or 5 years. Mine is practically as good as new. The only place where it rusted is where I bent the sheets at the corners.

If corrugated sheets are bent before they are galvanized they will resist the weather for a long time, particularly on vertical surfaces where the beating of the rain is less severe. I have used galvanized flat sheets for many years for roofs of buildings in the country and have found them to last almost indefinitely. But I have always painted them, not, however, with oil paint. I have also several boats made of galvanized steel and have never had any of them rust through except where bad dinges broke off the galvanizing.

The paint that I always use on these roofs is coal tar paint, when I can get it. Sometimes I have to take asphalt paint at a higher price. The most satisfactory paint I ever used was coal tar paint at 50c. per gal. It sticks to galvanized steel better than anything else I ever tried, and the time to paint it is just when it is placed on the roof or side of a building, regardless of whether it has weathered or not.

There is no theory about this. I bought some "black" iron and some galvanized steel about 10 or 12 years ago and put them both on the same roof. The "black" iron was painted red when I bought it. I had to replace every square foot of it years ago. The galvanized sheets, which I painted with coal tar paint, are still practically as good as new. I have yet to find a spot rusted through.

I have three buildings and part of a fourth roofed in this same manner at Godfrey Station, Pa., and would be glad to show them to anyone who wants to see what galvanized steel painted with tar paint will do. Come in the summer.

Pittsburgh, Dec. 23, 1922. Edward Godfrey.

Arch Dam Measurements

Sir—In *Engineering News-Record*, Nov. 30, 1922, there appears an article by Fred A. Noetzli on "Arch Dam Temperature Changes and Deflection Measurements."

In this article some deflection measurements of the Salmon Creek Dam, Alaska, are given and some speculation is made on these deformations. According to Mr. Noetzli's calculations and formulas this dam should have cracked horizontally in several places, otherwise this particular case would not fit the formula.

To the actual observer there are no visible cracks. Although there is no drainage tunnel in this dam where leakage can be directly observed, there are 3 vertical holes in each of the two contraction joints. These holes were put in for the purpose of grouting, but up until 2 years ago grouting had not been done; the water had not been low enough to cause the joints to open and make grouting feasible. The leakage always was zero commercially, which it would not have been had there been any horizontal cracks. During the last two years the writer has not followed the performance of this dam but does not believe that any horizontal cracks could have developed as there are absolutely no reasons why they should; this work was a first class construction job.

It is impossible to calculate an arch dam accurately unless shear and cantilever action can be eliminated or nearly eliminated (not neglected). This can be approximately but not fully accomplished by grouting the contraction joints under pressure. Then whatever shear there may be in the structure with reservoir empty is in the opposite direction from what it will be with reservoir full. In this way shear and cantilever action are at least greatly reduced in amount by reducing the deflection from the vertical position of the dam.

When a dam is so constructed that with reservoir full the deformation in a down-stream direction becomes smaller than is now general, then it is permissible to raise the allowable stress above say 350 lb. per square inch, which stress may now be regarded as the upper limit for conservation design.

Professor Cain's formulas for arch dams are very likely the most accurate brought out, and if shear and cantilever action can be kept low, are perhaps as accurate as formulas for this complicated problem can be expected to be.

San Francisco, Calif., Dec. 26. Lars Jorgensen.

Much Ado About Nothing—but Dams

Sir—The inane discussion in your issue of Dec. 21 and earlier as to what the height of a dam is, reminds me of an old English conundrum which ran as follows: If it takes a yard of soap to make a flannel waistcoat for a pig, how far is it from St. Paul's to Christmas Day? The answer, I believe, was twelve shillings and sixpence.

Before this momentous question, as to the height of a dam, is settled, I should not be at all surprised to hear that the Arrowrock Dam is really 352.562 ft. in height and not 351.000 as reported, inasmuch as the latter height was measured from a projecting rock on the ground line, now found to be loose.

Why not start a discussion as to what the height of a building is? The question as to whether the foundations, basement floor, natural ground, filled ground, or sidewalk should be the datum would no doubt lead to an endless argument. Then we might try to decide what the height of a mountain is; maximum, minimum or mean? After that, I don't think we should have any difficulty in deciding what the height of folly is.

As to the engineer who avers that "A Dam Is as High as It Dams" I hasten to reply, "Not by a Dam Site."

Denver, Colo., Dec. 29. E. Clinton Jansen.
Chief Engineer, the Colorado Power Co.

[Does our correspondent think that by mere levity he can end a discussion that goes back to the first lofty structure on record? Has it occurred to him that the confusion of tongues had as its main topic a question as to the real height of the Tower of Babel?—Editor.]

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Charles F. Loweth Elected Am. Soc. C. E. President

Has Been Chief Engineer of Chicago, Milwaukee & St. Paul Ry. For Past 12 Years

Charles F. Loweth, newly-elected president of the American Society of Civil Enigneers, has been chief engineer of the Chicago, Milwaukee & St. Paul Ry. since December, 1910. From the same date to Jan. 1, 1913, he was also consulting engineer of the Chicago, Milwaukee & Puget Sound Ry., now operated as the Puget Sound lines of the Chicago, Milwaukee & St. Paul Ry. In his present position he has general supervision of all the engineering, except that of the mechanical department, on more than 10,000 miles of railroad.

The ballot, canvassed yesterday morning, revealed a total of 2,581 votes cast, of which number Mr. Loweth received 2,564. The other officers elected were: Vice-president, Zone 2, George S. Davison, 2,416 votes; vice-president, Zone 3, Anson Marston, 2,447; directors: District 3, Glenn D. Holmes, 2,393; District 5, E. B. Whitman, 2.402; District 7, George H. Feukell, 2,413; District 8, T. L. Condron, 2,414; District 9, R. N. Begien; and District 12, George C. Mason, 2,396.

Elected President of Am. Soc. C. E.

Charles F. Loweth

Born March 3, 1857, at Cleveland, Ohio, Mr. Loweth received his education at Oberlin College, Oberlin, Ohio. He began his enginneering experience in 1876 as rodman on surveys of the Cleveland, Lorain & Wheeling Ry., now part of the Baltimore & Ohio R.R., and was later employed as draftman for the Atchison, Topeka & Santa Fe R.R. In 1881-1882 he was engaged as an engineer in the construction of the Des Moines & Northern and St. Louis, Des Moines & Northwestern Railroads (now parts of the Chicago, Milwaukee & St. Paul Ry.) In 1882-1883 he was engineer with Raymond & Campbell, bridge builders, Council Bluffs, Iowa.

From 1883 to 1901 he was in business as consulting civil engineer in St. Paul, Minn. During this period he designed and supervised the construction of water-works, sewarage and electric lighting systems for more than 100 municipalities throughout the Northwest, as well as a large number of bridges for various railroads, cities and counties, extending from Michigan to Oregon. During this period he was also consulting engineer on bridge construction for the Northern Pacific R.R., the Minneapolis & St. Louis Ry., the Minneapolis, St. Paul & Ste. Marie Ry., the Chicago, Milwaukee & St. Paul Ry. and several others, and chief engineer for the South St. Paul Belt Ry. and Davenport, Rock Island & North Western Ry. In March, 1901 Mr. Loweth became engineer and superintendent of bridges and buildings of the Chicago, Milwaukee & St. Paul Ry. at Chicago.

Mr. Loweth has always taken a prominent part in technical society activities. He has served as a director and vice-president of the American Society of Civil Engineers. He is a past president of the Western Society of Engineers, and served as treasurer and two terms as director of the American Railway Engineering Association. He maintains a membership in the American Society for Testing Materials. The Civil Engineers' Society of St. Paul claims him as a member and past president. As representative of the American Society of Civil Engineers on Engineering Council he performed a notable service.

War Fraud Suits Are Basis of Am. Soc. C. E. Resolution

At its meeting held on January 17 the American Society of Civil Engineers unanimously adopted resolutions expressing its concern over the indictment of several members of the Society, and the institution of civil suits to recover alleged fraudulent expenditures in connection with war construction. The resolution also urged that, in the interests of justice and in accordance with constitutional guarantees, defendants be immediately tried so that if any be guilty, punishment may be imposed, and if innocent, accusations may be lifted. The resolution provided also that copies be sent to President Harding, Attorney General Daugherty, and to presiding officers of the Senate and House of Representatives.

Am. Soc. C. E. To Vote Again on F. A. E. S. Affiliation

Arguments For and Against Membership To Accompany Ballots To Be Sent Out Feb. 15

At the meeting of the Board of Direction of the American Society of Civil Engineers held January 15 and 16 on the eve of the annual meeting of the Society, it was voted to call for another referendum of the membership as to whether the Society should affiliate with the Federated American Engineering Societies. When the matter was brought to the attention of the annual meeting yesterday morning the Board's recommendation was approved and the president and Board of Direction were instructed by a unanimous vote to send with the ballots arguments why the Society should or should not join the Federation. These arguments are to be prepared by two committees: one composed of three directors who favor affiliation with the Federation, and the other to contain three directors who oppose membership in it. Ballots will be mailed the Society membership Feb. 15 and will be canvassed 50 days thereafter. At the 1922 autumn meeting held in San Francisco the Board expressed a favorable attitude toward joining the Federation, provided the financial situation of the Society should warrant it. The outgoing Board has now recommended to the incoming Board that the budget for 1923 provide the necessary appropriation for membership in the federation during the last nine months of 1923.

The outgoing Board recommended to the incoming Board the appropriation of a sum sufficient to provide an allotment of $2 per member for local sections. A proposal was first considered to make the appropriation large enough to allow a $3 allotment, but it was defeated.

In the interest of economy a proposal for a conference of local sections was defeated. It was decided also on the ground of economy to discontinue the publication of the preliminary notice of applications for membership as a separate pamphlet and to include this information in the Proceedings.

The April meeting is to be held at New Orleans on April 18, 19 and 20.

The Board approved the formation of three technical sections, on: Power, Highways, and Irrigation, in addition to that already existing on Sanitation.

Greetings were received from the Engineering Institute of Canada.

C. E. Beam was elected assistant secretary of the Society. He had served since 1918 as assistant to the acting secretary. Mr. Beam is a B.S. in civil engineering of the University of Washington, class of 1914, and did survey, reclamation and highway work in Yakima and Walla Walla Counties, Wash., from 1914 to 1918.

The services of Eleanor H. Frick with the Society for 25 years were recognized and resolutions of appreciation were adopted.

New Honorary Members, American Society of Civil Engineers

SIR MAURICE FITZMAURICE

Sir Maurice Fitzmaurice, author of a number of technical books, former president of the Institution of Civil Engineers of Great Britain, and internationally prominent through his achievements in bridge engineering and irrigation and drainage work, was born in 1861. He was educated at Trinity College, Dublin, receiving degrees of M.A. and M.E. from Dublin and LL.D. from Birmingham. He was apprenticed to the late Sir Benjamin Baker, who also was an honorary member of the American Society of Civil Engineers. From 1901-12 he was chief engineer to the London County Council, and from 1912-18 served as chairman of the Admiralty Advisory Committee on Naval Works.

During the World War and subsequent thereto Sir Maurice Fitzmaurice held numerous governmental positions. During the war he was lieutenant-colonel of engineers in the Engineer and Railway Staff Corps and made two visits to the British front in Flanders at the request of the War Office, to advise on questions of drainage. During 1913 he made a trip to Australia to advise on naval harbors.

Sir Maurice has been engaged in various consulting work including that of the Forth bridge. He was also consulted regarding railways and docks in Canada, the Blackwell tunnel and the Nile reservoir dam at Assouan, Egypt.

From 1916-17 he served as president of the Institution of Civil Engineers. He is also a member of the Institution of Mechanical Engineers, an honorary fellow of the Society of Engineers, an honorary member of the Royal Engineers Institution, member of the Engineering Institute of Canada, vice-chairman of the Engineering Standards Committee, vice-chairman of the Institute of Transport and member of the Advisory Council on Scientific and Industrial Research.

In 1912 Sir Maurice was knighted. He has also received various orders, medals, etc., from the government as well as from British technical associations. He is the author of books on "Plate Girder Railway Bridges," "The Thames and Lea," "London County Bridges," "Main Drainage of London."

LEON JEAN CHAGNAUD

Leon Jean Chagnaud, who was born in a small town in the Department of Creuse, France, and was educated in the *Ecole des Arts et Metiers* at Chalons-sur-Marne, is perhaps best noted for his subaqueous and tunnel construction work. Shortly after his graduation he reconstructed the locks of the Canal du Centre and established the massive concrete fortifications about Toul. One of his professional achievements was the excavation for one of the trunk sewers of Paris. In this work he was largely responsible for the development of the modern method of shield tunnelling for subterranean and subaqueous excavation. On this job the first use in Paris was made of shield tunnelling.

Another of his engineering achievements was the construction of that branch of the Paris subway which extends from the Porte de Clignancourt to the Porte d'Orleans. For the execution of this difficult construction, he was rewarded by the Prix Berger and the bestowal of the Legion d'Honneur.

M. Chagnaud has served the state as a member of the Senate. In 1921 he was president of the Society of Civil Engineers of France.

WILLIAM CAWTHORNE UNWIN

William Cawthorne Unwin was born on Dec. 12, 1838, at Coggeshall, Essex, England. He was educated at the City of London School and was a pupil of the late Sir William Fairbairn. From 1861-68 he was manager of engineering works, and from 1868-72 instructor at the Royal School of Naval Architecture and Marine Engineering at Kensington. For the next thirteen years he was professor of hydraulic engineering at the Royal Indian Engineering College, Cooper's Hill, and during the ten years following that, professor of engineering, Central Technical College of the Guilds of London.

He was secretary of the International Commission on the Utilization of Niagara, and in 1891 was president of section G of the British Association. In 1894 Professor Unwin was a member of the Council of the Royal Society and in 1911 president of the Institution of Civil Engineers. He also served in 1915-16 as president of the Institution of Mechanical Engineers. From 1915-18 Mr. Unwin was a member of the Management Board of the Metropolitan Munitions Committee. From 1900-05 and since 1911 he has served on the Senate of London University.

Mr. Unwin was awarded the Kelvin Medal in 1921 and has had conferred on him the degree of LL.D from Edinburgh. He is also a fellow of the Royal Society, member of the Institution of Civil Engineers, honorary life member of the Institution of Mechanical Engineers, honorary member of the American Society of Mechanical Engineers, and honorary associate of the Royal Institution of British Architects.

He is the author of various technical books and has contributed articles on hydraulics and bridges for the Encyclopedia Britannica.

He is professor emeritus of the Central Technical College, City and Guilds of London Institute.

JOHN FRANK STEVENS

John F. Stevens, who has earned an international reputation in railroad engineering and planning, was born in West Gardiner, Me., April 24, 1853. He was assistant engineer, City of Minneapolis, Minn., from 1874 to 1876; became chief engineer of the Sabine Pass and Northwestern Ry. in 1876; and acted as assistant engineer for the Denver and Rio Grande Ry. in 1879, and the Chicago, Milwaukee and St. Paul Ry. from 1880 to 1882.

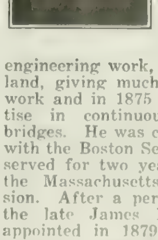
Mr. Stevens was division engineer for the Canadian Pacific Ry. from 1882 to 1886, when he returned to the Chicago, Milwaukee and St. Paul as assistant engineer. For the two years following he was principal assistant engineer of the Duluth, South Shore and Atlantic Ry., when he became assistant engineer of the Spokane Falls and Northern.

Mr. Stevens' next position was with the Great Northern as principal assistant engineer, being successively promoted to assistant chief engineer in 1893, chief engineer in 1895, and general manager in 1902. In 1903 he joined the staff of the Chicago, Rock Island and Pacific Ry. Co. as chief engineer, and became second vice-president in 1904. From 1905 to 1907, Mr. Stevens was chief engineer of the Panama Canal; and in 1907 acted as chairman of the Isthmian Canal Commission.

In 1907 he became vice-president of the New York, New Haven and Hartford R.R. and had charge of operation. From 1909 to 1911 he became president successively of the Spokane, Portland and Seattle Ry., the Oregon Electric Ry., the Oregon Trunk and the Pacific and Eastern. He was head of the American Railway Mission to Russia in 1917, and acted as director of a corps of railway experts in Manchuria.

Mr. Stevens is an honorary member of the Association of Chinese and American Engineers, and president of the Inter-Allied Technical Board supervising the technical and economic operation of the Siberian and Chinese Eastern Ry., with headquarters at Harbin.

CLEMENS HERSCHEL



Clemens Herschel, past-president of the American Society of Civil Engineers and a former director and vice-president, and inventor of the Venturi meter, was born in 1842 and was graduated from the Lawrence Scientific School of Harvard University in 1860. He then went abroad to pursue further engineering studies in France and Germany.

Returning to the United States he undertook various engineering work, chiefly in New England, giving much attention to bridge work and in 1875 he published a treatise in continuous revolving drawbridges. He was connected at one time with the Boston Sewer Department and served for two years as a member of the Massachusetts Railroad Commission. After a period of service under the late James B. Francis he was appointed in 1879, to the position of hydraulic engineer of the Holyoke Water Power Co. He constructed the Holyoke testing flume and established a system of metering and of recording water consumption of the turbines in the Holyoke mills. The need of an instrument for accurately measuring the flow of water in large pipes led to his invention of the Venturi meter. For a paper upon this invention and its uses he was awarded the Thomas Fitch Rowland prize of the society in 1888. He also received the Elliott Cresson gold medal of the Franklin Institute of Philadelphia for the same invention.

In 1889 he was made chief engineer of the East Jersey Water Co. Later he served on the commission that made a report on the practicability of the deep rock tunnel plan of distribution of the Catskill water in New York.

Mr. Herschel served as treasurer of the Boston Society of Civil Engineers from 1874 to 1880, and was president of the society in 1890-91. He is also a member of the Institution of Civil Engineers of Great Britain.

He has published a translation of "Frontinus and His Two Books on the Water Supply of Rome A.D. 97." The "One Hundred and Fifteen Hydraulic Experiments," another treatise on hydraulics, was published by Mr. Herschel in 1897.

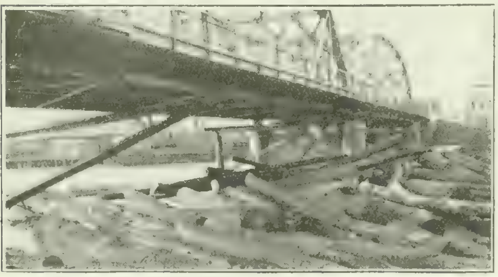
Chance for Outside Contractors on Milwaukee Sewer Work

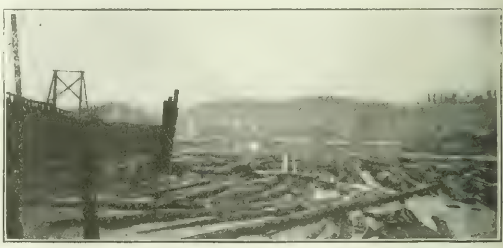
Sewer contracts at a total estimated cost of $2,500,000 are to be let soon at Milwaukee under what T. Chalkley Hatton, chief engineer of the Milwaukee Sewerage Commission, believes are conditions favorable to contractors and which, in view of the amount of work now in hand by local contractors, afford a special opportunity to outside contractors. Mr. Hatton has sent the following statement for publication in *Engineering News-Record*.

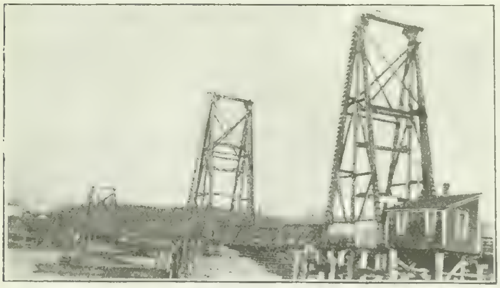
"The Sewerage Commission of the City of Milwaukee and the Metropolitan Sewerage Commission of the County of Milwaukee, both of which are operated under the same engineering staff, purpose, within the next two months, letting contracts for building several miles of intercepting sewers ranging in size from 24 to 88 in., the majority of which will be built in tunnel partly under city streets and partly through suburban districts. There will be twelve contracts ranging from $100,000 to $600,000 each, and aggregating about $2,500,000. Bids will be received from week to week until all are covered. Bid advertising will begin about Feb. 1.

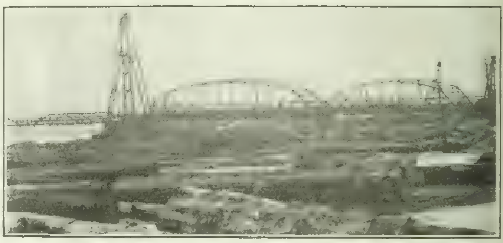
"The money is on hand to pay for this work in cash as it progresses. There are no political connections or labor affiliations to hamper or embarrass contractors. Most of the local contractors, competent to carry on this class of work, are pretty well tied up with present contracts with the two commissions, and it is a good opportunity for competent outside contractors with good organization and equipment to secure reasonably profitable contracts."

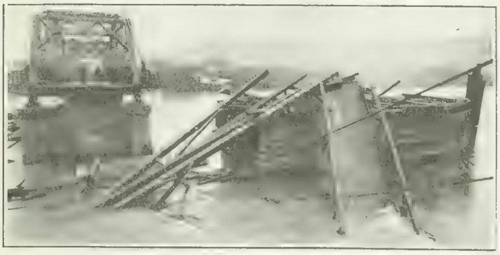
Rusted Anchorage Cables Believed Responsible for Failure of Kelso Suspension Bridge

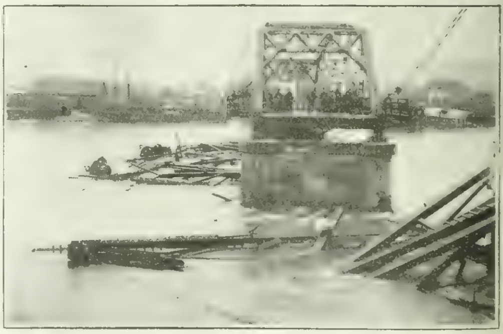












Falsework of an uncompleted new bridge downstream of the suspension bridge (see left upper view) caused a log jam which shoved against the pile piers of the old bridge (right upper view, showing upstream side), but this jam was cleared several days before the collapse and is not believed to have contributed to the failure. The piers of the old bridge are still standing, apparently intact except for such damage as would be done by the falling towers.

The suspension system of the old bridge (seen from downstream and upstream respectively in the two middle views) broke in the anchorage of the upstream cable at the east end (right-hand end of left-hand view). The five anchorage ropes of the upstream cable show marked deterioration below ground. Tests of these are being made.

F.A.E.S. Council Reports Progress at Meeting

Activities of American Engineering Council Cover Matters of Public Interest

Sixty delegates responded to the roll call of the annual meeting of the American Engineering Council of the Federated American Engineering Societies at Washington, Jan. 11-12, and discussed the reports of the various committees. Action of the Council at the meeting comprised the election of officers, a resolution recommending that the Department of Commerce report facts on business conditions, and recommendations that the Federal Water Power Commission be given a larger personnel, and that the Patent Office be given further relief. The rest of the sessions consisted in transmission to various committees of the Council of different proposals and listening to the reports of the president, the secretary, and some of the committees, the most important of which was the public affairs committee.

PROGRESS MADE

Both the president and the secretary emphasized the fact that the Council and the F.A.E.S. were progressing gradually and surely toward the fulfilment of their missions and that they were becoming an increasingly greater power in Washington. In this connection the Committee on Public Affairs reported that it had considered the following subjects: The Great Lakes-St. Lawrence waterway, national parks, proposed tax on foreign books in English, appointment of an engineer on the Civil Service Commission, Department of Public Works, international standard rating system, ship subsidy bill, hydraulic laboratory, regulation of trade associations, Merchant Marine Act, Bacharach Bill, revision of mining law, and the appointment of a successor to Dr. Stratton as director of the Bureau of Standards. The committee on study of the business cycle called attention to the necessity of bringing to the attention of the business executive the facts regarding statistics of business for the purpose of aiding him in forecasting, and suggested also that the Department of Commerce establish an agency for the forecasting of business conditions and for the distribution of such information. As stated above, however, the meeting changed this suggestion to a recommendation that the department furnish facts and not forecasts. The committee on industrial ideals suggested that engineering colleges give an increased attention to the social aspects of engineering activities.

There was discussion of the possibility of increasing the size of the bulletin and the taking of advertising therein, which resulted in a resolution to refer the whole question to the executive board.

After describing a number of the more important engineering projects now under contemplation in Italy, he wound up with a suggestion that the engineer can be a better interpreter of international amity than any other man, because his life has been devoted to the development of those things of each nation that the other nations need and want. This idea was expanded by

(Continued on p. 136)

Revise Structural Steel Stresses

Working stresses and a specification for structural steelwork were considered on Jan. 5 by a board of engineers called together by the American Institute of Steel Construction. The board, consisting of Prof. M. S. Ketchum, E. R. Graham, W. J. Watson, W. J. Thomas, and Prof. Geo. F. Swain, met at New York (Mr. Graham absent) and agreed on revision of the now current working stresses. A design specification was drafted and discussed. It is now being put into final form, and according to expectations will be completed and definitely adopted within a few weeks.

Bennett Will Retire July 1

Charles J. Bennett, for the past ten years state highway commissioner of Connecticut, will retire at the expiration of his present term, July 1, and assume the general managership of the Edward Balf Co., Hartford, a firm which does a general contracting and stone-crushing business. Mr. Bennett has declined reappointment as highway commissioner, though he is presumed to be willing to act as a member of a commission which the legislature may authorize. Mr. Bennett has been prominent among highway officials and in highway engineering work for many years, having taken an active part in the sessions of both the American Association of State Highway Officials and the American Road Builders Association.

Mr. Bennett's early professional experience was secured in upper New York State where he was engaged in private and public work. He was also employed by the Rochester Ry. Co., the Terminal R.R. of Buffalo and the Buffalo, Rochester & Pittsburgh Ry. For 12 years Mr. Bennett was in the office of the New York State engineer and surveyor, most of the time on barge canal work. During the latter part of this period he was in general charge of the Albany office.

Franchise Awarded for Carquinez Straits Bridge

The supervisors of Contra Costa County, Cal., on Jan. 8 awarded the Rodeo-Vallejo Ferry Co. a franchise to construct a bridge across Carquinez Straits between Morrow Cove and Valona. Two other applications for constructing a bridge in this vicinity made by the San Francisco Transit Co. and the Dillon Point Development Co., respectively, were denied. Previous reference to all three proposals was published in *Engineering News-Record*, Nov. 30, 1922, p. 949.

The terms of the franchise are that the company shall start construction within four months and complete the bridge within three years and shall post a bond of $50,000 to guarantee fulfillment of all requirements. The terms were all accepted by the applicant. Announcement was also made at this meeting that an agreement had been reached between the Rodeo-Vallejo Ferry Co. and the California Hawaiian Sugar Co. whereby the latter withdraws opposition to the location of the proposed bridge piers. Agreement on this point is believed to have been a prerequisite to approval of the project by the United States War Department.

Overdevelopment Basic Evil, Says Coal Commission

Labor and Transportation Troubles Hinge on Seasonal Demand and Surplus Mines and Workers

Overdevelopment and irregular demand are declared by the President's coal commission, in its first preliminary report, to be paramount difficulties besetting the coal industry. To variation in demand are charged the part-time operation in the bituminous mines and transportation difficulties in the handling of coal to the consumer.

The commission, though not yet in possession of enough facts from which to form valid conclusions, reports, however, that it has perfected an organization and gathered much data. When the vital factors have been determined hearings will be held and field investigations carried on to determine what are the facts with respect to these issues. In this way the commission hopes to avoid wasting time in the investigation of collateral issues. After this process it will be in position to formulate its recommendations to Congress.

TELEGRAMS ARE PUBLISHED

In its report the commission publishes the telegrams it exchanged with the operators and miners while they were in conference at Chicago in early January trying to reach an agreement as to future wage-scale making. In these the commission urged that should negotiations fail both parties should agree to continue for another year the scales now in force. The conference broke up without an agreement, but a further session is scheduled for today in New York. In the report the commission states that it "has reason to believe that an agreement will be reached in the near future that will avert any widespread cessation of mine operation in the union fields on April 1, thus assuring the needed coal supply for at least another year."

The farreaching importance of the investigation is summed up by the commission in the following concluding paragraph of its report:

"The inquiry involves the whole question as to what is best for the people, free competition, government or private ownership, regulation or control in the coal industry. Should the operators in given areas be permitted to combine so that the low-cost mines would furnish the product to the people and the high-cost mines be kept in abeyance to meet an emergency properly regulated as to price and profit by some governmental agency, or should this prime necessity of life and business be left wholly to open competition in the market? This problem is of so great moment with reference not only to theories of government but also to the economic life of the republic that the view of the commission is left to its final report.

"The commission believes that the public interest in coal raises fundamental questions of the relation of this industry to the nation and of the degree to which private rights must yield to public welfare. It may be that both private property in an exhaustible resource and labor in a public service industry must submit to certain modifications of their private rights, receiving in return certain guarantees and privileges not accorded to purely private business or persons in private employ."

Seven Bronze Towers to Relieve New York Traffic Congestion

Six more traffic towers, like the one recently unveiled at 42nd St. and Fifth Ave., New York City, and shown herewith, are soon to be erected at strategic traffic points, replacing old towers. The towers are the gift of the Fifth Ave. Association to the City of New York.

Each tower is almost entirely of bronze with a granite base 4 ft. square and 3 ft. high, and securely bolted to a concrete foundation. The tower is 28 ft. high and the lower part is open to permit an unobstructed view up and down the street. The space occupied by the traffic officer is inclosed in glass. The tower is heated with an electric stove. Around the base of each tower are laid granite striking blocks which fend off traffic and protect the tower.

BRONZE TOWER CONTROLS TRAFFIC

The design for the tower was selected from among 130 designs submitted in a prize competition, the Fifth Ave. Association offering prizes of $500, $300, and $200, for first, second, and third places, respectively.

Turner to Study Detroit Traffic

The Transit Commission of the City of Detroit is to have a traffic survey made under the direction of Daniel L. Turner, consulting engineer for the New York Transit Commission. It is estimated that the work will take about a year. Mr. Turner will make a report on the transit conditions as he finds them with recommendations, and the survey will include also a consideration of the Detroit suburban transit situation.

F.A.E.S. Council Reports Progress at Meeting

(Concluded from p. 135)

Calvin W. Rice, of the American Society of Mechanical Engineers, in describing the recent South American Engineering Congress and by Elmer A. Sperry, in describing the conditions today in Japan as observed in a recent trip to the Orient.

One of the most interesting features of the meeting was the banquet on Jan. 11, which was attended by ninety-one guests. On that occasion, the principal address was made by Ambassador Caetani, the engineer whom Italy has sent to the United States to be near this government. Ambassador Caetani said, among other things:

"Your kind invitation made me feel that, besides sailing for America as Italy's Ambassador, I was going home to my old stamping grounds somewhat still invested with the qualifications of an engineer. We pride ourselves in saying: 'Once an engineer, always an engineer.' Whatever may be the course of life followed by one of us, it will always be marked by the indelible seal of the scientific, practical and logical training to which an engineer is subjected during the early years of life.

"I judge that many of the colleagues present have followed in life most disparate occupations which often had little to do with engineering; such has been my personal experience during the agitated years since the beginning of the war. We can say that in each and every occupation we have felt and thought and acted chiefly as engineers."

SOME DISSATISFACTION VOICED

During the course of the business sessions, some dissatisfaction was voiced with the conduct of the affairs of the Federated Societies. The point was made that member societies had too little voice in what was being done and some fear was expressed that an effort might be made to make of the Federation a super-society. It was pointed out by President Cooley and by L. W. Wallace, the executive secretary, that every effort has been made to conduct the Federation so that it would be a sort of House of Representatives—highly responsive to, and in no way dominating, constituencies. Certain other functions of the Federated Societies were likened to that of an embassy in Washington, representing member organizations. It was established that ample opportunity has been afforded to the membership of the member societies to acquaint themselves with all details of the Federation's activities. In the end, the difficulties were ironed out and the general discussion by members of the Council indicated a complete sympathy with the broad purposes of the Federation but emphasized the need of devising every means possible to acquaint the individual engineer, as well as the member societies, with the work completed and problems to be undertaken by the Federation and its committees.

M. E. Cooley, of the University of Michigan, was re-elected president for the ensuing year. The vice-presidents elected for the Council were J. Parke Channing and Calvert Townley of New York; Philip N. Moore of St. Louis; Gardner S. Williams of Grand Rapids, Mich. L. W. Wallace continues as executive secretary.

Engineering Societies

Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION, New York; Annual Convention, Cleveland, Feb. 19-20.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 13-15.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30

The Engineering Institute of Canada will hold its annual general business meeting at Montreal on Jan. 23, 1923.

The Northeastern Section of the American Society of Civil Engineers will hold its annual meeting, with election of officers, Jan. 27 at the Boston City Club, Boston, Mass. There will be brief talks by men of public affairs on the subject, "Engineers in Business and in Public Positions."

The Iowa Engineering Society meeting, Jan. 23-26, inclusive, has scheduled papers the afternoon of Jan. 24 in all six sections, drainage, highway, mechanical-electrical, municipal, railroad and structural-architectural. All other sessions are general.

The Boston Society of Civil Engineers will have an illustrated paper by Arthur T. Safford, engineer of locks and canals, Lowell, Mass., on "The New Hydro-Electric Development of the Amoskeag Manufacturing Co. at Manchester, N. H.," at its joint meeting Jan. 24 with the Massachusetts Institute of Technology student chapter of the American Society of Civil Engineers.

The New York State Association of Builders will hold its annual convention and election of officers Jan. 30 and 31 at Elmira, N. Y. Stephen A. Smith of Albany is president, and Edward A. Keeler of New York is secretary and treasurer.

Personal Notes

C. A. EMERSON, JR., whose resignation as chief engineer of the Pennsylvania State Department of Health to become associated with Fuller & McClintock in their new Philadelphia office, was recently noted in these columns, has been made consulting engineer of the department named.

W. L. STEVENSON, for the last four years assistant chief engineer of the Pennsylvania Department of Health, has been appointed chief engineer of the department to succeed C. A. Emerson, Jr., who recently resigned. From 1898 to 1908 Mr. Stevenson was engaged on municipal engineering work for the city of Philadelphia, including the construction of the Walnut Lane Bridge. During the next ten years he continued with the city as engineer in charge of sanitary surveys of the rivers and streams; operation of the sewage experiment station; construction and operation of the Pennypack Creek sewage-works; preparation of the comprehensive plan and report on the collection, treatment and disposal of the sewage of the entire city of Philadelphia; and the design, contract letting and beginning of construction of the Frankford Creek high-level intercepting sewer and the grit chamber for the North East sewage-works. During the war Mr. Stevenson was sanitary engineer and assistant director, Department of Health, U. S. Shipping Board Emergency Fleet Corporation, in general charge of water supplies, sewerage and other sanitary engineering work the emergency shipyards and their vicinity.

PAUL D. WRIGHT, of Erie, a farmer by birth, a civil engineer by education, and a manufacturer by occupation, has been appointed commissioner of the Pennsylvania State Highway Department by Governor-elect Pinchot. Mr. Wright, a graduate of Yale, is president of the Reed Manufacturing Co. This is the first time he has held public office. He is 50 years of age.

J. GERALD PHELAN, engineer with the Fletcher-Thompson, Inc., engineers, Bridgeport, Conn., has been appointed commissioner of the building department of Bridgeport. Mr. Phelan succeeds the late Charles H. Botsford, who was building commissioner for twenty years.

HENRY B. SMITH, of Mount Holly, N. J., has been named by the Burlington County Board of Freeholders as county engineer of Burlington County to succeed Harold Wills.

EDWARD L. CRUGAR, district engineer of southern lines, Illinois Central R. R., has been appointed engineer of construction, with headquarters at Chicago. J. W. KERN, JR., roadmaster of the St. Louis division, succeeds Mr. Crugar, with headquarters at New Orleans.

J. G. HALL, who formerly was appraisal engineer with M. E. Cooley, consulting engineer of Ann Arbor, Mich., has become associated with H. Miscampbell, Duluth, Minn., and is in charge of the engineering department.

H. T. HAZEN, who has been acting chief engineer of the Canadian Northern Ry., eastern lines, has been made chief engineer. His new offices are in Toronto.

ALLAN T. BONE, formerly engineer with the George A. Fuller Co. in construction work in Canada, is now with the Shawinigan Engineering Co. on design of equipment and plant loyout.

W. G. THOMPSON, former chief engineer of the New Jersey Highway Department, and more recently chief engineer on the construction of the ideal section of the Lincoln Highway, has been made chief engineer of the Bay Construction Co., St. Petersburg, Fla. He is charged with the design, equipment of a force for and the construction of a six-mile private highway toll bridge across Old Tampa Bay between the cities of St. Petersburg and Tampa. The bridge is known as the Gandy bridge, after George F. Gandy, Sr., formerly of Philadelphia, who conceived the idea of the bridge's construction and secured a charter from the Florida Legislature.

J. T. WHITTLESEY, consulting engineer of San Francisco, has been appointed a member of the California State Railroad Commission for a period of two years, filling a vacancy caused by a resignation. Mr. Whittlesey is a graduate of Yale University, class of 1889, and has been a resident of California since 1912. Before going to California he was successively, superintendent of the motor department, Brooklyn (N. Y.) Street R.R.; chief engineer of the Brooklyn Rapid Transit Corp.; superintendent of the Stephenson Car Co., Elizabeth, N. J.; chief engineer of the United Electric Co., Newark, N. J.; and chief engineer of the Department of Public Service Corp. of New Jersey.

EUGENE A. YATES of New York, consulting engineer of the Alabama Power Co., has been appointed general manager of the company, relieving W. N. Walmsley, who has resigned the position of general manager, held for the last seven years, because of poor health. He has been vice-president of the company for two years. On his return from South America, where he went as Alabama's delegate to the Brazilian exposition, Mr. Walmsley will resume his duties as vice president, acting in supervisory capacity. Mr. Yates was chief engineer of the company in the construction of Lock 12 and has given much time to construction of Mitchell dam in association with O. G. Thurlow, the company's chief engineer.

J. J. FLAD, who for several years has been in the employ of the state architect's office at Madison, Wis., has become associated with A. SMALL. They have recently opened an architectural and engineering office at Madison.

D. B. RUSH, who has been associated with the engineering department of Robert W. Hunt & Co., inspecting, testing and consulting engineers, has been appointed manager of the cement department at the general office, Chicago. Mr. Hunt is a graduate of Rose Polytechnic Institute. Prior to his joining the Hunt company he was successively employed by the engineering department of the Chicago & Alton R.R.; Horace G. Burt, civil engineer; W. F. M. Goss, railway engineer; the late John F. Wallace, and Bion J. Arnold.

BRIG.-GEN. WILLIAM BARCLAY PARSONS was chosen chairman of the trustees of Columbia University for the seventh time at the recent annual meeting. During the war General Parsons served with the 11th Engineers regiment, becoming its commander, having risen from major to colonel. After the war he was deputy chief engineer, G. H. Q. Organized Engineer Reserve, U. S. Army. He was made a brigadier-general in 1922.

R. M. MORTON has been selected as state highway engineer of California and head of the state department of public works, succeeding AUSTIN B FLETCHER, who recently resigned. As chief highway engineer of Sacramento County and more recently of San Diego County, Mr. Morton has constructed some of the most important roads in the state.

STEPHEN A. FOSTER has been appointed street commissioner of Toledo, Ohio, succeeding the late J. W. MCGINNIS.

FRANCIS C. CURTIN, of Syracuse, N. Y., and THOMAS J. MORRISON, of Rochester, N. Y., have been appointed engineers in charge of the middle division and the western division, respectively, of the New York Barge Canal.

Obituary

WILLIAM F. BATES, since 1918 town engineer of Montclair, N. J., died from heart trouble Jan. 10 at the age of 52. Mr. Bates was born in Boston. He was for many years associated with Major Christopher Harrison, then city engineer of Everett, Mass. Major Harrison and Mr. Bates went to Montclair in 1917 as town engineer and assistant, respectively, and when Major Harrison retired in 1918 Mr. Bates became town engineer.

VAUGHAN C. MILLER, superintendent of public works, Lima, Ohio, dropped dead Dec. 12, from heart trouble, while driving a car. He was a graduate civil engineer of Ohio State University and was 33 years old. Mr. Miller had been connected with the city of Lima for the past ten years, as rodman, draftsman, assistant city engineer and city engineer and when Lima took up the city manager form of government he was appointed superintendent of public works.

HILMAR F. SMITH, supervising engineer for the construction service of the Quartermaster Corps, U. S. Army, at Belleville, Ill., died there Jan. 6, aged 30 years. Mr. Smith was a graduate from both civil and electrical engineering courses at Rutgers College. Previous to his employment at Belleville he had been supervising engineer on the construction work done by the Quartermaster Corps at Muscle Shoals, Ala.

HENRY H. LYNCH, engineer and former head of the old cable-car systems in San Francisco, died in that city December 30 at the age of 72. Until a few days prior to his death, Mr. Lynch was in active service as chief engineer of the Peninsula and San Jose Railroads. Mr. Lynch went to California at the age of [illegible] and for a number of years represented large interests in the work of reclaiming delta lands in the Sacramento river. One of the greatest projects he entered upon occurred through his association with Ferdinand De Lesseps, in their first efforts to construct the Panama canal.

CHARLES H. BOTSFORD, building commissioner, of Bridgeport, Conn., for the past twenty years, died at his home in that city, Dec 29, following a heart [illegible]. Mr. Botsford was 70 years old

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

More Suggestions—

For Better Equipment and Repair Parts Service

IN THE Dec. 14 issue was begun a discussion of "Better Equipment Maintenance and Repair Parts Service." Its object is to show how some of the misunderstandings between maker and user of construction machinery can be avoided. This week's contribution is a recital of experiences by a manufacturer of concrete mixers and cranes:

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From the
Koehring Co., Milwaukee, Wis.

AT THE present time we are manufacturing five sizes of paving mixers and seven sizes of construction mixers. The records, therefore, must be very complete in order that proper repair part service may be given. A thorough and easily read repair list is furnished for all machines so that orders may be placed and filled with a minimum of delay. In case any question arises as to the meaning of an order, the customer is immediately advised by wire and further information is requested, or a repair part list is furnished to him with the request that he furnish part number. Often the repair part list that was sent out with the machine becomes lost or is at the office of the owner instead of being in the field. The superintendent, therefore, in making requisition for the part does the best he can in describing the part that he desires. If, however, in ordering parts, he will give in all instances the machine number and the machine size, which is to be found on the name plate, it will be of material assistance. In case no repair part list is available and no number is found on the part, a sketch showing the exact location of the part, or the part itself should be sent in for duplication.

Owners are giving a great deal more thought to the care and use of their construction equipment than formerly. The mechanics are appreciating the necessity of keeping the machines clean and well lubricated to prevent expensive delays due to breakages.

Each machine should be equipped with an extra set of cables. In fact, many contractors are ordering an extra set of cables sent with the machine. These are then wired to the frame at some point where they will always be accessible instead of in the warehouse.

The machine should be inspected regularly, preferably when closing down for the day and again in the morning, and should receive a very careful inspection once a week. Many contractors find a regular Saturday inspection is desirable, as it allows minor adjustments and repairs to be made on Sunday without delaying the operation of mixing.

In summing up, it is suggested that all users equip their mixers with a complete repair part list, and instruct the operator in the use of this list, so that when parts are needed they can be ordered with a minimum of delay. Further, some individual on the job should be made responsible for complete inspection of the machine each week to make sure that some part is not wearing unduly. He should have authority to order parts if wear is apparent.

(To be continued next week)

Construction Equipment Exported

For the month of October, 1922, the U. S. Department of Commerce reports the export from the United States of 32 concrete mixers valued at $27,485; 228,785 lb. of miscellaneous construction equipment valued at $40,498; and 155 bucket and belt conveyors valued at $32,228.

Japan was the biggest consumer of concrete mixers, 11 units costing $8,835 being shipped to that country; Canada came next with 5, and Mexico third with 4.

During the month Canada received from the United States 73,405 lb. of miscellaneous construction equipment valued at $15,132; Brazil came next with 52,513 lb. valued at $7,032. Conveyor shipments to Cuba amounted to $15,000.

Review of Construction Equipment and Materials During 1922—Part III

DEVELOPMENTS in construction equipment and materials during 1922, as noted in "Engineering News-Record's" review beginning in the Jan. 4 issue, took the form of improvements in details rather than in new types of machines. Previous installments of the review included power shovels, concrete chuting equipment, industrial locomotives, elevating loaders, rock crushers, road graders, mixers, and concrete road building plant. This week additional classes of equipment are covered.

Clamshell Buckets

INCLOSED gearing, to eliminate contact of the material handled with the operating parts, with consequent wear, was the feature on one type of clamshell. Improvements were also made on the multiple sheave reeved type of grab bucket to prevent breakage of the main closing or hinge shaft. One manufacturer reports no material changes in bucket standards, but cites a demand for a great many special buckets to cope with usual conditions of service.

Wellman-Seaver-Morgan Co.

EXCESSIVE wear on parts, due to the abrasive action of the material handled, is done away with in the Wellman-Seaver-Morgan Co.'s geared clamshell bucket with all working parts inclosed in a cast-steel casing. This design, it is claimed, departs from the usual design of grab-buckets employing ropes or chains for their operation in that the completely inclosed gearing produces the necessary digging power. This feature also makes possible effective lubrication. The bucket is made in capacities of $\frac{3}{4}$, 1, and $1\frac{1}{2}$ cu.yd.

Orton-Steinbrenner Co.

TO PREVENT the possibility of breaking the main closing or hinge shaft on its multiple sheave reeved type of grab bucket, the Orton & Steinbrenner Co. is now making the hinge shaft in three parts. The center part carries the closing sheaves, is constructed separately and may be removed from the sheave block by two bolts. This design is claimed to have the advantage of permitting the replacement of a worn sheave or bushing without threading the entire shaft. The two end parts of the shaft are pinned in the block, the hinges are cantilevered and made interlocking.

An improvement in the power-wheel bucket has involved offsetting the closing shaft from the hinge shaft. This feature increases the size of the power wheel and adds to the digging efficiency of the bucket.

Locomotive Cranes

TO make the operation of locomotive cranes independent of rails, manufacturers, almost without exception, are furnishing equipment mounted on crawlers. The year's developments were along lines of improving the convertibility of these machines from bucket to dragline, power shovel, or skimmer-scoop work, simplifying operation by reducing the number of gears and clutches, and improving steering facilities. Forged steel gears instead of steel castings above the rotating base and a wider range of traveling speeds were introduced. For great mobility one manufacturer announced a crane designed for mounting on a standard motor truck chassis.

Through their national organization, locomotive crane manufacturers have agreed upon performance standards for standard-gage equipment which now accompany all specifications issued. The purpose of these standards is to enable the prospective purchaser, when asking for bids, to know that he is receiving quotations upon the same kind of equipment. These standards, among other details, list the minimum safe load for 12-ft. and for 40-ft. radius for cranes with rated capacities of from 10 to 30 tons.

Bay City
Dredge Works

CAST-STEEL gears and boxes are now furnished on the model 16 crane where cast iron was formerly used. Other improvements include a cut-steel drive connection to the engine. For road grading a skimmer scoop of ⅝-yd. capacity, claimed to be the largest manufactured for half-circle type of equipment, was introduced; it has a bearing on both the top and bottom of the boom rather than on the flanges of the channel, as was the case with former skimmer scoops. The varied uses to which the company's excavator crane may be put are indicated by its ability to handle seven different kinds of bucket scoop.

A one-man excavator with a ⅜-yd. bottom-dump shovel type dipper was developed to meet the need for a light, economical machine to fill the gap between heavy shovel equipment and hand labor.

Brown Hoisting
Machinery Co.

IN ADDITION to crawler and four-wheel railroad truck mountings, the small Brown crane is now mounted on eight-wheel trucks for service on construction work. An improvement made in this equipment was the introduction of a two-speed travel gear, giving it more power, particularly on the crawler traction.

Browning Co.

THE MOST important change in the Browning equipment during the year was in the gears above the rotating face. These are now made of forged steel instead of steel castings. This change is designed to increase the life of the gears and to assure perfect teeth, which, it is claimed, is sometimes impossible with steel castings. The company is just completing a machine mounted on crawler traction.

Byers
Machine Co.

TO COMBINE light crane service with ability to move quickly from one job to another, the Byers company designed its Truckrane with a special base to permit mounting on any standard motor truck of 5 tons' capacity or larger. The outfit is designed for use with a ½-yd. bucket and has a maximum operating radius of 20 ft. The weight of this crane without bucket or counterweight is 11,200 lb. These cranes are furnished unmounted.

For the full-circle crane a half crawler mounting—road-wheel steer in front and caterpillars in the rear—is supplied in addition to the full crawler or wheel mountings. On the full-length crawler model the design provides for steering by power from the operator's position. A feature of the equipment is the self-locking bronze worm which allows the boom to be raised or lowered under load in connection with or independently of any other crane operation.

Industrial
Works

IN ADDITION to the development of its full revolving crane on crawler treads, the Industrial Works, during 1922, delivered to the Virginian Railway Co. what is claimed to be the largest railroad wreck crane ever built. With all outriggers set it has a capacity of 200 tons at 17½-ft. radius, as against 160 tons, the greatest capacity heretofore. Without outriggers, the crane has a capacity of 42½ tons at 17½-ft. radius. The equipment is mounted on special six-wheel railroad trucks and is operated by steam.

Koehring Co.

ON ITS LARGE crane excavator, designed to handle a 1-yd. bucket at 45-ft. radius, the Koehring Co. introduced a spur-gear drive, friction clutch and double drum, by which it is possible to boom the loaded bucket in and out as often as necessary. This feature, it is claimed, eliminates the necessity of traveling with the crane back and forth when taking or discharging its load. The crane excavator is of the full revolving type, mounted on crawler traction, and is equipped with 100-hp. four-cylinder gasoline engine. It has three speeds forward and one reverse.

Another improvement was in the use of two line speeds on all cranes to facilitate interchangeability from clamshell to dragline work.

Link-Belt Co.

ONE OF THE features of its revolving crawler crane emphasized by the Link-Belt Co. is the fact that only sixteen gears of all descriptions are used as compared with about thirty gears in older types of crane. Equipped with two independent hoisting drums, the machine is suitable both for clamshell and dragline work. The power unit is a 50-hp. gasoline engine for which a 40-hp. electric motor may be substituted.

Orton-Steinbrenner Co.

A WIDE variety of uses is provided for by the interchangeability features of the Orton & Steinbrenner combination locomotive crane and power shovel in sizes of ¾ and 1 yd. Among the year's improvements were, in addition to an auxiliary steam-shovel dipper, a reeved type of dipper shovel and a skimmer scoop attachment. The latter may be suspended from the regular crane boom without detaching it, and is designed for tearing up old pavements or grading work.

In the crawler-tread type of machine a new steering gear has been introduced to permit the crane to be turned while traveling, loaded, irrespective of the relative positions of boom and car body. The steel bevel differential propelling gears are now cut from the solid, instead of being molded, and are placed inside a heavy cast gear case and run in oil.

Pawling &
Harnischfeger Co.

FOR CITY use a combined ⅜-yd. shovel, dragline and locomotive crane was brought out during the year; it was provided with wheel traction instead of the crawler mounting heretofore used.

A machine handling a ¾-yd. bucket at a 40-ft. radius, developed originally for the U. S. Reclamation Service, was adapted to general construction service. This dragline excavator has four movements forward and reverse on crawler traction. The power unit is a 75-hp. gas engine.

Moore Bros.
Crane Co.

A PATENTED gear-shift device on the Moore 1-yd. dragline crane enables a single universal clutch to swing the crane, propel the machine, and raise and lower the boom. The only other clutch is used for the drum. In this way a reduction in the number of shafts, gears, levers, and bearings is secured.

Hoists

DURING the year several manufacturers brought out new lines of small (8 hp.) hoists. On the larger type silent chain belt drives were introduced as well as new automatic brakes. Third-drum attachment may now be obtained for bolting onto two-drum units for work with excavating buckets or draglines.

Clyde
Iron Works

THERE WAS added to the Clyde equipment during the year a line of small gasoline hoists of from 8 to 15 hp. The motor is complete with radiator, fan-cooling attachment and all accessories. Power transmission from the engine to the hoisting drum is through a silent belt chain drive. On the company's builders' hoist of this type a reversible elevator sheave is furnished which can be operated independently from the friction drum.

Mead-
Morrison Mfg. Co.

A NEW engine was designed with patent automatic brake especially adapted to three-drum hoists for grab-bucket operation. The mechanism is such that the brake may be allowed to grab at its full power, checking the load without jar on the machine or rope. This brake has been standard equipment on the company's motor truck winches and in future will be furnished on its new hoists. All hoists are being equipped with asbestos frictions and asbestos-lined brakes.

New hoists are made with two drums; a detachable third drum is available for bolting to the two-drum units if needed. The manufacturers point out that a contractor standardizing on this equipment may own perhaps a dozen two-drum outfits and several third-drum attachments, thus providing for three-drum operation at a minimum initial investment for plant.

J. S. Mundy
Hoisting Engine Co.

THIRD-DRUM extensions for double-drum hoists have been developed for work involving the use of buckets and draglines; they may be bolted to the main frame of standard hoist units. On electric hoists a patented locking device is installed by means of which a load is prevented from falling in case the current is cut off. Other recent improvements provide for the use of non-burning friction blocks instead of wood blocks and the coring out of the brake flanges in order to air cool the brakes.

To increase the service of two- or three-drum hoists a patented swinging drum is now furnished for operating the bull-wheel of a derrick. It is detachable, like the third-drum extension above noted.

Pawling & Harnischfeger Co.

GAS-ENGINE hoists ranging from 8 to 110 hp. were added to the Pawling & Harnischfeger line of construction equipment. These hoists are furnished also with electric motors or for belt drive. On the gasoline hoists the engines are four-cylinder vertical tractor types.

Gasoline Engines

As a source of power for operating construction plant the gasoline engine has developed into a widely used type of equipment. On contracting work now it is no novelty to see such a diversified range of plant as concrete mixers, industrial locomotives, pumps, hoists tractors and trucks, road rollers, power shovels, locomotive cranes, elevating conveyors, and a host of other equipment operated by internal combustion engines. In adapting their engines to the varied types of plant, manufacturers have introduced improvements insuring reliability of operation, elimination of vibration, and lowered operating costs. There is a growing demand for multiple-cylinder gasoline engines in the construction field. Even on the small-capacity concrete mixers for one-bag batches, two-cylinder engines have been substituted for single-cylinder units, while on mixers of larger size (½yd. or more in capacity) four-cylinder gasoline engines are replacing steam engine and boiler outfits.

Buda Co.

IN ORDER to take advantage of the flexibility and general utility of the four-cylinder type of gasoline engine, the Buda units are being mounted on either structural steel or cast-iron bases and equipped with all needed accessories. These units are being supplied with and without radiator equipment in connection with the operation of centrifugal pumps where water from the pumping operation itself is utilized for cooling the engine.

Other developments include provision for taking off the drive directly in line with the engine or at right-angles to it. Reducing and accelerating gears are used to adapt the speed of the driving end to specific requirements. By means of a flexible coupling a direct connection to the flywheel may be made, a type of installation adapted particularly to cases of gas-engine-driven electric generating units.

On its electric generating units the company has installed a number of safety features, including an overvoltage relay which stops the engine in case anything happens to the governor controlling the speed.

Novo Engine Co.

A GASOLINE hoisting *unit*, as opposed to a hoist coupled to a gasoline engine often unsuited for such purposes, was announced by the Novo Engine Co. The unit is a four-cylinder outfit intended for use on heavy construction operations. The engine is completely housed. Its speed of 1,000 r.p.m. is less than that of the automotive type engine. Two flywheels are furnished to insure uniform power output.

Wisconsin Motor Manufacturing Company

THERE has been no radical change in the Wisconsin line of equipment, except the addition of a new 4 x 5-in. four-cylinder over-head valve model. For industrial uses the company manufactures a wide range of sizes, including two models of heavy-duty motor with ratings of 53 and 79 hp. respectively.

Worthington Pump & Mach. Corp.

THE Worthington company entered the contracting field during the year with a kerosene-gasoline engine designed to operate concrete mixers and other types of equipment, such as diaphragm pumps and small plunger pumps. These engines are of the throttling governor type and are built in sizes from 2½ to 8 hp.

Air Compressors and Pneumatic Tools

IMPROVED control was a feature of compressor design in both stationary and portable types, particularly in respect to automatic unloading devices. A wider range of sizes and greater individual air capacities were offered in the mobile units, while one novel feature was the use of 8-in. pipe to serve the double purpose of forming the framework of a portable machine and at the same time acting as an air receiver. As was the case with other types of construction equipment, rubber-tired mountings for portable compressors showed an increasing use during the year. To serve an ever-widening field for pneumatic tools equipment has been developed for digging clay, calking pipe, tamping backfill, demolishing concrete masonry, scaling rock, and driving spikes. In addition, manufacturers have devoted considerable attention to improvements in the light, portable type of air hoists.

Chicago Pneumatic Tool Co.

COMPRESSOR cylinder wear has been reduced by adding to the mixture of the casting a percentage of Mayari steel. During the year the company has perfected the control of its electric-driven compressors. Automatic equipment was developed for motor-driven compressors of the belted type, whereby, in addition to unloading the machine when the maximum pressure is reached, the design provides, depending upon the time required for unloading, for automatically stopping the motor, shutting off the oil supply, and then reaching normal speed before the machine cuts in again.

On the portable type of compressor rubber-tired trailer mountings are furnished. Operating speeds of these machines are controlled by an auto-pneumatic throttle which functions both in throttling down and speeding up.

For the company's line of pneumatic tools improved lubricating features have been developed and during the year an oil separator was introduced to prevent waste of oil through the discharge. With this device lubrication need be attended to only once a week as against daily without the separator.

Cement-Gun Co.

AN INGENIOUS type of design was adopted for the Traylor portable gasoline-driven compressor by which the frame of the machine is formed of 8-in. pipe connected with a cast-steel head, the pipe serving both as an air receiver and a bearing frame. The air is inletted at one end of the pipe and discharged at the other, thereby insuring large receiver capacity and cooling area. This equipment is mounted on rubber-tired automobile wheels, springs and axles.

Ingersoll-Rand Co.

GREATER individual air capacities and a better arrangement of sizes suitable for operating various groups of air tools were features of the year's development of the Ingersoll-Rand portable type compressors. A pneumatic clay digger was among the important air tool developments; it is, essentially, a pneumatic pick for both open trench and tunnel excavation. Applications of pneumatic hammers were made for calking lead wool and cast lead in pipe joints, for tamping backfill, and for demolishing concrete masonry. To facilitate the haulage of cars, skidding of timbers, and hoisting light steel a new line of double-drum hoists of the light portable type were put on the market.

Sullivan Machinery Co.

OPERATION by belt from a tractor is provided for in a new type of Sullivan portable compressor mounted on a steel truck. The company's direct-flow angle-compound steam-driven compressor was introduced during the year. Its valves are under the control of the speed and pressure governors and the admission timing is regulated by speed and pressure factors. The exhaust valves may be set to suit local conditions of back pressure.

Pneumatic tool improvements included a pick hammer for drilling shallow bolt holes in rock or concrete, scaling rock, driving spikes, and other miscellaneous uses. The company's 16-lb. spader is equipped with both short and long shank tools for underground work or open trench. A non-rotating hammer drill, with long stroke and powerful blow, was developed for breaking pavements or concrete masonry.

Two types of portable air hoists were announced during the year, both single and double-drum. The double-drum type was designed for hauling scrapers in loading work at stock piles and in moving earth or other loose material. It is also applicable to derrick work.

The application of the Sullivan drill sharpening machine was extended to the making of stone channeling machine gang bits. Dies and dollies for this special work are now available.

Extra size diamond-drill core fittings were provided for deep oil-well tests in wild-catting and in production drilling.

Worthington Pump & Mach. Corp. A SMALL vertical single-cylinder air compressor was put on the market during the year for contracting work by the Worthington corporation. It follows standard lines for equipment of this sort, except that the Laidlaw feather-valve used on the company's larger air compressors is installed on these small units. Consisting of a piece of ribbon steel, the valve weighs less than 1 oz. and, on account of its lightness, quietness and smooth operation are assured at high speeds.

(To be concluded)

Business Notes

AMERICAN ROLLING MILL CO., Middletown, Ohio, has engaged Dwight P. Robinson & Co., New York, for engineering and construction services on an extension to its plant at Ashland, Ky. The extension will include a jobbing and sheet mill, a galvanizing plant, and other work.

GENERAL ELECTRIC CO., Schenectady, N. Y., according to an announcement by G. E. Emmons, vice-president, has reorganized its general manufacturing department, effective Jan. 1. H. F. T. Erben, heretofore manager of the Schenectady works, has been named vice-chairman of the manufacturing committee and ranking member of the general manufacturing staff. Charles E. Eveleth succeeds to the position of works manager. J. A. Smith will continue as general superintendent.

NOEL PUMP & MANUFACTURING CO., of Orange Cove, Calif., has filed articles of incorporation with the county clerk at Fresno. The company is capitalized at $50,000. The directors are Carl F. Noel of Modesto, C. J. and W. J. Noel of Orange Cove.

S. W. LINDHEIMER, dealer in railway and contractors' equipment, Chicago, will sail for England this month to develop a large deal in railway track material.

EDWIN L. KING has been appointed, effective Jan. 1, district sales manager for the Reading Steel Castings Co., Inc., Bridgeport, Conn. His headquarters will be in Chicago and he will succeed M. L. Chase, resigned.

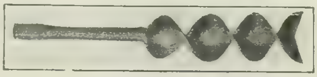
GEORGE MACNOE, manager of the Boston office of W. B. Connor, Inc., merchant-engineers, has been recalled to New York to take charge of the contractors sales department, handling heating and pumping equipment.

GIBB INSTRUMENT CO., Bay City, Mich., has taken over, under exclusive license, the manufacture and sale of the automatic and semi-automatic electric arc-welding machines developed, and heretofore manufactured by the Fred Pabst Co., of Milwaukee and has contracted to act as selling agent for the Pabst line of [illegible] covered electrodes. The Gibb company has announced its intention to cover the entire field of electric welding equipment.

Equipment and Materials

Ground Auger for Contractors

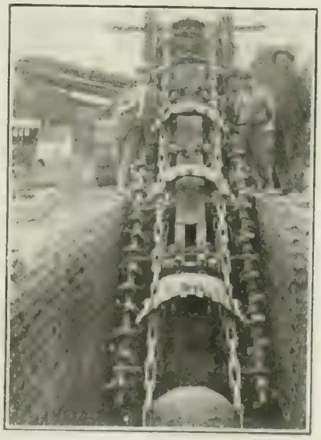
For the use of contractors in testing ground for foundations and for boring from street excavations under sidewalks and pavements for installing pipes or wires by plumbing, electric and gas companies, the W. H. Anderson Tool & Supply Co., Detroit, has designed a special type of auger, shown in the accompanying illustration. The point is different from the usual nut auger and no lead screw or lips are used. The cutting edges are fish-tailed to permit of quick cutting and immediate release when pulling out to empty the earth accumulated in the screw.



The augers are built in diameters from $1\frac{1}{4}$ to 5 in. Augers 3 in. and less in diameter have the shank threaded to fit standard $\frac{3}{4}$-in. pipe couplings while those larger than 3 in. are threaded to fit standard 1-in. pipe couplings.

Auxiliary Cutter Increases Range of Trench Widths

A trench-excavator attachment, by means of which the cutting range of its excavators is increased without changing the buckets, has been perfected by the Buckeye Traction Ditcher Co., Findlay, Ohio. The rotary auxiliary cutter, as the device is called, makes it possible to cut, with one machine, trench widths which would formerly have required two different models. The device is intended to increase the variety of trench work on which the average contractor can afford to bid. With the new cutter the range of trench widths now possible with various Buckeye models is as follows: Model C-10, from 24 to 48 in.; C-15, from 24 to 60 in.; and C-20, from 10 to 76 in.



The device, as shown in the photograph, consists of cutting teeth mounted on two shafts, one on each side of the boom. As the shafts revolve these teeth dig into the trench side walls outside of the buckets, giving an extra cut on each side. The shaft supports are adjustable, permitting variation of cutting widths.

No additional power is required as the cutters take the load off the regular bucket side cutters. Power is transmitted by heavy steel roller chain operating from the shaft that drives the digging buckets. Four men, in two hours, it is stated, can attach or remove the auxiliary cutter. The new device has been used during the past year by the McHugh-Cole Co., contractors of Lima, Ohio. Their C-15 Buckeye excavator with the auxiliary cutter, has handled trenches from 30 to 60 in. in width.

Publications from the Construction Industry

Power Shovels—THEW SHOVEL CO., Lorain, Ohio, is distributing three new illustrated bulletins dealing with (1) its type A-1 steam shovel with 1-cu.yd. dipper, (2) all-steel semi-flexible type of continuous tread truck, and (3) proper methods of lubricating steam shovel machinery. The two bulletins first mentioned give details both in text and pictures of the shovel and tread. The third bulletin, on lubrication, contains a number of valuable suggestions as to the quality of lubricant best suited to various uses and its methods of employment. Gargoyle lubricants manufactured by the Vacuum Oil Co., New York, are recommended. Among the subjects covered in detail are the lubrication of steam valves and cylinders; gears, pinions and racks; gasoline engines; electric motors; bearings for steam, gasoline and electric shovels; wire rope and cable; and compressed-air operated shovels. Contractors will find in the lubrication bulletin information which should enable them to maintain their equipment in good condition and cut down on repair bills.

Mounted Crushers and Bins—SMITH ENGINEERING WORKS, Milwaukee, features its mounted gyratory rock breakers, screening plans and portable bins in a 15-p. illustrated bulletin explaining the use of this equipment in utilizing local materials for road building. The crushers are made in three sizes, the largest having an hourly capacity of 25 to 30 cu.yd. of $1\frac{1}{2}$-in. stone.

Hydrants and Valves—MICHIGAN VALVE & FOUNDRY CO., Detroit, in an 11-p. illustrated pamphlet, presents cross-sectional drawings and brief descriptions of its fire hydrants and valves. One of the special features of the company's compression hydrant with frost case is a bronze extension piece containing the valve seat and drip which is bolted to the standard pipe of the hydrant and provides for universal adjustment of nozzle to any desired position with relation to the street. The entire standpipe, including all working parts, can be unscrewed from the box and lifted out through the frost case for inspection and repair. Other types of equipment dealt with are water gates, valve boxes, indicator posts, check valves, and sluice gates.

Business Side of Construction

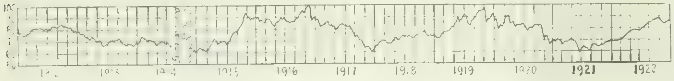
FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Trend of Stock Exchange Prices Upward

Combined Averages of Fifty Stocks, Half Industrials and Half Rails, Shown Over Ten Year Period

That the rise and fall in prices of securities in the stock market, constitutes a reliable barometer of future business conditions, is definitely pointed out by the Annalist *in its survey of the stock market of 1922, given in part, as follows:*

THE stock market of last year saw continually advancing prices for securities in what might be termed a bull market. It was, however, not a bull market in the general sense of that term. The demonstration was far less violent than that of the market of 1919, and it was probably influenced to a certain extent by investment demand, whereas the market of 1919 was one of the highest degree of speculative endeavor. The market of last year actually started in the latter half of 1921 and was a market that succeeded to a certain extent in predicting the future. It has often been said that the stock market acts as such an index and it is perfectly true that the stock market of 1922 was a barometer, and a correct barometer, to business conditions.



AVERAGE PRICES ON NEW YORK STOCK EXCHANGE

It was evident shortly after the turn into 1922 that business was improving and speculative buying of securities began in a moderate way until it was discovered that the floating supply of stock was not by any means large, that investment purchasing had been going along steadily, and that the foundation had been laid for an upturn of substantial proportions. The story of the year is perhaps best told in the market averages. The *New York Times* compilations show that the combined averages of fifty stocks, twenty-five industrials and twenty-five rails, touched a low point of 66.21 on Jan. 21, which was the low point of the year. The high point for that month was 70.27, and from then on the trend of prices was steadily forward. In September the averages touched a high of 90.23 and the low for that month was 84.49, a low that was practically on a par with the high point for July of 84.50. Stocks touched their highest point of the year on Oct. 18, when the averages reached a high of 93.06.

Aside from the business improvement, which the stock market was discounting, there was one other important development of the year, namely, the declaration of stock dividends, which provided a stimulus to stock market activities for many weeks. It was not quite clear why this rush to declare stock dividends should have been so favorably construed in Wall Street.

Financial Briefs

Bank Debits last week (ending Jan. 10) totaled $9,898,000,000, or $1,325,000,000 under the preceding week, when a large volume of year-end payments were shown.

Stock Dividends declared in 1922 aggregate $1,484,000,000, for 139 companies. More than a billion of this was distributed by units of the Standard Oil group.

English Securities issued in 1922 amounted to £584,951,000, against £392,800,000 in 1921 and £248,237,000 in 1913. Of last year's total, about 75 per cent were government loans, 3 per cent were municipals, and 22 per cent were for industrial and railway issues.

Bond market steady while a particularly heavy total of offerings ($200,000,000) was being absorbed. New York Central $12,660,000 4½s equipment trust notes, to yield 5 per cent, were several times oversubscribed. Municipals active. Rails dull. Public utilities active and price trend slightly upward. Industrials quiet. Foreign securities strong.

Central Car Clearing Agency Proposed

Urging the establishment of a central clearing house agency for freight cars, S. Davies Warfield, President of the National Association of Owners of Railroad Securities, addressing a convention in Cincinnati, Jan. 12, gave the following reasons for the recurrence of car shortages:

"(1) That each carrier has not furnished, both as to class and amount, its quota of car equipment in proportion to the total requirements of transportation as a whole; (2) that every carrier has not secured as high efficiency out of the cars it operates as other carriers operating under like conditions; (3) that there has never been put in effect standardized plans under which freight cars shall be purchased, rehabilitated or rebuilt; (4) that methods are not practiced that will produce a better supply, more extended use and wider distribution of certain classes of interchange freight cars now in service or to be put in service; (5) that freight yard and terminal facilities are not used or being constructed such as will jointly operate quickly to handle and unload and return cars for reloading."

If the average load per car obtaining in 1920 and 1921 had been secured in 1922, it would have required 132,440 cars fewer in the first quarter of 1922 and 486,206, in the second, or an aggregate of 618,644 cars to handle the same relative amount of tonnage, according to the American Railway Association.

Steel Ingot Output Gained 73 per Cent in Year

Demand Keeping Prices Firm — Railroads Buying Heavily—Fuel, Pig Iron and Labor More Plentiful

Actual tonnage figures on steel ingot production, as reported by thirty companies which made 87½ per cent of the country's output in 1921, show a total of 29,116,453 tons during 1922, as against 16,826,946, for the preceding year.

With a gain of 73 per cent in production in one year, the present operating rate at 80 per cent of capacity and strong demand holding prices firm; an increased output is predicted for 1923, despite rumors of an impending coal strike.

The strength of the steel position is due largely to heavy bookings of tonnages for future delivery, as well as prospects of a sustained demand throughout the next quarter.

The railroads lead in the consumption of finished steel products; orders for steel cars at the present time representing the heaviest booked in the last seven years. Of the total output of finished steel during 1922, railroads consumed about 22 per cent and the construction industry about 15 per cent.

With a slight improvement in the labor situation since October, due to seasonal falling off of outdoor employment, and sufficient supplies of coal, coke and pig iron, the steel industry faces an active period as to orders and production; but as to price, the current quotation of $2 per 100 lb., Pittsburgh, on structural shapes, represents the price level prevailing at the beginning of the year 1916.

Steel ingot tonnages, by months, during the last two years are shown in the following table:

STEEL INGOT PRODUCTION IN GROSS TONS

Month	1921	1922
January	2,203,186	1,593,482
February	1,749,477	1,745,022
March	1,570,978	2,370,751
April	1,213,958	2,444,513
May	1,265,850	2,711,141
June	1,003,406	2,634,477
July	803,376	2,487,104
August	1,138,071	2,214,582
September	1,174,740	2,373,779
October	1,616,810	2,872,415
November	1,660,001	2,889,297
December	1,427,093	2,779,890
Total	16,826,946	29,116,453

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 29 to 42, are the following large projects:

Office building, Los Angeles, Calif., to MacDonald and Kahn, $1,500,000.

Theatre and office building, Milwaukee, Wis., to M. Tullgren & Sons Co., $1,500,000.

Apartment, New York, N. Y., $1,000,000. Work will be done by separate contracts under supervision of architects, Gronenberg and Leuchtag.

Gain in December Bond Sales

Long-term municipal bond sales during December totaled $55,927,980, for the entire country, representing an increase of $14,063,817 over the preceding month, according to the *Commercial and Financial Chronicle*. The total for the entire year 1922, however, reached $1,040,186,612, as compared with $1,208,768,274, for the whole of 1921, a decrease of nearly 14 per cent.

Short-term securities issued during December, amounted to $35,126,155, of which $29,050,000 were issued by New York City.

Sales of long-term securities in Canada totaled $21,020,784, during the month. The Province of Ontario issued $15,000,000 of this total, and the Ontario Hydro-Electric Commission, $3,000,000.

Among the more important issues of the month were: State of Missouri, $5,000,000 4½s at 99.56, a basis of about 4.73 per cent; South Dakota, $3,000,000 4¾s at 100.91, a basis of about 4.70 per cent; New Jersey, $2,000,000 4¼s at 102.097, a basis of about 4.06 per cent; Memphis, Tenn., $1,452,000 4¾s and $1,509,000 5s at 100.19, a basis of about 4.86 per cent; Allegheny County, Pa., $2,250,000 4¼s at 101.87, a basis of about 4.10 per cent; Cleveland, Ohio, $2,000,000 4½s at 100.66, a basis of about 4.43 per cent; Richmond, Va., $2,000,000 4½s at 102.242, a basis of about 4.37 per cent; Hartford, Conn., $1,500,000 4s at 100.669, a basis of about 3.94 per cent; St. Louis County, Mo., $1,000,000 4½s at 98.81, a basis of about 4.63 per cent and Government of the Philippines, $13,000,000 4½s at 95.07, a basis of about 4.79 per cent.

Of the thirty-six representative issues listed in the accompanying table, eight sold at par, twenty-three, above and five, below part; the yields ranging from 4.06 to 5.92 per cent.

Rates varied from 4 to 6 per cent. New England issues all drew 4 per cent. The 6 per cent disposals were all located in the Southern and Western states. Western bonds, that is to say those in the far Western states, observed a minimum rate of 5 per cent. Those drawing from 4½ to 5 per cent were fairly well distributed throughout the country, especially in the Middle Atlantic and Middle Western groups and the states immediately west of the Mississippi River.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, **in Construction News, pp. 29 to 42,** are the following:

About 203 mi. of highways, Ontario, Canada, for Province of Ontario $3,000,000.

Hotel, Philadelphia, Pa., for Philadelphia Hotel Co., $3,000,000.

Loft, Philadelphia, Pa., Hoffman-Henon Co., architects, $2,000,000.

Office building, Memphis, Tenn., for Security Building Co., $1,000,000.

Lodge and office building, Harrisburgh, Pa., for International Brotherhood Compensation and Relief Fund, Inc., $1,000,000.

High School, Boston, Mass., for Schoolhouse Commission, $1,000,000.

School of Medicine, Denver, Col., for Regents of University of Colorado, $1,250,000.

Art Museum, Marion, Pa., for A. Barnes, $3,000,000.

Sewer, Milwaukee, Wis., for Sewerage Commission, $900,000.

Grading, surfacing, etc., Bismark, N. D., for State Highway Dept., $1,000,000.

REPRESENTATIVE PUBLIC BOND SALES DURING DECEMBER, 1922

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Maturity	Dated	Purchased By
Missouri	Road	$5,000,000	4½	99.56	4.73	....	Dec 5, 1922	Kuhn, Loeb & Co., of New York and others.
New Jersey	Road	2,000,000	4¼	102.097	4.06	1923–53	Dec. 9, 1922	Dillon, Read & Co., of New York and others
County								
Daviess, Ind	Road	20,800	5	101.17	4.77	1924–33	Dec. 15, 1922	Fletcher Savings & Trust Co., Indianapolis
Humphreys, Miss	Road	100,000	6	105.07	5.50	1923–47	Dec. 15, 1922	Liberty Central Bank of St. Louis.
Montgomery, Ohio	Road improvement	93,000	5½	102.325	5.05	1924–32	Aug. 15, 1922	A. C. Allyn & Co., of Chicago
Summit, Ohio	Road improvement	392,000	5	101.07	4.79	1924–32	Jan 1, 1923	Ohio State Bank & Trust Co., of Akron.
Vanderburg, Ind	Road	8,700	4½	100		1924–33	Dec. 26, 1922	West Side Bank of Evansville.
Wayne, Ohio	Improvement	100,000	5½	102.066		1923–31	Sept 15, 1922	Prudden & Co., of Toledo.
Township								
Belle Valley School Dist., Noble Co., Ohio	School building	75,000	5½	105.01	4.93	1924–44	Aug 1, 1922	L. R. Bollinger & Co., Cincinnati.
Chicago Sanitary Dist., Cook Co., Ill	Sanitary improvements	3,000,000	4	98.0792	4.22	1925–43	Jan. 1, 1923	First Trust and Savings Bank and others, of Chicago.
Hadden Heights, School Dist., Camden Co., N. J.	School building	287,000	5	104.763	4.64	1924–61	Dec 1, 1922	Haddon Heights National Bank.
Lakewood Ocean Co., N. J.	Road improvement	195,000	5	100		1926	July 15, 1922	[illegible], New York City
Lebanon School Dist., Lebanon Co., Pa.	High School Annex	110,000	4½	102.02	4.11	1933–53	Jan 1, 1923	[illegible] & Co., of Philadelphia
Liberty School Dist., Allegheny Co., Pa.	School building	27,000	4½	101.58	4.36	1923–51	Jan 1, 1923	[illegible] & Co., of Pittsburgh
Livonia Common School Dist., No. 10, Livingston Co., N. Y.	School building	10,000	5	102.15	4.54	1924–33	Jan 1, 1923	[illegible], of Rochester
Memphis Independent School Dist., Hall Co., Tex.	School building	110,000	5½	102.31		1924–63	Dec 21, 1922	Stern Bros. & Co., of Kansas City.
Middle Fork Irrigation Dist., Hood River Co., Ore.	Ditch	75,000	6	98.78	...	1928–53	Jan. 1, 1923	Ralph Schneelock Co., of Portland
Oyster Bay Union Free School Dist. No. 21, Nassau Co., N. Y.	School building	75,000	4½	100		1927–56	Dec. 1, 1922	Sherwood and Merrifield of New York
Municipality								
Bedford, Ohio	Street improvement... Road improvement Water	10,958 [illegible] 4,140	5½	101.24	5.26	1924–32	Dec 1, 1922	[illegible]
[illegible], N. Y.	Bridge	20,000	5	100				[illegible]
[illegible], Kan.	Paving	50,000	[illegible]	100		1942	[illegible] 1, 1922	[illegible]
[illegible], N. Y.	Sewer Paving	35,000 30,000	4½ 4½	101.169 100.736	4.36 4.38	1923–42 1923–37	Jan 1, 1923	[illegible]
Hackensack, N. J.	Sewer	490,000	4½	102.22	4.33	1924–61	Jan 1, 1923	Eldredge & Co., New York City.
Haddon Heights, N. J.	Street and drainage Sewer improvement	[illegible] [illegible]	5 5	100 100		1923–40 1925–62	Feb 1, 1923	Haddon Heights National Bank.
[illegible], Mont.	Sewer	5,000	6	100			Dec 26, 1922	Bankers' Trust Co., of Denver.
Jenera, O.	Street improvement	[illegible]	6	100.2875	5.97	1924–28	Oct 1, 1922	Farmers Bank Co., of Jenera.
[illegible], Wyo.	Sewer	[illegible]	[illegible]	100.63		1943	[illegible]	[illegible]
[illegible], N. H.	School	300,000	4	[illegible]	4.23	1923–32	[illegible]	[illegible]
Sioux City, Ia.	School	[illegible]	[illegible]	103.45		1925–32	[illegible]	[illegible]
Port Huron, Mich.	Paving Sewer Sidewalk Curb	[illegible] [illegible] [illegible] [illegible]	[illegible]	101.90 101.90 [illegible] [illegible]		[illegible] 1923–33 1923–25 1923–25	[illegible] 1, 1922	[illegible]
Princeton, N. J.	Sewer	[illegible]	[illegible]	[illegible]	4.30	1924–33	[illegible] 1, 1923	Princeton Bank & Trust Co
[illegible]	Street.. Water and sewer	40,000 15,000	[illegible]	[illegible]		1933–[illegible]	[illegible]	[illegible]
[illegible] Improvement Dist., [illegible]	Improvement	[illegible]	[illegible]	[illegible]		1938–42	[illegible]	[illegible]
[illegible], N. Y.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Winona, Kan	Water	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]
Winnipeg, Manitoba, Canada	[illegible] Hydro-electric system Local improvement	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]

Cement Shipments Break Record

A total of 116,563,000 bbl. of cement were shipped to consumers throughout the United States during 1922, according to latest statistics issued by the Geological Survey. This represents the heaviest total of shipments recorded in the history of the industry. Shipments during 1921 reached 95,051,000 bbl. or a little over three-quarters of the total for the year just passed.

The total output for the year reached 113,870,000 bbl. as compared with 98,293,000, during 1921, a gain of 15 per cent in production.

CEMENT PRODUCTION SHIPMENTS AND STOCKS.

	1921 No. of bbl.	1922 No. of bbl.
Production	98,293,000	113,870,000
Shipment	95,051,000	116,563,000
Stocks on hand at end of year......	11,938,000	9,134,000

Stocks of finished Portland cement at factories, Dec. 31, 1922, amounted to 9,134,000 bbl., or 2,804,000, under the quantity on hand one year ago.

There were also about 2,823,000 bbl. of clinker, or unground cement, at the mills at the end of December, as against 1,949,000 bbl. at the beginning of the month.

As shown in the accompanying table, stocks on hand Dec. 31, 1922, were not only lower than those available Dec. 31, 1921, but shipments exceeded production by nearly 3,000,000 barrels.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of January 4; the next, on February 1.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb....	$3.14	$3.95	$4.40	$3.02½	$3.15	$3.85	$3.25	$3.70	$3.50
Structural rivets, 100 lb............	3.85	4.60	5.25	3.75	4.00	4.80	4.75	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb......	3.04	3.85	3.15	2.92½	3.05	3.62½	3.35	3.70	3.25
Steel pipe, black, 2½ to 6 in. lap, discount........................	54%	52.50%	47%	59½%	57-5%	41%	39.2@51.8%	40%	22.50
Cast-iron pipe, 6 in. and over, ton.....	+55.50	47.82	—57.00	—51.20	56.16	65.61	55.00	55.00	55.00
Concreting Material:									
Cement without bags, bbl...........	2.60@2.70	2.54	2.25	2.05	2.29	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd...............	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd........................	1.00	1.32	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd..........	1.75	2.00	+1.80	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft........................	59.00	36.00	50.00	52.00	42.75	+51.50	35.00	25.00	90.00
Lime, finishing, hydrated, ton......	16.80@ 17.10	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.......	2.75@ 3.13½	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000...	23.50	10.00	—10.85	11.00	18@19	12.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, per block........................	Not used	.0859	.115	....	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block........................	.1230	.0859	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.......	+.93	+1.00	—1.07	.98	1.01	—1.10	1.04	.86	1.02
Common Labor:									
Common labor, union, hour..........	.60	.35	.30@.50	......	....	.50@.55	.56¼	.50@.60	......
Common labor, non-union, hour....	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.50	....	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180 lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.13). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $22.50; 6-in., $108.

Changes Since Last Week

Continued heavy demand for finished steel, particularly railway materials, responsible for present firmness in prices. Quotations of $2 per 100 lb. on steel bars giving way to somewhat frequent quotations of $2.10@$2.15, f.o.b. Pittsburgh. Bars showing especially heavy demand; mills sold through first quarter, and considerably well booked for second quarter deliveries. Shapes unusually firm for this season of the year; quoted at $2 per 100 lb., f.o.b. mill. Quotations under $2, on steel plates, no longer appearing in the market; mills rapidly filling up on orders, principally for car materials.

Lumber market firm, especially as to yellow pine. Mill stocks of pine are sufficient to meet demand; dealers' yards, however, are not heavily stocked. Existing prices are unusually steady for this season of the year. Douglas fir, however, advanced $1 per M.ft. b. m. in Denver, during week. A total of 361 mills reporting to the National Lumber Manufacturers' Association for the week ending Jan. 6, show 643,763,469 ft. cut; 804,854,584 ft. shipped and orders for 785,211,989 ft. b. m. This represents a drop, in one week, of nearly 9 per cent in production; 3 per cent in shipments and 4 per cent in orders.

The National Lumber Trade Barometer, Jan. 12, 1923, shows the position of the industry at 30 per cent below normal as to output; 20 per cent below, on orders and 12½ per cent below, in shipments. Despite recent quietude of linseed oil market, price fluctuations are reported in four principal cities reporting weekly to *Engineering News-Record.* New York quotes advance of 3c. and Atlanta, 5c. per gal; while declines of 2c. are reported in Dallas and 3c. per gal. in Denver, since last week. Red and white lead, both dry and in oil, rose ½c. per lb. during week, making the second advance since December.

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
Editor

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The Civil Engineers Speak

IN DEMANDING an early trial for those of its members who have been caught in the sweep of the indictments and civil actions arising out of the alleged camp-construction frauds, the American Society of Civil Engineers has risen to a responsibility incumbent upon it as national spokesman for the civil engineers of the land. As has been pointed out in these columns, these indictments transcend the personal and impeach the competence and the honor of the construction industry, in which the civil engineer is so important an element. Until these charges have been proved or refuted the engineering profession has a duty to perform—a duty to itself, to the American public and to those of its ranks who contributed so worthily to the needs of their country and who now stand accused, along with the defendants. Speedy punishment for the guilty and equally speedy exoneration for the innocent are but the minimum requirements of plain justice, and the society does well thus to register the sentiment of the profession.

Engineers and the Traffic Problem

FROM cities both large and small evidence indicating the seriousness of the traffic problem keeps accumulating and from the automotive industry and the motor-vehicle registration bureaus of the states figures are received showing an ever-increasing production and a correspondingly high registration. Existing conditions have forced upon the public an appreciation of the need of improved methods of traffic control if streets are to be made passable for the movement of vehicles and the crossing of pedestrians. Traffic control began as a police function and has developed very largely under police administration. Engineers, until recently, have had an insignificant part in its development and yet it is essentially a problem on which engineering thought is needed, particularly at the present time when all sorts of schemes involving the cutting of new streets through built-up sections of cities, elevated vehicle roadways, street widening projects, arcaded sidewalks, pedestrian tunnels or bridges across crowded thoroughfares are being suggested as solutions. Many of these projects, of course, are impracticable while others may become realities in the near future. Certain it is that the engineer should have a deciding voice in the adoption or rejection of plans for the solution of the city traffic problem.

Some Special Pleading

IN COMMON with many others, we have noted with concern the growing number of automobile killings in the United States and have demanded a greater care on the part of both drivers and pedestrians and a more serious consideration of the traffic problem by the governmental authorities. To us this has seemed a most serious menace and one which is increasing. We find now, however, on reading a recent article in an automobile journal that the danger is exaggerated; that while in fact the total number of deaths due to automobiles is increasing the number *per automobile* is decreasing. In other words, by analogy if the number of yellow-fever deaths increase there need be no concern so long as the deaths per fever-bearing mosquito decrease. Or possibly this statistician would claim that, like the dog who by ancient common law is entitled to one bite, every automobile is entitled to one accident.

A Notable Arch

FOR a record-breaking structure the big arch of the Cappelen bridge at Minneapolis is of amazing simplicity. When one recalls that not fifteen years ago any masonry arch of over 200 ft. span was worthy of special record for its size alone, the design and construction of one of 400 ft. span would seem to call for almost prayerful study. The Minneapolis engineers, however, do not appear to have found the bridge of more complication than a similar one of much smaller size, and while they have insured its safety and economy by all proper precautions they have done little more either in design and construction than to apply the accepted principles of concrete arches. All three arches, the two of 200 ft. and the main span of 400 ft., are in reality plain concrete ribs in which large steel frames are incorporated for the general purpose of toughening the concrete rather than for specific tensile service. Few of the complexities of reinforced concrete had therefore to be considered in the main members, and the design resolved itself merely into a question of large-scale masonry arch design. Construction was equally simple, especially in the enlargement to mammoth size of the common multiple-post timber falsework for which the shallow stream and the firm subsoil presented highly favorable conditions. Taken all in all the Cappelen bridge is notable not only because it is the largest masonry arch in the world built at a location not naturally suited to arch construction, but also because it demonstrates how the art of design can progress evenly through successive stages to application to unexpected dimensions.

Sanitary Engineering Broadened

SANITARY engineering has been restricted by some in times past to include nothing or little except sewerage. This has been more notable in England than America, and a few decades ago than now: as witness Baldwin Latham's "Sanitary Engineering," which was devoted to sewerage, and the later British work of the same title by Moore and Silcock, which went a little further afield and included refuse disposal. In America, sanitary engineering has been recognized as having a wider scope, but aside from the textbook Merriman's "Elements of Sanitary Engineering," American engineering literature has no book on sanitary engineering as a whole. All this may be due in large part to the vastness of the subject, which has led to works on one branch alone and found them requiring large volumes like Flinn, Weston and Bogert's "Water-Works Handbook," or Hering and Greeley's "Municipal Refuse," or extending into two, like Ogden's "Sewer Design" and "Sewer Construction," or into three, like Metcalf and Eddy's "American Sewerage Practice."

Nothing short of a liberal shelf length would suffice for a series of comprehensive treatises that would be required to cover all the phases of the five-fold division of sanitary engineering given in H. P. Eddy's address following the organization of the Sanitary Engineering Division of the American Society of Civil Engineers last week. Condensed to one word each, Mr. Eddy's five divisions are water, sewerage, scavenging, insects, and air.

The function of the Division of Sanitary Engineering, Mr. Eddy suggested, is to advance the science and art of each of these five divisions, and the chief ways and means of doing this are co-operative research and the dissemination of sound information. Not the least of the latter is the bringing home to city officials, voters and taxpayers the fact that to maintain the integrity of sanitary engineering works by adequate maintenance, and to ensure efficient operation, is as much the function of the sanitary engineer as is design and construction. This, with the five-fold division of the subject, is a broader conception of sanitary engineering than is held, we fear, by some members of the profession and much broader than has yet been grasped by one in a thousand of city fathers and the people they are chosen to serve.

Prepare Now for Next Year's Road Show

HIGHWAY improvement occupies a better position among the engineering activities of the country as the result of the convention and exhibition put through in Chicago last week by the roadbuilding interests of America. This new rank is not merely because an intelligent list of highway questions was discussed by men high in the roadbuilding councils of state and nation but because an association, in one organization, of all persons concerned in highway development has shown that it can activate vitally and with entire harmony of various personal interests. The engineer, the contractor, the materials producer and the equipment manufacturer each demonstrated at last week's convention that he can to his own advantage work in association with all the others to perform a great educational task.

No other organization in the field of highways serves the same broad purpose as does the American Road Builders' Association. It embraces every person and every interest having scientific concern with and practical duties to perform in road construction. The Association of State Highway Officials is, in contrast, a close organization of public officials. Other associations have special fields, like that of highway transport, and many are merely bureaus for roadbuilding propaganda, or special privilege, of one sort or another. To note the success, therefore, of the only association of all technicians engaged in roadbuilding is gratifying, particularly following a period of disorganization which at times threatened to be fatal.

The reasons for the quick recovery of the last year need not be considered. It is more important to prepare to satisfy the obligations of next year. In the convention and exhibition which are to come in another twelve months a greater task is promised than that which confronted those who conducted the work of the convention and exhibition which have just closed. Such perfection as characterized the activities at Chicago last week was due to preparations begun far in advance of those of any previous years. This lesson should not be lost. Preparation for the congress and road show of 1924 should be begun immediately.

An Analogy and a Suggestion

IN COMMENDING the report on the New York transit problem published by the Merchants' Association of that city, *The New York Times* speaks as follows:

> The report . . . is of first-class value. It is the work of a committee of experts. They have been studying the questions involved for a long time, without fear or favor. Personalities they put entirely out of their findings. The political bearing of the subject they pass by as beneath notice. They are not concerned with winning votes, but with doing something for the great body of passengers who are overcrowding our transit facilities, and whose larger interests have been almost lost sight of in the squabbling of politicians.

All this, with appropriate changes in wording, might be said with equal force concerning the work of the Board of Economics and Engineering of the National Association of Owners of Railroad Securities, in its investigation of the equally harassing but vastly more far-reaching problem of the New York Port terminals of the trunk-line railroads. That board, too, was "a committee of experts," all engineers, eminently qualified for their undertaking. It is a coincidence, indeed, that Col. F. A. Molitor happens to have been chairman of the merchants' committee as well as of the security owners' board. The analogy follows even more closely Just about the time the board took up the terminal problem alternative plans for its solution were much in the public eye, and we doubt not the board found itself compelled to do just about what the *Times* says the merchants' committee has done, that is "to take the two plans . . . before the public and subject them to minute scrutiny and searching analysis." Probably it did just that and then drew generously upon its native wit and aggregate experience to supplement whatever it may have found worth while in the rival proposals.

Unfortunately, however, all this must remain the subject of speculation alone, for the report that embodies the findings and the judgments of the board has not yet been made public. Requests for its publication, conformably to the precedent set up in an earlier study of the Chicago terminals, have been of no avail. For some reason the report on the New York terminals has been suppressed. Just why, no one seems to know and it would be futile and unfair to hazard a guess.

But now that the Interstate Commerce Commission has been invoked to iron out the differences between the Port Authority and the railroad managements, is it too much to hope that someone may be prevailed upon to let us know what is in this jealously guarded report? It is quite possible that the revelation might leave us unsatisfied and disappointed. Maybe the security owners think there is not a helpful idea in the entire document. Perhaps that is why it has been withheld.

But what harm though it should be a "dud"? What harm could befall the railroads, or the City of New York, or the Port Authority or the general public if these engineers had failed to hit upon the right answer? They have not the authority to impose their ideas on the community, and if their ideas are unsound those who have the authority may easily reject them. At least we should have the benefit of the findings and the opinions of an exceedingly able committee.

We commend to the Interstate Commerce Commission, therefore, simply as a worth-while speculation, a reading of the report on the New York terminals prepared for the National Association of Owners of Railroad Securities by its Board of Economics and Engineering. That is, of course, provided it can manage to get hold of a copy.

From Politics to Production

IT WAS evident last week that a new spirit animates the American Society of Civil Engineers. That it is felt by most of the membership was proved by the spontaneously voiced opinions of many men representing different orientations and geographical locations. The large attendance at the annual meeting, the general atmosphere of activity and interest, the technical character of the proceedings, and several developments in the direction of more efficient work, were expressions of this spirit. In its essence it is one of determination to work hard in co-operation for the advancement of engineering, and quite obviously it rests on a restored belief in the overshadowing importance of technical activity. There is every evidence that the new spirit will endure. It means progress.

With this happy change it becomes certain that the political turmoil which marked the society's recent past has subsided—soon to end finally, no doubt—and that useful production is resumed. The sword has been beaten into the ploughshare. The turn of events is to the advantage of all, not merely the members of the society but all votaries of the civil engineering profession. Now that the dominant professional organization again devotes its great energies solely to the advancement of engineering science and art, the profession regains the strength which resides in union.

The meeting was of a character well suited to the celebration of the society's seventieth anniversary. It embodied an interesting divergence from a precedent set by former ages, according to which the membership gathered together from distant parts of the country once a year for the sole purpose of discussing administrative business; for almost the first time the annual meeting was made a technical gathering. But while this innovation was significant, more important expressions of the realignment of purpose in the society were the organization of technical divisions and the definite recognition of research as a major phase of the society's work.

The organization of technical divisions was in a sense the outstanding event of the meeting. Sanitary, power, irrigation and highway divisions were formed, and, with others likely to follow soon, the society may be said to have changed overnight from the form of a large unwieldy committee of the whole to an assemblage of specialized working groups co-ordinated by general meetings and joint counsel and co-operation. Whether or not the change will prove to be thoroughgoing, a sound course of development is assured; the organizing sessions brought together strong gatherings of specialists imbued with the will to do useful work—and no brighter promise of success could be asked. Many organizational details are yet to be worked out, but since able men are back of the movement, in the divisions as well as in the general councils of the society, a sound solution of the remaining problems may be counted on. Further, as the experience of other societies in specialization is available as guide and warning, there need be no apprehension that the mistake will be made of providing the deadening excess of mechanism with which some such movements have burdened their parent bodies.

But while the technical specialization, being new, attracted most attention, it is inherently no more significant of the recrystallization of spirit and purpose within the society than the affirmation of the policy of stimulating research. Established in a tentative way a year ago, the policy received its final endorsement at the present meeting. The attitude of the membership was made evident in a separate session devoted to research. The view of the governing authorities of the society expressed itself in the creation of two further special research committees, adding to the half dozen or more which have been at work during the past year. Thus the society progresses in carrying out by new means its foundation aim of advancing engineering knowledge, and it does this by calling into action increasingly larger numbers of its members under specific assignment of work.

In respect to both specialization and research the society has now assumed consciously and effectively a function which heretofore it performed only vaguely and indirectly, namely that of stimulating and drawing out the productive capacity of its membership to the benefit of professional knowledge. The technical division system serves this end by concentrating the ability of the various specialists among the membership in separate groups where the power of mutual influence will be greatest. The cultivation of research serves the same end by providing means of assembling the questions and undetermined points of engineering science and bringing to bear upon them the many scattered investigative powers existing within the organization. The certain result will be an increased efficiency of society work, through the systematization and concentration of vital agencies which have been unco-ordinated until now. Thus the society's intellectual and technical resources are integrated and made of greater service to the profession and to the world.

These developments within the society are unmistakably bound up with the new spirit observable at last week's meeting. But it is neither necessary nor profitable to speculate whether they are the result of the new spirit or its source. The important thing to note is that all that is being done works to strengthen the bond between member and society, the bond of purposeful technical work.

Only a modest beginning has been made so far in the new activities, let it be remembered. Even in these beginnings, however, it is evident that they are connected with the life nerve of the society's existence. They have meaning and importance then for the whole profession, and give a solid basis for the most hopeful expectations concerning the fuller development of our civil engineering art.

Design of 400-Ft. Concrete Arch of the Cappelen Memorial Bridge

Largest Concrete Arch Ever Built Will Be Completed This Year—Span Required to Provide Navigation Waterway and Clear Old Bridge—Thrust Partly Balanced by 199-Ft. Side Spans

WITH the largest concrete span in the world, a 400-ft. arch containing 2,300 cu.yd. of concrete in each of its two ribs, the Mississippi River bridge at Franklin Ave., Minneapolis, recently renamed the Cappelen Memorial Bridge in honor of the engineer who planned it and began its construction, is one of the most important and interesting works of structural engineering now in progress. Aside from its magnitude, it is remarkable for being built by the city as force-account work; all Minneapolis construction has been done in this way for years.

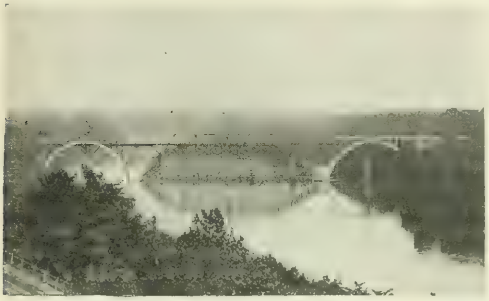


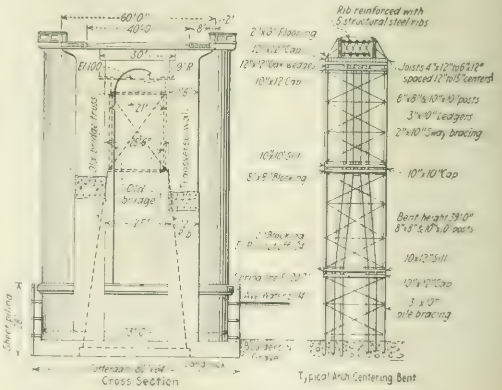
FIG. 1—CAPPELEN BRIDGE OVER MISSISSIPPI RIVER
Centering of 400-ft. arch under downstream rib

Though it constitutes a formidable engineering problem, the bridge is strikingly simple both in its design and in the construction methods being applied to it. Under N. W. Elsberg, superintendent of construction for two years and now city engineer, the work has progressed to completion of the piers and ribs, and concreting of the floor is now in progress. The coming season will see the completion of the structure.

Preliminary data, with an outline sketch, were given in these pages Feb. 12, 1920, p. 335. The leading considerations and data of the design, made available by Mr. Elsberg and K. Oustad, bridge engineer for the city, are given in the present article.

Governing Conditions at the Site—Located in the southwestern residential district of Minneapolis, Franklin Ave. crosses the Mississippi as one of the main connecting links between two well settled sections. The old structure here is a five-span steel bridge about thirty years old, with a roadway only 18 ft. wide; its 302-ft. main span is of through arrangement, while the four 174-ft. side spans are deck. It has long been inadequate and its replacement has been contemplated for a number of years. After completion of the South Third Ave. bridge—ten 200-ft. concrete arch spans—seven years ago, F. W. Cappelen, the city engineer, at once put the Franklin Ave. crossing problem under study. The new concrete arch bridge is the outcome of this study.

Permanence and monumental appearance were desired in the new bridge, the latter quality because of park and residential surroundings and the scenic value of the site. This pointed to a masonry or concrete arch structure. With regard to navigation requirements, however, a span of at least 300 ft. would be necessary. Nevertheless, Mr. Cappelen developed a project for a concrete arch crossing to replace the old bridge, and it was subsequently approved by the city government and



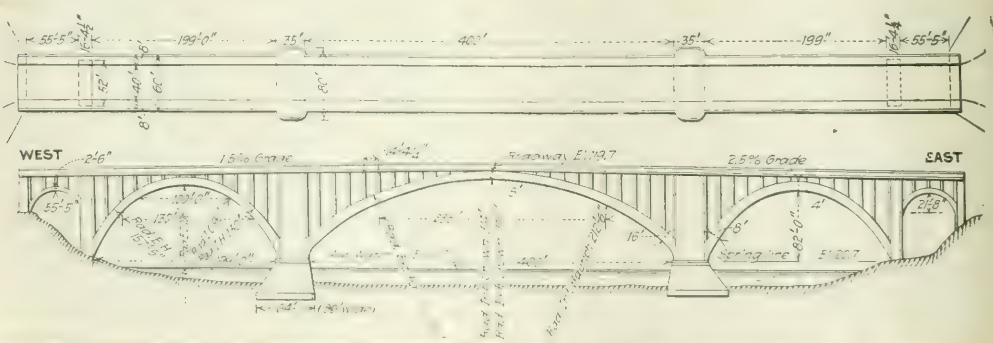


FIG. 2 FRANKLIN AVE. CONCRETE ARCH BRIDGE—THREE-STORY CENTERING FOR MAIN ARCH RIB

the necessary funds voted by the city council. Construction began in the latter part of 1919.

General Conditions—Franklin Ave. crosses the river near the head of the Mississippi River gorge lying between Minneapolis and St. Paul. The river is about 900 ft. wide here, or about 1,100 ft. between the edges of the bluffs. The banks are about 100 ft. high, of limestone, while the river bed is in St. Peter sandstone, thinly covered with drift and alluvium. Sound rock lies 15 to 30 ft. below water. Thus, a good foundation is available for any type of structure. River navigation is not at present important, but is expected to become so in future with the aid of ponding by the government dam several miles downstream, completed a few years ago. A wide channel with substantial clearance height was therefore demanded by the War Department (minimum width 300 ft., clearance height 50 ft.).

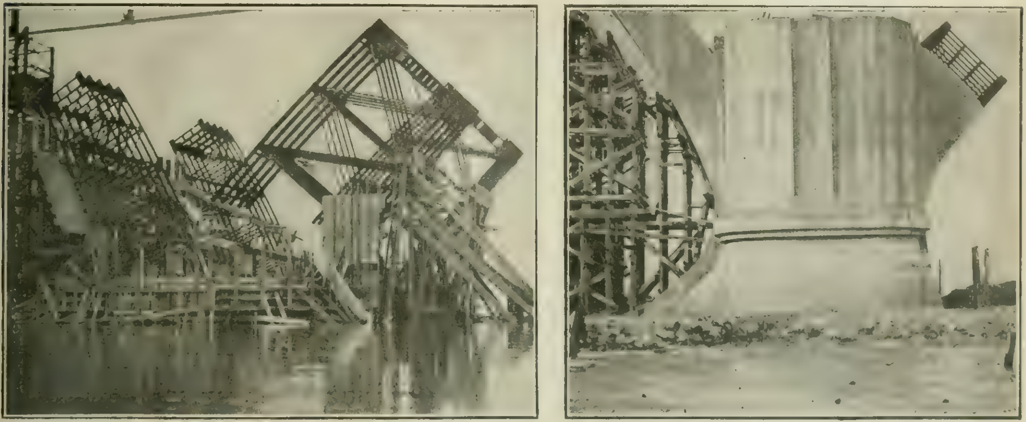


FIG. 3—RIB REINFORCEMENT AND COMPLETED PIER WITH RIB SECTIONS

It was desired to interfere as little as possible with traffic across the old bridge during construction, and to maintain at least a pedestrian crossing throughout the work. Further, the possibility of using the old bridge for transportation of material during construction was an important consideration. It seemed necessary, therefore, to clear the old structure by building outside of it, and to make the main span long enough to pass beyond the old piers.

General Design—Applying these datum points to a preliminary sketch layout, a central arch span of about 400 ft. resulted. The height of the banks called for a floor elevation some 10 ft. higher than that of the old bridge, the latter being below bank level. With a moderate grade up to the center of the new structure, then, a rise of about 90 ft. was obtainable in the central span.

In order to transmit to the sides of the gorge the larger part of the thrust of this span, it was desirable to make the side spans as long as possible. Keeping the level of their outer springing lines at the bottom of the gorge limited their span to about 200 ft., however. Under these conditions the thrust on the main piers could not be balanced, unless the side arches had been made of shallow rise by depressing the crown far below roadway level, which was not considered esthetically desirable. But a pleasing proportioning of spans was obtained, and Mr. Cappelen's skill and good taste in design soon developed this layout into the general plan as now being carried out, and as shown in the drawing and views herewith.

The detailed design, largely worked out by Mr. Oustad, is unusually simple in its architectural features, making use of almost no ornament; for example, the ends of the spandrel columns are simple square faces, without any molding. The result is a demonstration of what can be achieved with plain details provided the structural proportioning is good.

For simplicity in construction, a slab-and-floorbeam deck (without stringers) was adopted. Since street-car loadings were to be provided for, a reasonable limitation of slab thickness restricted the column spacing to about 15 ft. longitudinally of the bridge. The adopted spacing in the main span (14 ft. 4½ in.) was maintained also in the side spans, with suitable detail adjustment of span length.

The deck width was governed by the width of the approach streets as defining the character of present and future traffic. The streets have generally a 40-ft. roadway, and this figure was adopted for the bridge. As there are other bridges reasonably near by, the nearest a mile downstream and three-fourths of a mile upstream, no very intense concentration of traffic at this crossing is looked for, and it is believed that the 40-ft. width will always be adequate. The total deck width of 60 ft. obtained after two 8-ft. sidewalks were added agreed well with the structural requirements of the arches as to width. To clear the old bridge, the arch ribs had to be spaced 25 ft. apart in the clear; a rib width of 12 ft. was considered the minimum permissible, and this brought the over-all width of the arch structure to 49 ft., leaving 5½ ft. of bracketing for the sidewalk on either side.

Arches—In laying down the general design, Mr. Cappelen had made it an initial condition that the springing line of the arches should be above high water. There is a possibility of 5 or 6 ft. of flood rise above pool level, and accordingly the pier belt course which defines the elevation of spring was placed at about this height above low water. The arches themselves are approximately parabolic; more exactly, they are curves fitted closely to the mean pressure line and then faired out by drawing three-centered intrados and extrados curves. The crown thickness of the 400-ft. arch is 8 ft. and the skewback thickness 16 ft. The corresponding thicknesses of the 199-ft. arches are 4 ft. and 8 ft.

With these curves and dimensions, the arches do not experience any extreme-fiber tension under any conditions. The reinforcing steel could not be proportioned for definite stresses, therefore, but it was designed by judgment, to give a good interbonding of all parts of the rib. It represents about 0.8 per cent of the rib section. (See the pressure lines under half-live load, Fig. 6.)

Structural-steel reinforcement was adopted, for the sake of simplicity in erection and certainty of true positioning. Each rib contains five longitudinal frames or trusses, tied together by frequent cross-frames. The chord angles are 6 x 6 x ½ in. in the large arch and 4 x 4 x ⅜ in. in the small. The frames enter the pier concrete only far enough for bond, and do not extend to the base course (Fig. 5).

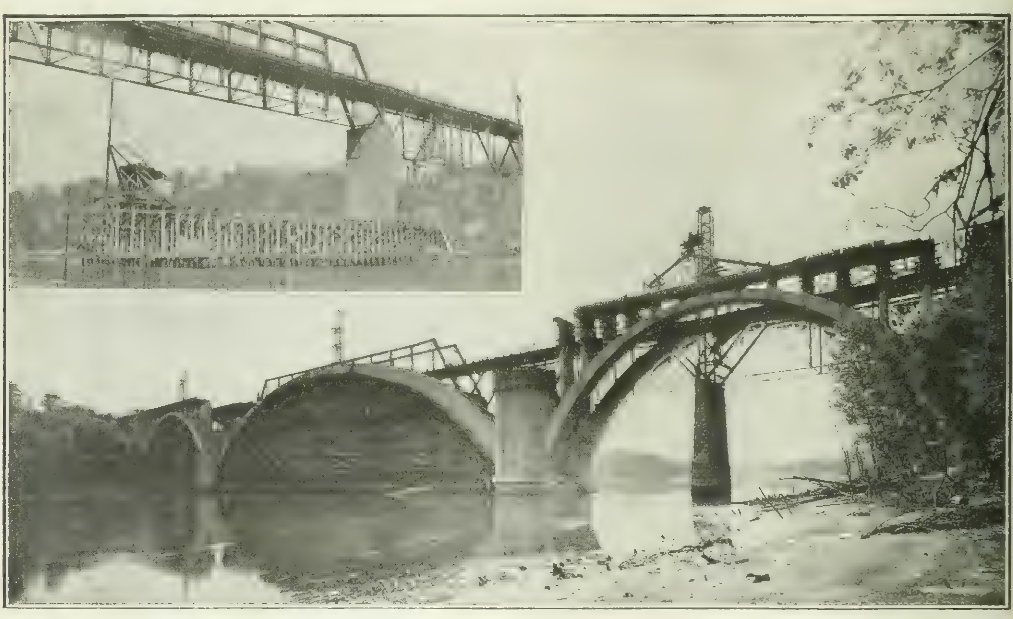


FIG. 4—THREE SPANS CROSS THE 868-FT. WIDTH BETWEEN THE MISSISSIPPI GORGE BLUFFS

The old steel bridge, shown in the insert view, was narrow enough to permit of building the ribs of the new arch structure alongside and at the same time keeping the old crossing in partial service.

Piers—It was expected that a good foundation would be found about 25 ft. below pool level. In actual construction, the west main pier was founded at 26 ft. below pool level, and the east main pier at 20 ft. The rock encountered is a massive sandstone, moderately soft, and somewhat fissured; the strata dip slightly from both banks toward the middle of the river. There being a net outward thrust on the main piers due to the excess thrust of the large arch, in order to keep the resultant pressure line as steep as possible the pier was made solid to a level well above the springing line; thence upward it carries two hollow shafts rising to roadway level. The thrust is transferred into the foundation rock chiefly by friction on the base, though there is also lateral bearing of the concrete against the rock sides of the foundation excavation, which was cut 2 to 3 ft. into the rock to get good bearing material. The base is horizontal, and no artificial keying or doweling was thought necessary to supplement the natural roughness of the rock surface obtained.

On account of the inclination of the thrust, the pier had to be made unsymmetrical in order to keep the resultant near the center of the foundation. The resulting pier design is quite unusual. There is bottom reinforcement to take care of footing tension, and skin reinforcement all around for protection against shrinkage effects. The footing pressure is about 4½ tons per sq.ft.

Construction conditions made it necessary to concrete the base course in separate sections. Care was taken to key and dowel the sections together, and a second base course extending over the whole foundation area was concreted on top of the lower or seal course, for further integration of the pier concrete.

The end piers are simple, bearing on the rock practically at the springing-line level.

Deck Design—Originally it was planned to place precast floor-beams in notches formed in the tops of the spandrel columns. Most of them are being cast in place, however, while for convenience some are being precast.

These beams, having a net span of 25 ft. and carrying a floor area of nearly 360 sq.ft., are 24 x 54 in. in section. The slab, cast over them as a separate operation, is 12 in. thick over the roadway and 9 in. over the sidewalks and will carry a pavement of wood block on sand or sand-cement fill on the roadway, and a sidewalk pavement of 24-in. square concrete tile on cinder filling.

In the original design a rather elaborate baluster handrail was planned. Precast handrail of this type that was placed on the South Third Ave. bridge has not proved wholly satisfactory, however, and it is thought preferable to cast the rail in place. A much plainer rail, moreover, is considered quite as satisfactory in appearance as one containing ornate spindles.

Floor expansion is provided in general at alternate floorbeams, or about 29 ft. apart. The expansion end of the slab is here supported on a brass plate laid on half of the floorbeam. The curb is cast in place, separate from the floor slab. The sidewalk coping or fascia course, which also forms the face of the balustrade, is similarly cast in place.

Loading and Stress Analysis—A highway loading of maximum type was assumed in proportioning the structure. The arches were analyzed by the elastic theory as fixed-end arches, the radial springing-line joints being considered fixed. Partial loading and temperature effects were considered.

For the two street-car tracks, 40-ton four-axle cars were assumed, using the axle loads direct for the floor slab and beams, and an equivalent uniform load of 1,200 lb. per lineal foot of track for the main arches. In designing the floorbeams, one axle on each track was placed directly over the floorbeam. For designing the slab (spanning from floorbeam to floorbeam), a four-wheel truck was placed in maximum moment position (center of span at one-quarter wheel base). The load of one track was assumed to be borne by an 8-ft. width of slab, this being the width under a 6-ft. tie plus 1 ft. on either side. As the ties will be bedded in cinder concrete, an effective distribution of the rail loads along their length is expected to be obtained.

For the roadway and sidewalks, a load of 100 lb. per square foot for slab and beams was assumed outside the car tracks, and for the arch ribs a load of 80 lb. The width preempted by the street-car loading was taken as 20 ft., leaving a 10-ft. roadway-loading strip on either side. No impact was added to the roadway loading, but 25 per cent impact was added to the car weight in designing the slab and beams. The compression in the 400-ft. span is 563 lb. per sq.in. at the crown and 408 lb. at the spring line; a temperature rise of 40 deg. would add 16 lb. per sq.in., making the maximum compression 579 lb.

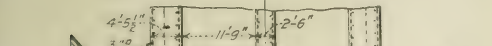


FIG. 5 MAIN PIER AND RIB HAUNCHES

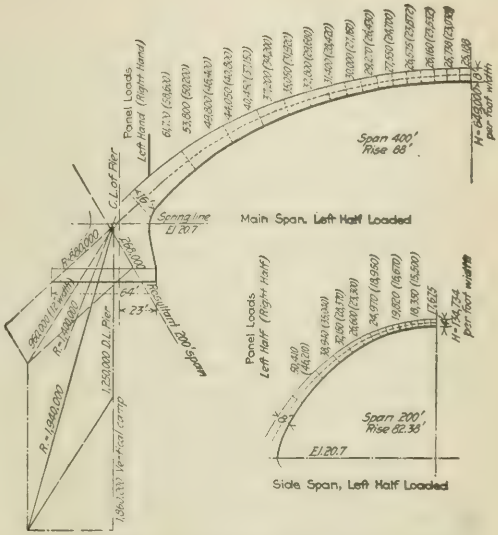


FIG. 6 PRESSURE LINES FOR LEFT-HALF LOADING

The arch stresses nowhere exceed 600 lb. per square inch (compression). The slab and beams were designed in accord with the recommendations of the Joint Committee on Reinforced Concrete (650 lb. compression in the concrete, 16,000 lb. tension in the steel, and straight-line stress variation).

Construction—Construction was carried out with an interesting type of centering for the large arch, as indicated in Fig. 2, arranged for successive concreting of the two ribs. Workmanship of high quality was obtained, and the work progressed smoothly according to the schedule laid down in advance, except for the delay caused by a fire in the east portion of the main span falsework last winter, as noted in *Engineering News-Record* Feb. 9, 1922, p. 257. In spite of this the downstream (south) rib of the main arch was concreted in the last week of April and the other rib by fall. The sidewalk slabs were placed before the old spans were removed; the roadway floorbeams and floor are now being constructed after removal of the interfering parts of the old bridge.

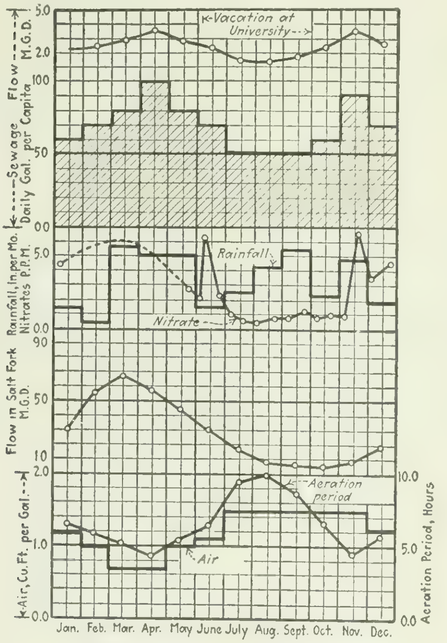
The ribs of the 400-ft. arch settled about 3 in. while they were being concreted, due to compression of the centering. When the centers were struck, about 6 weeks later, very little further settlement took place.

After the general design of the bridge was worked out by the late F. W. Cappelen, city engineer, the details were designed by K. Oustad, city bridge engineer. Until Mr. Cappelen's death the construction work was in charge of N. W. Elsberg. Since the latter became city engineer, F. T. Paul has been in charge of construction. J. E. Lundstrom is general foreman and Wm. McCaulley master mechanic.

Costs of materials and labor have risen since the work was begun, but it is expected that the original estimate of $900,000 for the total cost will not be exceeded. At the beginning common labor and skilled labor were paid 50c and 80c. per hour respectively, while at present 62½c. and $1 are being paid. The total concrete in the bridge is 30,000 cu.yd., of which the two main piers consumed 5,750 and 7,250 cu.yd., the ribs of the 400-ft. arch 4,100 cu.yd., and the ribs of the two 199-ft. arches 2,900 cu.yd. The side piers, abutments and 55-ft. arches contain 4,900 cu.yd. and the floor slab 2,100 cu.yd. The remaining 3,000 yd. are consumed in the columns, floorbeams, sidewalk brackets and coping.

Imhoff Tanks and Sprinkling Filters for Champaign and Urbana

CHOICE of Imhoff tanks and sprinkling filters for the treatment of the sewage of Champaign and Urbana, Ill., instead of by the activated-sludge process, was determined largely by the smaller cost of the former method. Estimates for each plan were made up on the basis of (1) electric power, purchased, and (2) oil engines, installed by the city. Using purchased power, tanks and filters were estimated to cost $400,000, with an annual operation cost of $16,800, making a total annual charge of $46,800. With oil-engine power, the first cost would be $410,000, the annual operation cost $14,200, and the total annual charge $44,950. For the activated-sludge plant, purchased power would require an outlay of $300,000, a yearly operating cost of $44,000 and a total charge of $65,500. If oil-engine power were used the first cost of an activated-sludge plant would be $345,000, the operating expense $33,800 and the total annual charge $69,600. It was these figures that led Pearse, Greeley & Hansen, consulting engineers, to decide on tanks and filters rather than activation, since either method would be satisfactory. The electrical power was figured to cost an average of 2.9c. per kw.-hr. Few, if any, activated-sludge plants in this country, the engineers mentioned state, have been built where the cost was more than 1c. per kilowatt-hour.



FACTORS AFFECTING AERATION PERIODS OF PROPOSED CHAMPAIGN-URBANA SEWAGE-WORKS

Based on estimated quantities in 1925, with reduction in air requirements in spring due to sewage dilution at that time. High nitrates also reduce air required in accordance with experiments of Dr. Edward Bartow.

In the accompanying chart are shown factors affecting aeration estimated for the 1925 capacity of 2.5 m.g.d. and it was on the required air per gallon that the final figures given above were based.

The sewage-works will be built by the Urbana and Champaign Sanitary District and paid for by a $500,000 bond issue. In the election campaign for these bonds well prepared booklets were distributed to help win the support of citizens and taxpayers.

Lighting Highways and Motor Vehicles

By David Beecroft
Vice-President, North Atlantic Division, National Highway Traffic Association

Extract from a paper presented at joint meeting of the North Central Division of the National Highway Traffic Association and the Michigan State Good Roads Association.

CONNECTICUT has gone further than any other state in a study of accidents and for two years has investigated every accident occurring on the highways of the state and has classified these accidents showing the number for which the blame is due to motor cars, motor cycles, trolley cars, horse vehicles, railroads, pedestrians, etc. This analysis for 1921 shows that approximately 91 per cent of all accidents on the highways can be eliminated by highway improvements, better highway lighting, improved signals, better lighting of motor vehicles, improved regulation of all vehicles and general education of those using the highway. The Commission of Motor Vehicles believes that only 7 per cent of all highway accidents cannot be avoided.

After reading the opinions of motor vehicle commissioners, in half a dozen states, that now have heavy motor truck travel, only one conclusion can be reached, viz: that perhaps with the single exception of Connecticut no adequate analysis of accidents has been made to establish any relationship between lighting of vehicles and the accidents. Perhaps up to the present we represent the consensus of opinion by stating that motor cars are too often overlighted and motor trucks generally underlighted.

Let us now briefly consider the highways on which these vehicles operate day and night. A few stretches of highway are being lighted with experimental systems, that give promise of excellent results and our state departments must keep this subject in mind as a part of the problem of making highways safe and the task of highway regulation.

The last year has witnessed rapid development in the use of signal lights at street intersections in suburban areas. No uniformity exists in the color or location of these lights. In one city of 40,000 population in the zone of Greater New York city there are three different colored lights on a leading highway in the distance of two miles. All three are blinking types of intermittent lights, one showing a green light in both directions; another a green in one direction and white in another; and another red in one direction and green in another.

There is no field for intermittent lights of this character on the highway because of the tax they impose on the mental energy of the driver. A steady green light is preferable.

In a night trip of 20 miles north from New York City, and in other directions as well, the driver is confronted with a veritable chaos of lighting schemes, each of which demands a mental problem at a time when the driver is approaching a danger zone and when most of his mental alertness is needed in watching other users of the highway and controlling his vehicle. All highway signal lights of this character should be standardized not only as to color, but as to height and location.

Studied Economy Is Trend in Modern Road Work

Highway Planning, Design, Construction, Maintenance, Administration Demand Strict Business Principles, As Shown by Abstracts of Road Builders' Papers, Read at Chicago Jan. 15-19

Keep the Public Sold on Highways

By H. E. Hilts
Acting State Highway Engineer of Pennsylvania

A STUDY of the history of transportation shows the necessity for leadership and vision. New ideas in transport, like all other commodities, have to be sold. Our present day commercial transport is sold and our interstate and intrastate carriers sell their particular facilities to their clients both by publicity campaigns and by paid agents.

In the field of highway transport, a new mode of common carriage has rapidly developed. It is still young and is still in its pioneer stage of development. It is a mode which, if used and promoted conservatively, will augment, simplify and make more economical and commercially more remunerative both ship and railway transport. If, however, its powers are spent in endeavoring to usurp the functions of the other carriers, it would seem that our new mode of transport will be retarded in its development. Education will help to prevent this danger. In common prudence state highway departments should play their part in giving the public authoritative information on highway transport, as it involves the roadbed and the right-of-way.

Broadly speaking, pay transport is that of the manufacturing and commercial interests, and these interests have to be sold (1) the idea of selective carriage by the motor truck on our highways in contra-distinction to the common carriage of the railroad, and (2) the use of the motor vehicle for short-haul traffic. In general, the commercial interests are exponents of the value of good roads, but there has been a marked laxity on the part of the state highway departments in giving out information which is live information, and the spasmodic attempts by personal address have not carried the message of economical use to these people. The road builder, the motor truck manufacturer, and the railroads have a common interest in selling the road user reasonable selective traffic, and the sale of the idea that a reasonable load should be carried within the legal limits of speed, and in a vehicle that meets all legal requirements.

The largest class of road user, the owner of the pleasure motor vehicle, has as yet to be sold the salient idea of highway financing. He does not yet realize that roads cost money, that definite road policies of construction, maintenance and administration are necessary. He does not realize that he has a vehicle that is dangerous to his fellow man when improperly used. The courtesy of the open road has not as yet made its appearance. If the road official does not take in hand and continually sell and resell the idea of road courtesy, he is leaving one of his greatest assets dormant.

The obligation of the state highway department is not fulfilled merely by selling ideas, for before it can sell anything, it, like any other business enterprise, has to have the healthy respect of the general public for its purposes, its judgment and its work. If the people are led to believe that its purposes are political, that its judgment is biased and its work is poorly handled and wastefully done, it can't sell ideas. Therefore, when the general policy of a live department is decided upon, after definite and long continued conferences with the people and with the interdepartmental divisions, let the people know—don't hide it. Expenditures are large, tens of millions of dollars yearly in many states, and the making available of funds in future years will be one of the jealous prerogatives of future legislatures. State programs always will depend upon the legislatures as representing the will of the people; therefore, public opinion should be courted.

Probably one of the most important policies, and one on which the public must be not only sold by telling, but repeatedly sold by retelling, is that of correlating construction with maintenance. A workable theory is that maintenance means not only the maintenance in the densely populated states, of the old roads, but also the improvement by current revenues of the rural roads which are in a primary system, and which are not yet susceptible to the expenditure of bond moneys for their improvement.

When the maintained main routes become increasingly burdensome year by year, not only on account of maintenance or other expenditures, but also on account of burdensome hindrance to economical vehicle or transport operation, then correlate these sections by durable construction. This correlation means a detailed study month by month, and year by year by the maintenance and construction engineers; it means study not only in the field, but also in the office after yearly charges have been segregated. An annual program involving 500 miles of resurfacing year by year; surface treatment of 1,800 miles a year, and construction of durable types at the rate of 500 miles a year must need be correlated, so that economical expenditures may be planned and made, and the details of a program of this character have to be sold to the public through the press, and by pointed constructive talks and lectures. The public must be made to realize that highway work is a great continuing business, and one which cannot be tampered with.

Sales are not all accomplished by cold type and conservative oratory. The most convincing public official I have ever met did not look upon visitors at headquarters as pests or ingratiating individuals who called because they wanted something. To him they were the individuals through whom he could talk to hundreds, to him they appeared as the representatives of their districts, and he would spend hours in conference, enlarging upon viewpoint after viewpoint, and gradually drawing their interest closer and closer until there was mutual understanding.

The total yearly volume of sales of a state highway department to the people of a state is anywhere from $12,000,000 to $45,000,000 per state, striking an average of say $20,000,000. Can we gather any light by comparing this average department with an efficient corporation doing this gross business a year? Does the corporation spend money to make sales, does it spend money to create desire for goods, does it spend a conservative sum for research and for increasing the efficiency of both the employee and the plant, and when all is said and done are these sums conservative with the ends achieved? You will say yes. Analyze the county or state highway department. Does it usually make any effort not to spend money for publicity purposes, but to create desire for roads through channels that are opened freely to them, does it allow in its budget anything for research or refined design practice, or does it organize for efficient publicity work? Most of us will admit broadly—no. Still when the public asks as to taxes, indifferent service, poor maintenance, misinformation, inferior detours, unanswered construction complaints, and all the other miscellaneous complaints that buzz throughout the year, we find that they all can be summarized to come under the broad general publicity outline. The only conclusion that can be drawn is that we haven't still perceived the business man's viewpoint.

Enthusiasm must be created for our work, our job and the things yet to be accomplished, because in the end it is the spark of enthusiasm that sells or builds or creates great enterprises.

Designed Subgrade

By C. M. Upham

State Highway Engineer, Raleigh, N. C.

THESE facts in connection with subgrade design may be conclusively stated:

1. The bearing power of nearly all soils is increased when the moisture content is decreased.

2. The bearing power is affected more by moisture in some soils than in others.

Therefore, the first two principles in the design of subgrades are the regulation or exclusion of water and the selection of a subgrade soil or material that has the highest bearing power and is least affected by moisture.

In selecting soil for subgrades, it is desirable to select a material that will have a high bearing value, even though it has become saturated with water. Generally speaking, the coarser the material up to a certain practical size for working, the less the capillary saturation and the greater the bearing power. Experiments have shown that a layer of coarse material such as sand or gravel, when placed over clay, retards the capillary water from rising to the top of the subgrade, or in the case of soil roads, to the top of the surface; from which it may be seen that the value of the design of the subgrade not only depends on the regulation of moisture but on the selection of the subgrade material as well.

Any system of drainage that will prevent water from finding its way to the subgrade will suffice or serve as a means of freeing the subgrade of the water that does by chance find its way there. Generally the solution is found in the selection of subgrade material and a combination of ditches and underdrains. Care should be taken that the ditches are only of a sufficient depth to lower the water table and are located far enough from the traveled way to interpose no hazard to traffic.

If side or longitudinal ditches are designed properly it seldom happens that longitudinal pipe underdrains are necessary, for the open side ditch will perform all the drainage functions of such drains.

Assuming that surface water may be cared for by ditches, and that water in the subgrade from springs and other sources may be relieved by underdrains and ditches, the problem of caring for capillary water still remains. The most satisfactory way to cut off capillary water is to introduce a layer of material of low capillary value, or, in other words, a material through which the passage of the capillary water will be retarded. This often can be accomplished by selecting in the grading of the road, material of low capillarity and using it for a subgrade on which will rest the hard surface, or in the case of soil roads, for that portion used by traffic. It often happens that it is more economical to borrow material, the bearing value of which is least affected by water, for the subgrade, and it sometimes may be desirable to waste materials from cuts, and borrow satisfactory material for the fills. Too much stress has been laid on the balancing of quantities and too little stress has been laid on the selecting of material entering the subgrade.

* * *

Immediate Tasks of Highway Research

By W. K. Hatt

Director, Advisory Board on Highway Research, National Research Council

TO expedite the collection of authentic data on the basis of which highways may be wisely selected to meet the economic needs of the region, properly built to conform to the economics of the situation, and operated in the interest of the public, the immediate necessities are:

1. Many problems in highway engineering are accompanied by corollary problems in economics of highway transport. What sum may profitably be spent in capital costs of construction to reduce a grade? The answer must depend on volume of traffic and on operating costs of road and vehicle. Again, decisions upon changing second-class into paved roads involve cost of road maintenance, tires, gasoline, and repairs and depreciation to vehicle, etc. Reliable data appear to be largely wanting. Research activities should be pushed.

2. The study of methods of financing road construction, and the distribution of the expense between those benefited, await fact-finding surveys. The study itself needs the services of trained economists. The source from which the tax dollar comes, and its distribution among roads, education, charities, etc., should be determined.

3. Studies of the effect of highway improvements on land values are needed; and also of the effect of highway improvements upon industry and the development of typical regions, such as truck farming or resort areas. The result of such studies will be a guide for similar areas under development.

4. The laws governing the growth and dispersion of traffic, and the mechanics and psychology of safely handling such traffic in congested areas, need study by research methods.

5. The purpose and methods of, and the instrumental equipment for, basic traffic surveys upon which state construction and maintenance funds may be allocated are live issues. A simple instrument for automatically counting and weighing traffic is now under development in the Bureau of Public Roads.

6. The large volume of valuable data, accumulated at the cost of hundreds of thousands of dollars, through studies of soil properties, effect of loads and strength of slab—data that underlie the as yet undisclosed principles of the mechanics of slab design—should be brought together and analyzed to uncover the principles of action. The instrumental equipment and technique in this field represent a remarkable advance in the science of measurement. With the mechanical principles determined, then the engineer can be given formulas for fitting the road to the load. If these principles are still hidden, final co-ordinated researches should be planned to settle these questions. If it is true, as it seems to be, that stiff slabs on soft subgrades should be thick at the edges and thinner at the center, what should be the proper distribution of the thickness, and how should slabs be reinforced to provide longitudinal stiffness?

7. The economies of pavement types in specified situations must be learned from carefully gathered data, so that decisions may be made less upon ex-parte arguments and more upon exact information.

8. The findings of laboratory tests upon materials of construction should be scrutinized in the light of experience in operation to determine to what extent these tests are predictive of service value in the road.

* * *

Hot-Mix Asphalt Sand Roads

By Vernon M. Pierce

District Engineer, Bureau of Public Roads

WHERE sand is the only available local road material, it may be quite practicable economically to construct a high class highway.

A considerable portion of the country along the South Atlantic coast, for example, has very little stone for road-building, although there is an abundance of sand. These localities are generally so situated that freight rates which govern the delivery of stone are prohibitive. A solution of the problem has been secured by the construction of a hot-mix asphalt sand road in the vicinity of Wilmington, N. C. First a survey was made of sand deposits in the vicinity of the proposed road and a product selected which most closely approximated a sheet asphalt sand grading. A portable asphalt plant was then erected at the deposit for preparing the mix. The roadway was graded in the usual manner. Cypress stringers, 2x8 in., were firmly staked along the sides as forms and were left in place to protect the edge of the road under traffic and to keep the foundation confined. The subgrade was thoroughly compacted and upon it was then placed a foundation course 3 in. thick after compaction of a mixture of sand with about 7.5 per cent of asphalt cement of approximately 45 penetration. Upon this base a surface or wearing course having a compacted thickness of $1\frac{1}{2}$ in. was then laid, which course was composed of sand, mineral filler and asphalt cement in such proportions as to approximate a standard sheet asphalt surface mixture. In this vicinity and under favorable conditions such a road can be constructed at less than $1.25 per square yard and answers the problem of a low cost road in an undeveloped section where hard surfaced roads are necessary for the development of the country.

Deposits of marl are of frequent occurrence along the South Atlantic coast and this material when locally available makes a most excellent foundation for a hard surface wearing course. Within a few miles of the road referred to above in North Carolina a 1-in. wearing course of the sheet asphalt surface mixture has been placed on an 8-in. compacted marl base at a low cost and promises to be very satisfactory to meet all needs for years to come.

* * *

Progressive Construction—Iowa Practice

By C. C. Coykendall

Assistant Chief Engineer, Iowa State Highway Commission

THE State Highway Commission, created in 1904, was vested with only advisory powers. Counties commenced building bridges and culverts of permanent construction and cutting down hills and filling hollows adjacent thereto. Toward the close of this period (1904-1912) the use of large blade graders drawn by gasoline tractors became quite general, resulting in the building of a considerable mileage of dirt roads to a natural grade, and to sections closely approaching present day standards.

In 1913, radical highway legislation reorganized the State Highway Commission, clothing it with drastic supervisory powers, and providing adequate funds for its support. The state continued its policy of non-participation in the cost of road building, but required all highway construction work, both road and bridge, to be done in accordance with plans and specifications either prepared by or approved by the State Highway Commission.

Under this scheme of operation, by the end of 1916 approximately 1,600 miles had been built to established grade in accordance with approved plans; approximately 25,000 bridges and culverts had been constructed of so-called permanent construction; practically the entire mileage of the county road system—some 15,000 miles in all—had been constructed to natural grade and standard section and was being rather systematically maintained.

Federal participation in highway building necessitated further changes in 1917 and 1919 in Iowa's highway laws. A limited trunk line system of approximately 6,600 miles was designated as the primary road system, upon which all federal aid allotted to the state, and all revenues derived from licensing motor vehicles, must be expended. The remaining mileage of highways was classified as secondary roads, approximately 11,000 miles of which constitute the county road system, and the remaining 87,000 miles still being under the supervision of the township officials.

Under this revised legislation the improvements undertaken on the primary road system consist largely of completing the construction of roads to established grade, providing the necessary drainage and drainage structures, and when this has been completed, surfacing with gravel or sand-clay construction.

On Dec. 1, 1922, of the 3,653.5 miles of the primary road system that had been constructed to established grade and the necessary drainage and drainage structures provided, 334.4 miles had been paved and 1,558 miles had been gravel surfaced, leaving 1,761.1 miles without surfacing of any kind. A large percentage of the mileage that has been gravel surfaced will need to be paved some time within the next decade if traffic is to be adequately served. In the meantime, however, traffic on these 1,558 miles of gravel surfaced highways is getting reasonably efficient highway service, whereas the same funds invested in pavement would have given traffic a high grade of highway service on only approximately 150 miles.

Progressive Construction—North Carolina

By C. M. Upham

State Highway Engineer of North Carolina

THE North Carolina method of progressive construction is to grade the road, using the same standards for line and grade that are used in hard surface construction. Only one standard of drainage structures is used regardless of whether the road is merely graded or is to be covered with a hard surface. This construction of graded road will care for the light traffic which generally exists in all newly developed localities. This graded road is at all times maintained and when the increased traffic creates a high cost of maintenance, then it is indicated that it is time to construct the next higher type of road surface. The next step in the progressive type road is to cover the graded road with a selected soil material, such as sand-clay, topsoil or gravel. This material is generally of higher bearing value than the natural soil, and is a material which is less affected by moisture and therefore more suitable for use as a road surface. This selected surface material is maintained as a subgrade highway until such time as the maintenance cost becomes excessive and the increased traffic indicates that a hard surface roadway is necessary.

The cost of grading and the drainage structures generally constitutes about one-sixth of the ultimate cost of a hard surface road. To add a selected soil surface adds very little difference to the cost of this construction; consequently about six times as much road, with a selected soil surface, may be constructed for the same money as though the money was spent for the immediate construction of hard surface roads. This makes it possible for transportation to be benefited to a much greater extent and the state to develop at six points rather than at one.

It will be noted that the construction of the selected soil surface is an addition to the graded road, and no previous step in the grading or construction of drainage structures has been lost or thrown away in the construction of this selected soil surface road.

In the progressive type road all steps taken in its construction include the utilization of all previous construction when transforming the road to the next higher type, and each step may be considered as a subgrade for the next higher type surface. This in itself justifies the expenditure of a sufficient amount of money to select soils of a character which may, with proper maintenance, be used as a surface material until such a time as traffic demands, or the cost of maintenance makes it necessary to construct the next higher type of hard surface. By this method of construction the graded road or the selected soil surface can truly be called a subgrade highway, and is often the economic solution for road construction over a large portion of a state system.

The ultimate step in progressive type construction is the addition of the hard surface. After the maintenance on the selected soil surface becomes excessive or when the country and traffic develop to the extent that a hard surface road is necessary, the next step is to construct the hard surface pavement directly on the selected soil surface. This method of progressive construction utilizes advantageously the selected soil surface as a stabilized subgrade for the hard surface pavement, and on account of the complete settlement, and on account of the character of the selected soil surface, the subgrade is stabilized sufficiently to aid the hard surface in carrying the loads.

Therefore it may be seen that with the construction of the progressive type road, light traffic or a small tonnage is cared for by a graded road of comparatively low cost. As the traffic demands and tonnage increases, the road is increased in strength, and the increase of the investment is justified. As the traffic and tonnage increase to the maximum, a hard surface road is constructed. The construction of roads on progressive principles means that the greatest percentage of the invested money is in permanent construction, and justifies the expenditure of bond money in any progressive type road.

North Carolina has constructed many progressive type roads. It has already completed its cycle by placing hard surfaces on roads which were previously graded and stabilized with a selected soil material, although at present it has a reasonable mileage of graded roads in the newly developed localities; it is maintaining as subgrade highways a large mileage of selected soil roads and thus affording a means of traffic to a great portion of the state. The completion of about 400 miles of hard surface construction in 1922, many miles of which were hard surface added to progressive type roads, demonstrates the complete and satisfactory manner in which the progressive type road is caring for the traffic in North Carolina. It shows that this method of road construction is no longer in the experimental stage but is economically and practically sound.

* * *

Restoring Macadam Roads

By W. A. Van Duzer

Assistant Maintenance Engineer,
Pennsylvania State Highway Department

BEFORE the actual operation of macadam resurfacing is taken up the depth of stone in the existing roadway is established by actual measurements. Test pits are excavated to the bottom of the stone in the center and measurements are taken on each side for a distance of half the width of the road. These pits are dug every 25 to 50 ft. The base is then widened out, and in places where sufficient foundation is not shown stone is added to secure the required depth. Then the road is scarified lightly and reshaped with a road machine. The base is brought to a true cross-section and grade by the use of a crown board and steel pins are driven every 10 to 20 ft. depending upon the profile and a cord stretched along the edge and to the top of the proposed ballast. Berms about 4 ft. in width and from 1 in. to 2 in. above the line are then built up.

Waterbound Resurfacing—More satisfactory results are obtained by the use of 1½ to 3 in. stone for waterbound macadam resurfacing. The material is dumped upon the sub-grade and forked, thus eliminating the danger of the segregation of the sizes, which is the cause of a great deal of subsequent patching. The stone is built to a crown board and then thoroughly locked with the roller after which the screenings are applied fanwise with a shovel and rolled until the voids are thoroughly filled. The water is then applied and the road rolled until the mortar is flushed or puddled and the road is then allowed to set before surface treatment.

The maintenance of the road during the time that it is setting consists principally of sweeping, either by caretakers or lightly by mechanical brooms or horse-drawn sweepers. The sweeping is done first to remove the caked or matted screenings from the edges, which must be done in order that proper penetration of the surface treatment material may be obtained, and second to replace these screenings in the center of the highway from which they have been removed by the action of traffic.

Surface treatment—Previous to the first application of the bituminous material, the screenings must be removed by sweeping so that the voids will show between the ballast to a depth of possibly ¼ in. Material must be applied in two applications with a pressure distributor, the first to be approximately ⅓ gal. to a square yard and the second from $\frac{2}{10}$ to ¼ gal. In some cases ⅓ gal. will penetrate the road from ¼ to ⅝ in., this penetration depending upon the kind and the cementing value of the stone.

The second treatment should be a high viscosity bituminous material, the quantity just sufficient to properly fill the voids and this can only be determined by experience, but in most instances varies from 0.25 to 0.3 gal. per square yard. Hard stone chips, from ¼ in. to 1 in. in size, dustless and free from dirt, should be used as a covering at the rate of from 20 to 30 lb. per square yard, or approximately 1 cu.ft. of stone chips to 1 gal. of bituminous material. Owing to the large chips used and to assist in compressing them into the bitumen, the treatment should be rolled with either a 5 to 8-ton tandem or a 10-ton macadam roller, as soon as the chipping is completed, but if a material that does not dry rapidly is used, equally good results can be obtained if the road is rolled from 24 to 36 hours after the bituminous application.

The third treatment may be either a high viscosity coal tar, water gas tar, or asphalt, or as an alternative, a hot material. We apply from 0.15 to 0.25 gal. per square yard of the hot material which requires from 30 to 40 lb. of chips. This treatment must be watched carefully as the road will bleed after being thrown open to travel and, if not given proper care, will pick up under tire wagon traffic. Stone chips for covering give the best results.

Bituminous Macadam Resurfacing—After the road has been brought to a true cross-section, approximately 3 in. of stone, varying in size from 1½ to 2¾ in., is spread to a depth of 3 in. This is locked by rollers and then the bituminous material is applied at the rate of 1¾ to 2 gal. to the square yard, depending upon the kind of material used. Stone is uniformly spread, varying in size from ⅝ in., which is properly rolled and a seal coat of from ½ to ¾ gal. per square yard of bitumen is then applied and chips of approximately ½ in. are spread over the surface. The road is then rolled until it is properly bonded.

Unbound Macadam—The method usually employed in the construction of unbound macadam is to scarify the old road surface, shaping it up with the road machine and rolling until a firm foundation has been obtained. Stone, clear of dust, varying in size from ½ in. to 1½ in. is piled along the side of the road. Just ahead of the distributor, the stone is spread uniformly to a depth of approximately 2 in. Where possible, traffic is kept off, or at least confined to one side. Then apply from ⅓ to ⅝ gal. per square yard of bituminous material with the proper penetration, or a larger amount where two applications are made, which is governed by the depth of the loose stone and is varied accordingly. The material is allowed to dry for from one to three days and is then rolled.

* * *

Salvaging and Maintaining Macadam

By Alex W. Muir

Superintendent of Maintenance, New Jersey
State Highway Department

IN preparation of the base, due to the improper use of bituminous materials in surface treatment, many roads have accumulated a thick, unstable bituminous mat. This mat must in all cases be entirely removed before laying the new surface, or failure will result due to the pushing of the old mat.

Waterbound Resurfacing—The stone advocated for waterbound resurfacing is as large as or larger than that which for years was used for the base course only. Great care must be taken to have the stone uniform, for pockets of fine stone will ravel during the period of curing and require additional work to rebind, and will even then result in blemishes in the surface. In estimating on the cost of work with this grading of stone one-half as much screenings as stone will be required. Too great emphasis cannot be placed upon the necessity of using screenings which are free from strippings and other foreign matter.

Surface Treatment—Emphasis should be laid upon the necessity of thorough removal of screenings by sweeping prior to the first application of bituminous material. Under no conditions must the bituminous material be applied upon a surface which is damp. The temperature of the atmosphere when the material is applied has a great effect upon the results. It is possible to do surface treatment work prior to June 1 and it is also possible to do it after Oct. 1. If, however, the work is confined to June, July, August, and September, very much better results will be obtained and it is probable that still better results would be obtained if the season could be cut down even more. Atmospheric temperature also is a determining factor in the grade of material which can be used on this work. During the height of the summer season excellent penetration will be obtained from a material of the consistency and general characteristics of Tarvia B and Ugite B. These materials are, however, of too high viscosity to give a penetration of any account under ordinary weather conditions after the first of October; it then becomes necessary to resort to a material having an even lower viscosity.

In Pennsylvania practice the first application of material is approximately ⅓ gal. per square yard; the second application from 0.2 to ¼ gal. per square yard and the third treatment from 0.15 to 0.25 gal. per square yard in accordance with the needs of the road. These quantities, it will be noted, are considerably less than is the common practice in surface treatment work and are, the writer believes, one of the secrets of the success of surface treatment work in Pennsylvania.

In Pennsylvania they do not ordinarily apply any covering to the first treatment. This procedure is undoubtedly desirable from the standpoint of the results to be obtained, but experience in New Jersey has been that the travelling public raises such strenuous objection that it is necessary, as a matter of policy, to apply covering material which should, however, be kept to the minimum. Mr. Van Duzer states that stone chips give the best results. Experience in New Jersey indicates that equally good results may be obtained by the use of crushed slag for cold surface treatment work. Great care must, however, be taken to obtain slag of a high quality. Our specifications for slag in New Jersey briefly are as follows: "All slag must be air cooled, have a fresh, clean surface, free from mud, dirt, clay or loam. It must not be brittle or glassy or have an apparent specific gravity greater than 3.0 at 15.5 degrees C. It must weigh not less than 70 lb. per cubic foot loose measure, and be free from decomposed products."

Bituminous Macadam Resurfacing—The salvaging of old macadam bases is unquestionably a matter worthy of more serious consideration than has ordinarily been given to it. Given a good subgrade and drainage conditions, a good stable macadam base represents an investment which should not lightly be discarded. It should not, however, be taken for granted that any macadam can be successfully treated in this manner. Before adopting such a procedure a thorough investigation should be made of all factors effecting the proposition.

* * *

Blade Grader Road Maintenance

By W. H. Root

Maintenance Engineer, Iowa State Highway Commission

THE most useful and indispensable tool for the care of earth roads is the heavy blade grader, a machine with a blade length of from 12 to 16 ft. heavy enough to do work that will require 30 to 50 drawbar horsepower. A blade grader with a back sloper attachment is preferred. This is an attachment which may be bolted on the end of the blade so that the ditch bottom and back slope may be cut at the same time as the inside slope. A properly designed back sloper will cut the ditch and back slope when the main blade is cutting the inside slope. The device should be adjustable so that the back slope can be flattened from 1½ to 1, to 2 or 2½ to 1 where extra dirt is needed.

No two miles of road require the same treatment, and the cost of blading, therefore, varies greatly. The following figures, however, roughly represent the cost of the average mile.

1 engineer, 25 hr. at 75c.	$18.75
1 grader operator, 25 hr. at 60c.	15.00
125 gal. of gas at 22c.	27.50
Oil and grease	3.00
Depreciation on a $6,000 investment figuring a 3-year life of 100 working days per year—2½ days at $20 per day	50.00
Estimated repair 2½ days at $5	12.50
Interest on investment (5% on $3,000) 2½ days at $1.50	3.75
Clearing right-of-way and incidentals	19.50
Total	$150.00

Earth roads are divided into patrol sections of about 10 miles each. A patrolman is usually equipped with a grader, a drag, a slip scraper, a plow, and a set of small tools. He also has access to other equipment such as wheel scrapers, mowers, etc. He furnishes one team all of the time and in most cases has a second team which can be procured when needed. On the heavy soils four horses have to be used even on a small grader.

Metering Road Service to Users

By J. N. Mackall

Commissioner of Roads, Maryland

THERE could perhaps be no more unscientific and inequitable way of measuring to the users of the roads the benefits they derive from them than the present method of motor vehicle registration existing in most of the states.

If the highway departments are going to say, and they generally are saying, that registration of motor vehicles is going to pay the cost of maintaining the improved roads in every state, then they must see that legislation is enacted which will make this burden fair and just to all. This cannot be done unless it takes into consideration the service obtained by users of the road.

If the railroads meter the service which they render to the public and charge a fee for it, depending upon the mileage travelled, and if the telephone company renders a specific service for a specific fee, varying with the quantity of service, and if the gas company, the electric light company and the utilities generally put in your house a meter which will measure the service which they render to you and bill you accordingly, then shall not the highway departments meter to the traveler the service which he has received from the roads and bill him accordingly? Certainly, this should be done if it can be done scientifically, economically and satisfactorily.

The metering to a vehicle the service which the road renders to it, regardless of whether it is at home or abroad, can be done in a perfectly simple manner by levying a tax on gasoline. The tax on motor fuel will not meter to the travelers with exact accuracy the service which they receive from the roads, but it will measure that service more accurately than it has ever been attempted. It takes into consideration the weight and speed of the vehicle, and the distance traveled, the elements which cause wear and tear; but it does not take into consideration the cost or value of the vehicle, or some theoretical horsepower rating. These latter are elements which do not cause wear and tear and have no bearing upon the service which the roads render.

It is conceded that pneumatic tires actually do much less damage to the road than solid tires. Therefore the solid-tire vehicle should pay a fee over and above the tax on motor fuel, but again is there not room for equalization? Rather than to charge, as is done in most states today, a definite fee based upon the carrying capacity of the vehicle, should this not be on gross weight? If we concede that weight is an element of wear and tear upon the road, then does it make any difference whether that weight is in the chassis or in the load, provided, of course, it is equally distributed in any event? As further evidence of the need for change in registration, we find most states licensing today upon the basis of either horsepower or of carrying capacity, and relatively few basing it upon the actual weight of the truck and load combined. In addition to the regular tax on motor fuel, there should be a fixed fee charged for the registration of motor vehicles varying with and based on the total weight of vehicle and load combined.

In conclusion, it would seem therefore, that if we can abandon quickly present unscientific and inequitable methods of metering to the user the service which he receives from the road, such as registration based upon horsepower, combinations of horsepower and weight, combinations of horsepower and costs, and substitute for them the tax on motor fuel for all pneumatic tire vehicles, we will be measuring this service almost as accurately any public utility measures the service which it renders to its patrons.

If in addition to the tax on motor vehicle fuel, we will place an additional charge against the users of solid tire vehicles, based upon the combined weight and carrying capacity of the vehicle, we will have reduced this to an almost scientific accuracy.

Vehicles other than those propelled by internal combustion engines, equipped with either solid or pneumatic tires, which are almost a negligible percentage of the total, can be registered on the basis of total weight for both pleasure and commercial vehicles.

Highway Abuses and How They May Be Eliminated

Financing, Design and Construction Abuses Precede Completion; and Uncontrolled Traffic Abuse Follows It

BY THOMAS J. WASSER
State Highway Engineer of New Jersey

Extracts from the presidential address before the American Road Builders' Association in convention at Chicago, Jan. 16-19, 1923.

OFTEN the greatest abuse that comes to our highways occurs prior to completion. Failure to finance wisely, faulty judgment as to type and width of pavement and choice of location to suit certain interests are common abuses of the highway before it is built. In detail some of the items are:

1. Making the term of bonds longer than the life of a pavement.

2. Failure on the part of the engineer to provide a design and type of construction to meet the requirements of modern traffic.

3. Faulty construction on the part of the contractor for personal profit.

4. Inefficient inspection due to lack of knowledge, and to insufficient salary being paid to attract capable men.

5. Acceptance of inferior work.

6. Permitting inferior material to be substituted for that specified when delays are brought about by conditions beyond the control of the contractor.

7. Sacrificing quality for speed.

8. Failure to provide for a satisfactory well marked and maintained detour during the period the highway is under construction.

9. Designing and building bridges for a live load less than that for which motor vehicles are licensed and narrower than the graded width of the highway.

10. Failure to provide for the elimination of railroad grade crossings.

11. Designing underpasses with a head room less than 14 ft. in the clear.

12. Lack of co-operation on the part of public utility companies and municipalities. The highway departments should advise all interested utility companies and municipalities as soon as a highway project is decided upon, and these interested parties should immediately proceed to perform all necessary sub-surface work thereby eliminating delay in the progress of construction and the necessity for opening the pavement in the near future.

13. Absence of caution on the part of bonding companies. Bonding companies becoming surety for inexperienced persons who are operating under the guise of contractors or construction companies jeopardize the interest of the State engaged in highway construction. They should limit the surety to a fixed amount for the first contract, increasing the surety on the second contract, and so on until the applicant establishes his responsibility for carrying out contracts of magnitude.

14. The tendency of contractors to bid too low. This fault has had more to do with the performance of inferior work than any one other cause, and inexperienced contractors just entering highway construction are chiefly responsible, yet the bonding companies will go on their surety just the same as they will for experienced contractors.

15. Use of inferior material. Competition in manufacturing or producing material used in construction is such that inferior material is frequently put in competition with satisfactory material, and by under selling is used in the work. In many cases where inferior material has been rejected by engineers and officials they have been charged with favoring some particular material or product for reasons other than its merits.

16. It has been definitely determined that excessive use of water in mixing injures the quality of concrete, yet in many cases engineers, contractors and inspectors still permit the use of excess water. The contractor permits it because his force can turn out more work, and he claims it just as good. The inspector tries to remedy matters, but is unsuccessful. The chief engineer cannot see all the work, and a subordinate in carrying out his chief's desires is accused of retarding the progress of the work. However, anything that tends to add unnecessary cost to the construction and maintenance of the highway should be considered an abuse just as much as should a violation of the provisions set down to protect it.

All of these abuses should be corrected at once, and the industry protected by the soundest kind of financing, engineering design, faithful construction and efficient inspection.

Abuse of the highways after completion is generally caused by a small percentage of users. Such abuse frequently results in accidents, causing injury and loss of life and destruction of property. Law enforcement alone will not overcome these conditions or decrease the number of traffic accidents. The problem requires: first, adequate traffic planning, and second, proper enforcement of regulation according to the plan.

In order to enable those whose duty it may become to work out an equitable and uniform plan to prevent the abuse of the highways, the writer recommends:

1. That the minimum graded width of all main highways be not less than 30 ft. and (a) That this graded width be kept clear of all encroachments, and (b) That all traffic rules be made uniform.

2. That a system of marking one-way streets be adopted, which will be uniform as to type and location of the markers.

3. That it is desirable to standardize all directionary and cautionary signs as to color and marking, and that posting signs other than directionary and cautionary on the right of way be made unlawful, and subject to a fine for each offense.

4. That the erection of signs on property abutting on the highway at curves, railroad crossings and intersections be discontinued, where such signs would obstruct the view of those using the highway.

5. That it is desirable to standardize colors to be used for degree of danger where illuminated signs are used, for instance, red at a railroad crossing or dead ends of highways, green for highway intersections, and amber for grades and curves.

6. That a uniform traffic regulation be adopted for intersecting highways to be in effect in the absence of traffic officers.

7. That a uniform maximum height, width, and length of vehicle be adopted.

8. That a uniform gross weight of vehicle and load for each class of commercial motor vehicle be established.

9. That all gas filling stations be located on property abutting on the highways, and not on the right of way; and that all gas filling stations shall display a visible tag on each pump, which shall be placed there by the State Department of Weights and Measures certifying as to the accuracy of said measuring device.

10. That parking of vehicles on both sides of a highway opposite each other, where a minimum distance of 20 ft. between the vehicles is not provided, be considered a nuisance and be made punishable by a fine.

11. That the erection of all booths and stands for the sale of goods within the right of way, and displaying farm produce in containers within the right of way be prohibited, and that the use of vehicles for retailing wares along the highway where such practice would cause persons to congregate on the paved portion be also prohibited.

12. That a uniform penalty for operating a defective motor vehicle on the highway should be provided. It is not the purpose of this paper, nor is the writer qualified to discuss automobile design; however, there is a common defect particularly in trucks, the correction of which would eliminate one source of danger. Tail lamps frequently fail to function due to the wires having been damaged by abrasion or exposure to splashing water. It would seem to be an easy matter for the designer to provide protection for these wires. Other defects that the writer has in mind

are broken or improperly adjusted brakes and badly worn tires.

13. That legislation be enacted to provide against motorists running past barricades on roads under construction, and destroying unfinished work.

14. That sidewalks be provided for the use of pedestrians along the highway adjacent to built up communities.

15. That pedestrians using the highways in the open country shall walk to the left, and that operators of all vehicles drive to the right.

16. That when one piece shipments that exceed the maximum weight allowed by law are made, they shall be shipped on specially built vehicles so designed as to distribute the load in a manner consistent with legal requirements, and only after obtaining permission from an authorized source.

17. That a uniform distinction be made between maintenance, betterment and reconstruction in order that comparisons may be made.

18. That motor vehicle taxation or license fees should not be any greater than that required to provide the sum necessary for maintenance of the highways.

19. That overloaded trucks being operated on the highways, when apprehended, be seized and held for a period of not less than five days, stored at the owner's risk and expense, and in addition the owner fined, in accordance with a penalty fixed for that offense.

20. That hauling companies, who contract for shipments by the ton, when caught overloading their vehicles, should have their license revoked, in addition to any other penalty.

21. That all operators of motor vehicles should be licensed, and that they be prohibited from operating a vehicle for more than twelve consecutive hours followed by eight hours rest.

22. That, in addition to any uniform motor vehicle law previously recommended, all applicants for drivers' license or renewal of same be required to submit a physician's certificate bearing date not more than one month back of the date of application. Certificate should be accepted only from designated physicians, and should certify that the applicant is in fit mental and physical condition to operate a motor vehicle.

23. That the examination for drivers' license require the applicant to be able to read and write English, and that license be granted only to citizens of the United States with provisions for tourists from other countries.

24. That the owners of all motor vehicles must carry liability insurance for each vehicle operated.

25. That all vehicles both motor and horse drawn be equipped with a clearance light visible from front and rear. This light should be of a shape other than round located on the extreme left side of the vehicle or load if over width, and showing green in front and red in rear.

Long Railway Tunnel Opened in New Zealand

The 5½-mile Otira tunnel on the New Zealand Government Rys. has been completed and the new line connecting the ports of Christchurch and Greymouth on the east and west coasts of the South Island will be in service early in 1923. Electric locomotives will operate the mountain division on which the tunnel is located. At present two railway lines of the Midland division terminate on opposite sides of Arthur's Pass and transfer of passengers and freight is effected by stages and wagons. The summit elevation of the pass is 3,050 ft. and of the tunnel 2,435 ft. The tunnel is on a continuous grade of 3 per cent. It is for a single-track line of 3½-ft. gage. In section it is 16 ft. 9 in. high above subgrade and 13 ft. wide at subgrade, with sides flaring outward to a width of 14 ft. 6 in. at the springing for the semicircular roof. Although in solid rock it is lined with concrete, the blocks for the arch lining being of precast concrete. A detailed description was given in *Engineering News* of May 9, 1912, p. 870.

Heat-Loss from Elevated Tanks in Winter

Heat-Loss Curves from Full-Size Tests—Coldest Water in Return Pipe Should Be Kept Above 35° F.

DATA on the heating capacity required to protect elevated steel sprinkler tanks from freezing have been developed by the Factory Mutual Laboratories, Boston, through full-size tests carried out between 1917 and 1922. The results, reported by C. D. Abbott, assistant engineer, are sufficiently precise and practical to permit of determining the total heat loss from an elevated tank in any climatic exposure, and selecting a heater of adequate capacity. In the following the principal results are summarized:

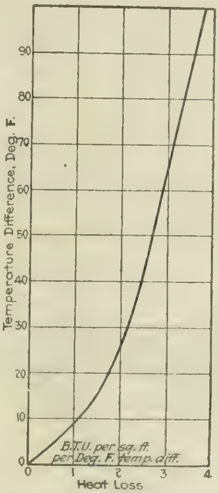


FIG. 1—UNIT HEAT LOSS, ELEVATED STEEL TANK

Loss per hour per sq.ft. water surface (including water in contact with steel) per 1 deg. F. difference between tank and outside air temperatures. Wind velocity at 12 mi. per hr.

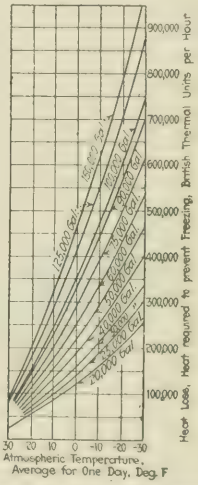


FIG. 2—TOTAL HEAT LOSSES VARIOUS SIZED TANKS

Computed for temperature difference between minimum tank temperature and average air temperature ranging 30 deg. F. to −30 deg. F. Frost-proof cased steel tanks with hemispherical bottoms.

Two 50,000-gal. sprinkler tanks with hemispherical bottom furnished the principal test data. One, located on the roof of a factory, had a height of 155 ft. above ground (34 ft. above the roof), while the other was on an independent tower and was 75 ft. above ground. Both tanks were connected by piping to a heater consisting of a cast-iron shell within which was a brass steam coil. The heater drew cold water from the tank discharge pipe and discharged hot water at about the center of the tank; both the 2-in. hot water pipe and the 8-in. tank discharge were protected by a three-ply two-air-space wooden frost-proof casing. A steam trap in the steam return discharged the condensation into a barrel, emptying through a meter, so that readings of total condensation were obtained. Steam separator, pressure gages and thermometers in various parts of the water piping were provided to enable all necessary data to be obtained. Most of the actual runs were made while the heaters were operating, but some of them were made with steam shut off, in which case the drop in temperature of the tank water measured the heat loss.

The results, reduced to hourly heat loss per square foot of tank surface for 1° F. difference in temperature between tank water and outside air are given by Fig. 1. The same data applied to tanks of various sizes and to various all-day temperatures of the outside air are represented in Fig. 2, from which the total heat loss of any tank in any location can be read directly. In the curves of Fig. 2 the tank water is taken to be at 45° F. average, corresponding to 35° F. in the coldest part of the circulating system, which is considered to be the minimum permissible temperature if freezing is to be avoided. The air temperature to be used in reading Fig. 2 is the all-day average temperature for the coldest day in the year at the place where the tank is situated; the temperature of this coldest day may be taken from the isothermals in Fig. 3, which are plotted from all available data recorded to May, 1922, for the eastern half of the United States.

Wind increases the heat loss, presumably by increasing evaporation and radiation. During the tests the wind velocity averaged about 12 miles per hour, and the curves in Figs. 1 and 2 are to be taken as applying to such wind. For higher wind velocities, the heat loss increases about 0.1 B.t.u. per square foot of *water* surface (top of tank) per degree temperature difference, for each mile per hour increase of wind velocity.

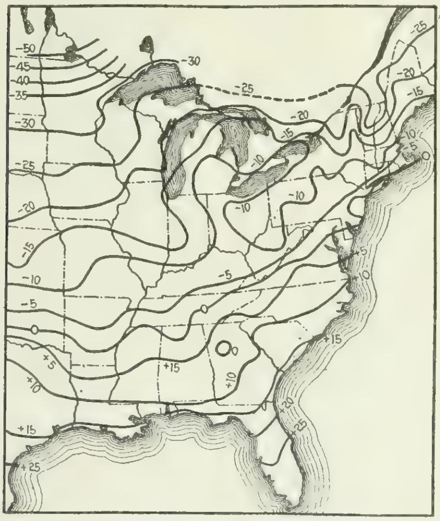


FIG. 3—MINIMUM ONE-DAY AVERAGE TEMPERATURES

The warmest water in the system was found at the top of the tank, and the coldest in the return pipe close to the heater. At the latter point the temperature should not be allowed to drop below 35 deg., and generally a minimum of 40 deg. is advisable. The average temperature of water in the tank ranges from 10 to 15 deg. higher than that at the coldest point of the return pipe. However, water in the settling basin, at the bottom of the tank, is most sensitive to changes in amospheric temperature, and to prevent the freezing of water or sludge trapped here the top of the frost casing should be connected tightly to the tank bottom.

In selecting a heater for a tank, it should be chosen large enough to prevent freezing on the coldest day, even though water should be near the freezing point at the beginning of the low temperature period; it is always possible that by accident or otherwise the temperature of the tank may have dropped almost to the freezing point at the beginning of the coldest period.

The effect of scale, corrosion and sediment in restricting free circulation in the heating system should be taken account of in laying out the piping; the circulating system should everywhere pitch in the direction favoring circulation, and horizontal runs as well as water pockets should be avoided; and as the rate of heat transfer in the heater is found to increase with the steam pressure, the steam supply should be such as to maintain adequate pressure in the coldest weather.

Floor of Forth Bridge Reinforced

REINFORCEMENT of the floor structure of the Forth cantilever bridge was carried out between 1913 and 1920, following several previous repair and reinforcement operations. A description by W. A. Fraser before the Institution of Civil Engineers recently gave details of the work.

Reinforcement was necessary mainly because of deterioration of the floor troughs, which carry the timber rail sleepers, by fracture through the plates between rivet holes and by loosening of the rivets. Traffic weights increased from driving-wheel loads of 17 tons at the time the bridge was opened, in 1890, to 22 or 23 tons at present. Trouble was noticed as early as 1906, at the time the timber sleepers were renewed, when the bad condition of the troughs in which they rested and the loosening of horizontal rivets of the sub-floorbeams was seen. Local repairs were made at that time. Three years later additional sub-floorbeams were placed in the internal viaduct, which served to stiffen the rail troughs, but the deterioration of the troughs continued, so that by 1913 renewal of the troughs on the main bridge and the approach viaducts and strengthening of the sway frames were taken in hand, a contract being awarded to Sir William Arrol & Co. The contract covered also reinforcement of the main trusses of the approaches, by reinforcement of the subverticals, the addition of diaphragms between the flat plates forming the tension members, and additional sway bracing. The rail troughs and the buckle plates on the approaches and the internal viaduct of the main structure were renewed, and the sway frames of the internal viaduct strengthened. The new tail troughs are made of three 17-in. channels specially rolled for the purpose. Some extension of this work was ordered after completion of the first contract in 1917, and this was completed in 1920. The total reinforcement work involved 3,212 tons of new steel, replacing 2,400 tons of old steel removed. The work involved an expenditure of about $700,000.

Indiana Highway Bridge Construction

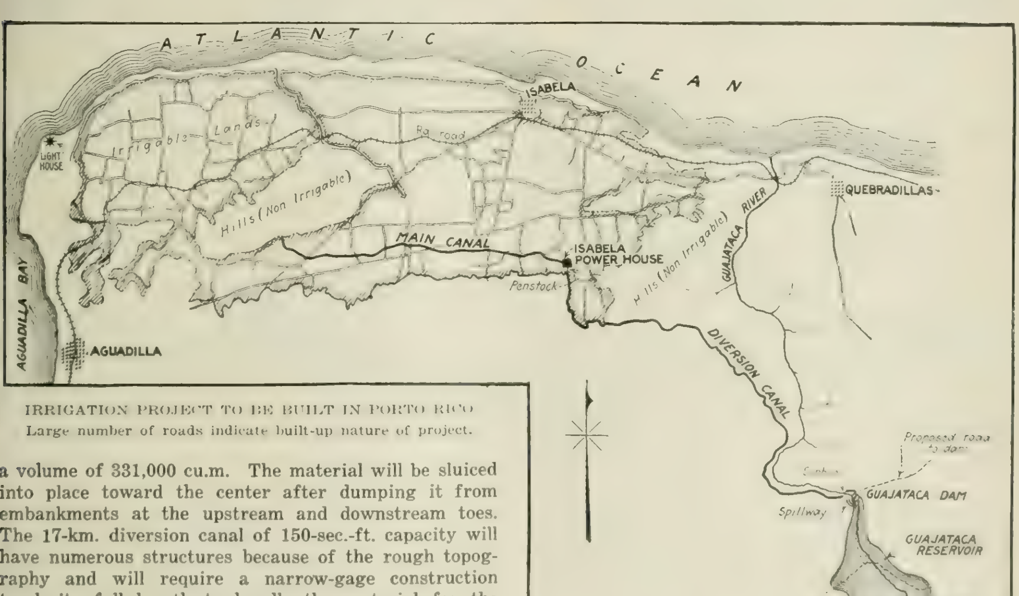
In three and one-half years since the organization of its highway commission, Indiana has constructed 148 bridges, at a total contract cost of $1,621,057.41. The total length of these bridges (some of the clear span length) is 2.52 miles. A little more than half of this bridge work was federal-aid construction. All the bridges are designed for 20-ton loads and have a minimum roadway width of 20 ft. Some have, in addition, 5-ft. sidewalks and a lighting system.

Porto Rican Irrigation Project Has Novel Features

Sinkholes in Reservoir Site to Be Sealed by Clay—Hauled-in Material for High Earth Dam to Be Sluiced to Place—Work Involves Expenditure of More than $3,000,000

By R. A. Gonzalez
Chief Engineer, Isabela Irrigation Service, Quebradillas, P. R.

MORE than three million dollars is to be spent shortly by the island of Porto Rico on the Isabela Irrigation Project which will irrigate 15,000 acres of land along the high rolling plain on the northwest coast. Despite the numerous sinkholes on the site of the storage reservoir required, geologists indicate that the project is feasible and the sinkholes can be sealed satisfactorily. Outlets of sinkholes in the flooded area were all found above the present river level. An earth dam, chosen because of the depth of the overburden, is to be built 37 m. high and 372 m. long on top. It will have a volume of 331,000 cu.m. The material will be sluiced into place toward the center after dumping it from embankments at the upstream and downstream toes. The 17-km. diversion canal of 150-sec.-ft. capacity will have numerous structures because of the rough topography and will require a narrow-gage construction track its full length to handle the material for the tunnels, trestles, flumes, siphons and lining. At the end of the canal a fall of 32 m. will be utilized to develop 950 hp. to be used in neighboring towns and to lift water above the canal level.



IRRIGATION PROJECT TO BE BUILT IN PORTO RICO
Large number of roads indicate built-up nature of project.

The land slopes from an elevation of 150 m. at the foot of the mountains to 85 m. above sea level at the steep bluff which follows the coast line around this part of the island.

One-third of the total area of the project is in small holdings of less than 20 acres. Another third is in holdings of more than 100 acres. The principal crops are sugar cane, tobacco, corn, beans, onions, sweet potatoes, fruits and cotton. Sugar cane will probably be the principal crop after irrigation is established.

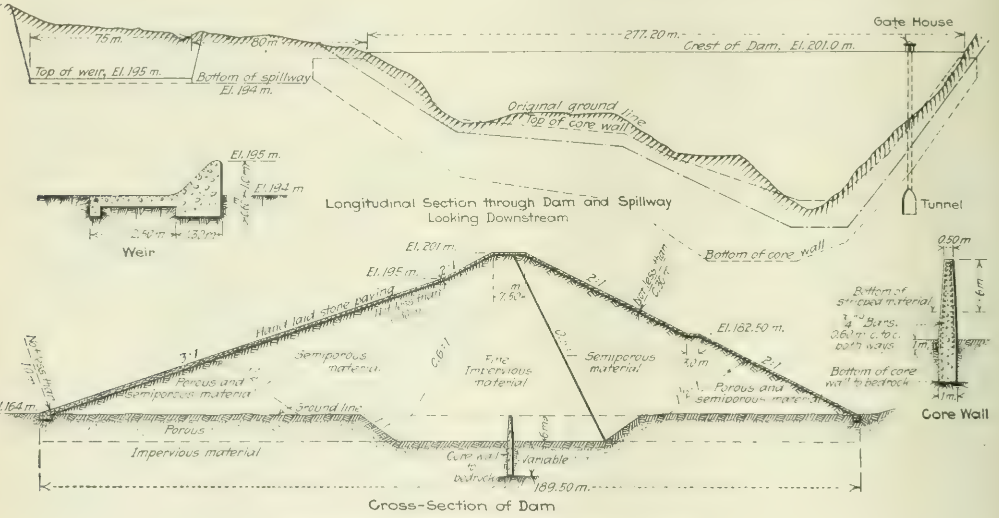
Water for the project will be stored in a reservoir of 28,000 acre-ft. capacity to be constructed on the Guajataca River at a point about 10 km. south of Quebradillas. The dam will flood a flat valley of 923 acres above the Quajataca Canyon.

Duty of Water and Water Supply—The lowest annual rainfall recorded in the irrigable district is 37 in. and the mean 54 in. It is believed that 70 per cent of it will be beneficial, resulting in a minimum of 26 in. and an average of 38 in. of beneficial rainfall. Sugar cane requires at least 72 in. of beneficial water per year. The duty of water has been taken at 4 acre-ft. per year delivered at the land, which will insure a good supply of water in the driest years.

Records of flow of the Guajataca River near the dam site have been kept for the last six years. Rainfall records at Lares, a town located near the center of the drainage area, are available since 1903, and indicate an average rainfall of 97 in. per annum. The fact that rainfall and run-off records have been kept over the same period of several years has been used to determine the percentage of run-off for this period. The percentage relation between run-off and rainfall was estimated at 60 per cent for the dry months from January to May inclusive, and 86 per cent for the remaining months. These percentages have been used to estimate the run-off for the whole period of years for which rainfall records are available. Although subject to considerable error, this is believed to be as close a determination of the run-off as can be made with the data available.

The drainage area above the reservoir embraces about 25 sq. miles of mountainous country. The comparatively high percentage of run-off (average about 75 per cent) indicates that there may be an additional drainage area contributing to the flow of the Guajataca River through sinkholes and underground drainage found in the limestone formation, characteristic of this region.

Geology of Dam and Reservoir Sites—Since the limestone formation and the presence of a well developed sinkhole country immediately north of the reservoir site caused considerable apprehension as to the suitability of the site for a reservoir, the services of a geologist, G. R. Mansfield of the U. S. Geological Survey, were obtained to study the geological conditions and to report on the probabilities of excessive seepage losses. Mr. Mansfield concluded that the project is feasible.



SECTIONS OF GUAJATACA DAM AND SPILLWAY

The country immediately north of the site is occupied by a broad belt of sharp featured limestone hills that rise approximately 1,000 ft. above sea level. Intervening depressions several hundred feet in depth, ranging in diameter from a few hundred feet to half a mile or more are bounded by steep slopes. These depressions are sinkholes developed to an unusual degree. Through this region the Guajataca River has cut a deep canyon. South of this hill belt is a more open country, where stream valleys are the features instead of sinkholes, though these depressions are also present. The reservoir site is in this belt of more gently sloping country. South of this belt there is another belt of rough limestone hills running east and west.

The limestone in which the reservoir site is located is softer than that in which the big sinkholes farther north are found, and contains a relatively high per cent of clay. The soil produced by the disintegration of this limestone is very stiff and clayey and 2 or 3 ft. thick over most of the reservoir site. Below this layer is a zone in which lumps of limestone are found in a clayey matrix, the matrix becoming less and less conspicuous with depth. The lower part of this zone grades into the unaltered bedrock. Bedrock is found at the dam site at a depth of about 12 m. except toward the middle where it is as much as 25 meters.

Some 80 sinkholes have been found within the area to be flooded, ranging in diameter from about 30 cm. to a maximum of 5 m. They have all been tested by pouring in water colored with analine and found to have outlets above the present river level.

The conditions considered favorable for the development of a reservoir at this site are summarized as follows: (1) The clay content of the rock tends to make it self-sealing. (2) The heavy clay soil derived from the decomposition of the limestone clogs the pores and cracks of the underlying rock and forms a thick cover that protects it from surface waters. (3) The open sink-holes are all comparatively small and can readily be filled and sealed. All of those thus far recognized have outlets above the present level. (4) Cracks in the exposed rock surfaces are comparatively few and can also be sealed. (5) The high percentage of run-off indicates that there is comparatively little loss of water by underground drainage. (6) The rapidity with which the river rises in response to heavy rains indicates that its basin is relatively watertight and that it sheds water easily.

Before the reservoir is filled the land will be cleaned and burned. Precautions will be taken while the water rises to detect all openings, and any that are found will be sealed.

The foundation conditions are being thoroughly investigated by means of diamond drill borings and test pits. These investigations are well advanced. Bedrock at the dam site consists of relatively soft, grayish-white limestone, interbedded with layers of stiff clay. It is found at depths of from 12 to 25 m. below the surface. The overburden consists largely of clay intermixed with lumps of limestone and of occasional strata of pure clay. A stratum of relatively hard but broken limestone from 3 to 6 m. thick lies immediately above the grayish limestone described as bedrock. The drill holes show a bed of fine sand which is considered to be a pocket rather than a continuous stratum.

Method of Building Dam—The central portion of the embankment is to consist of a puddle core founded on impervious material and a concrete corewall will be provided to cut off any percolation between the foundation material and puddle core. The bottom of the corewall will be founded on impervious bedrock well below any sand layer and will extend upward into the puddle core a distance varying from 6 m. at the maximum section to 3 m. at the ends of the embankment.

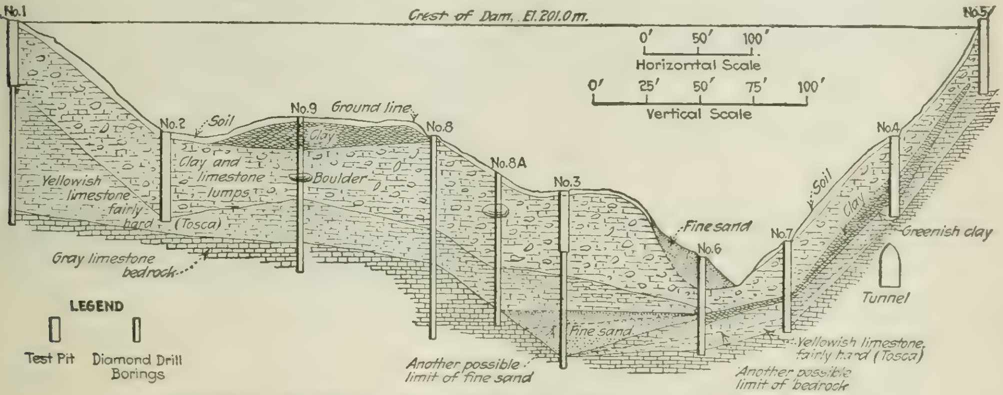
The section of embankment has been designed to facilitate the grading and compacting of materials by hydraulic methods. The embankment materials are to be loaded by steam shovels into dump carts which will be hauled from the borrow pits to the embankment by steam dinkeys. The track will be maintained along the outer slopes of the embankment where all materials will be dumped. No trestles are to be used as it is believed the required sluicing grade and the method of jetting will give sufficient elevation from which to dump the cars. After dumping the embankment material along the two outer slopes, it will be sluiced into place by hydraulic giants. This method of distributing the materials will effect very thorough compacting and uniform grading from the finest material in the puddle core to the coarsest material in the outer slopes.

The material available for the embankment consists of clay intermixed with lumps of limestone found near the dam site. Material excavated from the spillway channel will also be used. The percentages of clay vary from 30 to 60 per cent. Material will be selected from the borrow pits so as to keep the amount of clay between 30 and 45 per cent.

A tunnel 6 m. square will be provided in the right abutment for diverting the river during construction. The material excavated from the tunnel and portal cuts will be deposited in the outer toes of the embankment to serve as cofferdams for diverting the river and for unwatering the puddle core and corewall trenches.

The diversion tunnel will be utilized after completion of the dam as an outlet to the canal. It will be plugged by a concrete bulkhead wall near the inlet, and immediately downstream from it a concrete octagonal gate tower will be built over the tunnel. Two sluice gates will be provided at the base of the tower and a third one at the same level as the canal intake, which is 16 ft. above the base of the tower. The tunnel will also be plugged near its outlet with a bulkhead wall provided with a sluice gate. Immediately upstream from this bulkhead a vertical uptake shaft will connect the tunnel to the diversion canal.

At the left end of the embankment will be provided a spillway channel controlled by a low concrete weir 75 m. long. The spillway is designed for a maximum run-off of 1,100 sec.-ft. per square mile of drainage area, at which rate the maximum depth of water that will pass over the spillway is estimated at 3.75 m. The freeboard of embankment will be then 2.25 m. The spillway channel will be left unlined, although on account of the soft nature of the rock, it seems probable that ultimately it will have to be lined.



RESULTS OF TEST PIT AND DIAMOND DRILL EXPLORATIONS AT DAM SITE

Diversion Canal—Types of construction in the diversion canal include the following:

Unlined canal	8,000 m.
Lined canal	4,000 m.
Bench flume	2,100 m.
Tunnel (24 in number)	2 260 m.
Trestle flume	367 m.
Siphon	251 m.

The construction of the canal will be rendered difficult by the inaccessibility of portions of it, and by the fact that water will have to be transported considerable distances. In order that material may be transported along the canal it will be necessary to excavate first a bench along the same on which a narrow-gage track may be laid, and to open most of the tunnels so that the track may be laid through them. Concrete aggregate will be made along the canal as required by a portable rock-crushing and sand-making plant. Concrete work will be started from the center of the inaccessible section toward both ends removing the track as sections of the canal are completed.

The canal will be of 150-sec.-ft. capacity, and the slopes will be 0.0006 for canal and bench flume and 0.002 for tunnel, siphon and trestle flume. In fixing upon the initial grade and canal slopes the additional cost of a higher dam has been balanced against the value of the additional irrigable area and power development obtained.

Distribution System—The project lands consist largely of uneven, rolling country with many isolated hills and depressions or potholes through which the surface waters drain. However, there are some comparatively large areas of fairly uniform land. Topographic surveys have recently been made by the U. S

Geological Survey of about 32,000 acres, half of which has been classified as good irrigable land. Due to the uneven nature of the ground the distribution system will require a large amount of canal lining, flume, siphon and also a large number of drops, culverts, turnouts and measuring structures. In this connection careful consideration is being given to the use of precast concrete for these structures.

It is proposed to do all work by administration forces. The project, which is estimated to cost about $3,325,000, will be financed and constructed by the Government of Porto Rico. Construction work will not be started until the final designs and reports have been approved by the Legislature of Porto Rico.

A board of engineers from the U. S. Reclamation Service composed of F. E. Weymouth and J. L. Savage, recently visited the site of the proposed irrigation works. After a thorough examination of the plans and reports concerning the project, they submitted a report to the Governor of Porto Rico favorable to the construction of the project.

Accidents Decreased at Street Crossing Where Traffic Circle Was Used

A METHOD of passing vehicular traffic constantly and without a traffic officer was tried for some months at the intersection of Wilshire Boulevard and Western Ave. in Los Angeles and was described in *Engineering News-Record*, Sept. 28, 1922, p. 520. Some complaint was made as to this method of handling traffic and the City Council ordered the circle removed. When workmen began to tear it out there was such immediate and vigorous opposition that the order for removal was promptly withdrawn. By the time the order could be put into effect, however, the work of destruction was almost complete. What the city's future policy will be with regard to traffic circles has not yet been stated.

Meantime the accident statistics for this crossing taken from police reports show that not only did the circle reduce the number of accidents by one-half, but the seriousness of the accidents as indicated by the estimated amount of property damage was reduced in still greater proportion. The records of accidents at this intersection and at another intersection in the vicinity which handled approximately the same traffic are given in the accompanying table.

BEFORE THE INSTALLATION OF SAFETY CIRCLE AT WILSHIRE BLVD. AND WESTERN AVE.

	Wilshire and Western		Wilshire and Vermont	
Month, 1922	Number of Accidents	Estimated Cost of Property Damage	Number of Accidents	Estimated Cost of Property Damage
January	14	$415.00	9	$295.50
February	10	400.50	10	440.50
March..	16	471.75	7	80.00
April	10	204.00	4	17.00
Totals	50	$1,491.25	30	$833.00

AFTER THE INSTALLATION OF SAFETY CIRCLE AT WILSHIRE BLVD. AND WESTERN AVE.

	Wilshire and Western		Wilshire and Vermont	
Month, 1922	Number of Accidents	Estimated Cost of Property Damage	Number of Accidents	Estimated Cost of Property Damage
May	3	$16.70	15	$336.40
June	8	98.90	7	209.00
July.	12	157.20	10	298.80
August	2	6.50	10	351.75
September	4	37.15	13	286.50
October 1-17	3	37.00	7	158.00
Totals	32	$353.45	62	$1,640.45

Rail Reclamation Practice on the Illinois Central R. R.

Rails with Worn Ends Are Sawed and Drilled at Portable and Fixed Plants and then Relaid—Force and Output

SINCE the wear of rails often progresses more rapidly at the ends, necessitating renewal although the main part of the rail may be in good condition, it is frequently economical to cut off the damaged ends and thus reclaim rails good for relaying. Two plants for cropping and drilling rails which are worn or battered at the ends are operated by the Illinois Central R.R. One of these is a permanent plant at Centralia, Ill., and the other is a portable plant which is shifted to various distant points where worn rails are assembled. This portable plant therefore avoids a long haul of the rails to and from the permanent plant when the rails are to be relaid in the same district from which they have been removed, or in an adjacent district, when these districts are at a considerable distance from the permanent plant. Practically all the reclaimed rails are used in main track on the less important lines of the system.

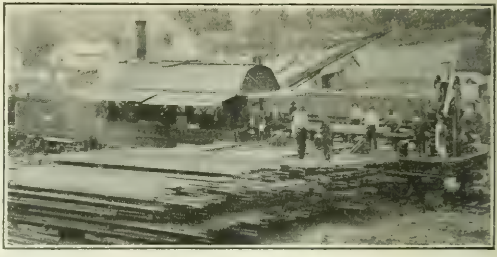


FIG. 1—RAIL RECLAMATION PLANT IN OPERATION

Worn rails from stack at the left are being sawed and drilled on the portable plant and loaded into cars for shipment.

Originally the rails were sawed to reclaim the maximum length from each rail, but this caused inconvenience due to the great variety of lengths. It was therefore decided to make a uniform crop of either 12 or 18 in. at each end, according to the length of splice that had been used. Thus worn 33- and 30-ft. rails give standard reclaimed rails 31 or 30 ft. and 28 or 27 ft. long respectively. The rails to be sawed are selected usually by the supervisor of the district on which the rails are removed. The weight of rails thus reclaimed ranges from 75 to 100 lb. per yard. It has not been necessary to caliper the heights of the rail ends in order to insure proper matching at the joints, owing to the fact that the rails taken out of track are usually loaded directly onto cars and the rails on each car are put through the machine as soon as they arrive. In this way the rails of each lot, with practically uni-

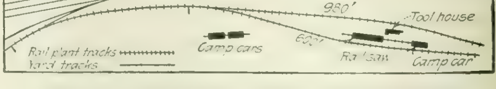


FIG. 2—LAYOUT OF RAIL RECLAMATION PLANT

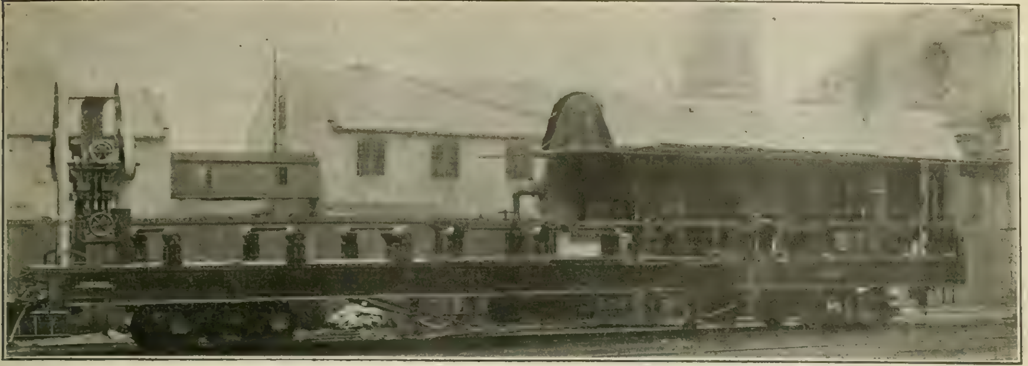


FIG. 3—PORTABLE RAIL SAWING AND DRILLING MACHINE

form wear, are kept together and do not get mixed with rails which come from other locations and might have a different amount of wear.

Portable Plant—The main feature of this plant is the rail-sawing car, 61 ft. long, shown in Fig. 3. A view of the plant in operation is given in Fig. 1, and the general layout is shown in Fig. 2. On the heavy steel underframe of the car are mounted a boiler, horizontal engine, 44-in. water-cooled disk saw running at 1,980 r.p.m., roller feed tables and two rail drills. A pneumatic hoist handles the rails to and from the tables, where they are secured by pneumatic clamps. Driven rollers in the feed tables provide for moving the rails easily. An air-brake pump with receiver 36 x 72 in. furnishes compressed air for the hoist, clamps and tables.

For drilling bolt holes for the new splices there are two double three-spindle drills operated from a countershaft driven by the engine. When the machine was purchased the railroad was using six-bolt splices, so that three-spindle drills were required, but the present practice is to use four-bolt splices, the drills being adjusted accordingly. In Fig. 1, the worn rails are stacked at the left and a derrick car is loading the reclaimed rails into a gondola car. During transportation and when not in use the sides of the car body or housing are lowered to enclose the machinery. This rail sawing machine was built by the Industrial Works, Bay City, Mich.

When running at full capacity there is a force of 21 men, as follows: Engineman, fireman, saw man, two drill men, two men loading and unloading rails, one helper, one handling the hoist, two chipping and oiling rails and straightening rails on the cars, eight men handling rails on feed table to saw and drills, one tool dresser helper and one man handling coal and cinders. About 6,000 ft. of rail can be sawed and drilled in an average 8-hour day.

Permanent Plant—The layout of the rail sawing plant in connection with the general reclamation plant at Centralia is shown in Fig. 4. The equipment includes a circular saw, shear, forge, rail bender, drill press, two rail drills and a saw grinder, with the necessary equipment of skids and roller tables. The machinery is driven by electric motors. A force of 22 men is employed, as follows: Foreman, saw man, air-hoist man, two drill men, four drill helpers, one marker (painting ends of rails to indicate length), five laborers unloading rails, four laborers loading reclaimed rails, one man feeding rails to saw, two men pulling the rails away from the saw. The average output of this plant is 10,000 ft. of rail drilled and sawed per 8-hour day.

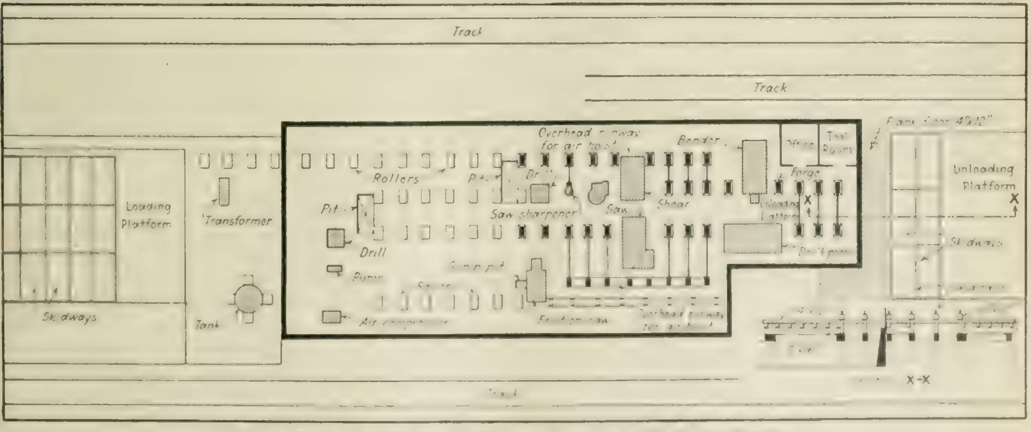


FIG. 4—PERMANENT RAIL RECLAMATION PLANT AT CENTRALIA

Annual Meeting of American Society of Civil Engineers

Vigorous Activity and Interest Displayed — Technical Sections Organized and Additional Research Work Initiated—Sessions on Education, Research and Town Planning—Loweth President

AN ATTENDANCE of more than 1,200 and a most active technical interest distinguished the seventieth annual meeting of the American Society of Civil Engineers, held at New York last week, covering the three days of Jan. 17 to 19. An important development of the society's work was initiated by the organization of four technical divisions of the society, through which intensive cultivation of separate fields of civil engineering is to be made possible by specialization. Another development was the extension of the action taken within the past two years toward encouraging research; two additional special research committees were created, one to deal with reinforced-concrete arches, the other with the strength of steel columns.

Three technical sessions were held during the meeting, and several technical committees presented reports of results, among them the committee on stresses in railroad track. Almost for the first time in the history of the society, administrative business took a quite subordinate position.

Ceremonies in connection with the bestowal of honorary membership upon five distinguished engineers, American and European, and the award of medals and prizes for papers contributed to the society, gave the opening session of the meeting a most impressive character. The new honorary members are Leon Jean Chagnaud, of Paris, constructor of the Loetschberg tunnel and of the Rove Canal tunnel; Sir Maurice Fitzmaurice, of London, long engineer to the London County Council; Prof. William C. Unwin, of London, distinguished educator and engineering authority; Clemens Herschel, of New York, past president of the society, hydraulic engineer; and John F. Stevens, of New York, railroad engineer, whose vitally important work in the construction of the Panama Canal was emphasized in the presentation.

Charles H. Paul was awarded the Norman medal for his paper on "Core Studies in the Hydraulic-Fill Dams of the Miami Conservancy District." The J. James R. Croes prize was awarded to William Cain for a paper on "The Circular Arch Under Normal Loads"; the Thomas Fitch Rowland prize to Gustav Lindenthal for a paper "The Continuous Truss Bridge Over the Ohio River at Sciotoville"; and the James Laurie prize to A. T. Safford and E. P. Hamilton for a paper "The American Mixed-Flow Turbine and Its Setting."

The business transacted at the meeting was noted in our news columns last week (p. 132); some further items are given this week (p. 181).

President Charles F. Loweth assumed office, succeeding John R. Freeman. George S. Davison and Anson Marston were elected vice-presidents, and Glenn D. Holmes, E. B. Whitman, George H. Fenkell, T. L. Condron, R. N. Begien, and George C. Mason were elected directors.

On Thursday about 650 members and their guests journeyed by special train to Bethlehem, Pa., where they inspected the Hill-to-Hill Bridge, now under construction. After luncheon at the Bethlehem Hotel as guests of the Bethlehem Steel Co., the party divided, one group going to inspect the John Fritz Laboratory of Lehigh University while the other was taken on a trip through the Saucon and Lehigh plants of the steel company. The lining for the Hudson River vehicle tunnel is being manufactured at the latter place and a section had been erected on the ground to show the cross-sectional dimensions and arrangement of the tunnel. A ring of the lining used in the first of the Hudson tubes was assembled also alongside the vehicle tunnel exhibit and illustrated in striking fashion the great size of the new tube.

On Thursday evening the society was addressed by Julius H. Barnes, president of the Chamber of Commerce of the United States, on the subject "Transportation Keyed to Production." Mr. Barnes based his remarks on the proposition that an advancing standard of living demands a production in excess of current consumption, that this production must be served by adequate distribution, and that in the processes of distribution, adequate transportation is the prime requisite.

After sketching the extraordinary growth in our productive capacity and in our volume of production he turned to a consideration of our transportation facilities which must provide for the distribution of these goods and pointed out that while economies in operation are continually making possible a greater volume of transportation for the capital invested in the plant, it is manifest that any material expansion of service must require large additional capital investments. The estimate made in 1907 by James J. Hill that the roads would have to invest 1,100 million dollars per year for five years to equip adequately the terminals of the country has been vitiated, in Mr. Barnes' opinion, by the supplementary service rendered by a new form of transportation—the motor truck.

But the proper adjustment of the transportation burden between the several agencies of railroads, highways and waterways is now a problem of the foremost importance, which, declared Mr. Barnes, must be painstakingly studied before large investments are made in terminal or other special facilities and equipment on the railroads.

Technical Committee Reports

Most of the technical committees of the society rendered reports. Notable among these were the third report on stresses in railroad track, and a final report on railroad bridge specifications by the committee on bridge design and construction. Other reports containing data of technical interest were those on soils and on highway bridge impact. Progress reports were rendered by the committees on highway engineering, on standard contract clauses, and on electrification of steam railroads, the latter committee having begun work only within the past year.

Track Stresses—Following on the investigations reported in 1918 and 1920, namely a general investigation of roadbed depression and stresses in the rails, and experimental study of the effect of locomotive counterbalance and the stresses in ties and ballast, the committee entered upon a study of curved track, which continued during the past three years. It finally reported on this subject at the present meeting. Careful comparative tests on straight and curved track under otherwise identical or similar conditions were carried on, of such remarkable thoroughness as to include, for example, 470,000 individual stress readings from autographic smoked-disk records taken under moving locomotives. The results show very high lateral bending stresses in the rails, both inner and outer, varying through a large range as the speed is increased, and also large lateral movement of the rails (distortion of track) as the locomotive moves over it. The phenomena of curve action of railway vehicles are more fully explored by these tests than by any prior investigations. Much light is thrown also on the decisive relation of locomotive design to the safety of track. As the report is voluminous, covering 162 pages with 102 diagrams and other illustrations, fuller indication of its contents must be reserved for another occasion.

Bridge Specifications—A specification for railway bridges submitted by the committee on bridge design and construction a year ago was exhaustively discussed and much criticised before the society during the year. In consequence the committee prepared what is virtually a new specification, differing from other current specifications in being much shorter and restricting itself to the more general considerations, so as to leave various detail requirements to the individual engineer. The specifications are intended to apply to spans of any length. The recently proposed M-system of engine loading, proposed by D. B. Steinman, is specified as an alternative to the E-system of Theodore Cooper. The old impact formula is retained. A column formula of the Rankine type is specified. The basic working stress specified is 16,000 lb. per square inch, but with the proviso that the design shall also take into account a live-load 50 per cent greater than that for which the bridge is designed, with 50 per cent increase in unit stress (thus giving a 24,000-lb. eventual base).

The committee expects to present a highway bridge specification in the course of the current year.

Foundation Soils—One of the main divisions of the work of the committee on bearing power of foundation soils, namely, a codification of existing practice with respect to allowable bearing power, was finally reported upon in this year's progress report. The committee finds that conditions are so variable, especially with respect to the identification of soils, that it is not practicable to prepare a codification of practice. In its study of soil constitution, however, the committee has progressed to the definite isolation of the colloidal constituent in clay, a sample of which was exhibited at the meeting. A review of recent literature on soil constitution also formed part of the report. Work of direct practical application is contemplated for the immediate future.

Highway Bridge Impact—One of the research committees of the society appointed only a few months ago, on impact in highway bridges, presented a summary of extensive tests of impact in a 150-ft. steel truss highway bridge with concrete floor, carried out in Iowa during the past summer. Very high impacts in some members of the trusses, and quite generally in the floor members, were found when trucks were run over slight obstructions placed on the floor. The highest results were found with a caterpillar tractor, in which case some impacts of 100 per cent even with unobstructed floor were observed.

Research Session

In recognition of the increasingly important position of civil engineering research in the work of the society, a separate session of the meeting was devoted to this subject. Four papers were presented. One of these, "Radio and Research," by O. B. Blackwell, dealt with a subject foreign to normal civil enginering but was of great interest and stimulative value.

Arthur N. Talbot, past president, and chairman of the society's committee on research, discussed the society's research activities at some length. Setting forth the basic reasons for including research in the society's normal functions—the fact that engineering science depends for its growth upon the conscious searching for new knowledge, and the fact that the society through its command of the field is in a favorable position to recognize needs and map out a program for investigative work—he pointed out that past work of the society in this field has been limited to discussing and publishing papers setting forth engineering knowledge, and has included no direct stimulation of research. Since the inauguration of a more aggressive policy a little over a year ago, distinct progress has been made. Research has been inaugurated in five subjects: working stresses for steel structures, flood protection data, irrigation engineering, hydraulic phenomena, and impact in highway bridges; and work is about to begin on the subjects of reinforced-concrete arches and steel columns. He pointed out, however, that there are very many problems awaiting investigation, and that it will be vital to the best success of the work to select wisely those problems which are most urgent. Much of the work will be of a kind that has value to many practical and commercial interests, who may be expected to support it, but Prof. Talbot emphasized the fact that the society has a specific duty toward subjects which are not likely to appeal to outside contributors.

Engineering Foundation—A concise review of the development of the two organizations known as Engineering Foundation and Division of Engineering of the National Research Council was presented by Alfred D. Flinn, director of the Engineering Foundation. He stated that this organization is "an integral part of the organism of the founder societies and of each one individually, just as the Library is," and that it is "their joint instrumentality for research and investigation, especially for such projects as involve more than one branch of engineering and science." The paper also contains a list of the investigations now under way in charge of the Division of Engineering of the National Research Council, including the following subjects: Deoxidizers, electrical core losses, electrical insulation, fatigue of metals, hardness testing of materials, heat treatment of carbon steel, marine piling investigations, molding sand, Neumann bands, physical changes in iron and steel below the thermal critical range, pulverizing, and uses of tellurium and selenium. Two other investigations, on heat transmission and on illumination, are not yet organized. Engineering Foundation, on the other hand, has supported an investigation of hollow-crested weirs, and has organized a study of arch dams and a study of wood-finishing processes. It expects to participate in a study of reinforced-concrete arches in co-operation with the research committee of the American Society of Civil Engineers. A study of the technical features of the boll weevil campaign is under advisement.

New Views On Steel—Under the title "The Study of Steels for Engineering Structures," Dr. George K. Burgess, of the U. S. Bureau of Standards, reviewed the present status and probable future of steel as a structural material in rather broad perspective. Describing the present as a stage intermediate between the low-carbon steel and the alloy steel periods, he suggested the possibilities that may be found to lie in the use of aluminum and duralumin; the former is credited with a structural efficiency (strength divided by weight) only one-tenth lower than that of structural (mild) steel, while the efficiency of duralumin is three times that of aluminum and one-fifth greater than that of heat-treated alloy steel. He referred at some length to the steady tendency toward the use of higher-strength steels, and discussed both nickel-steel and copper-manganese steel (the latter in decidedly encouraging terms), as well as silico-manganese steel. There does not appear to be much room for improving the quality of structural metal by cleaner furnace practice, however important this may be in high-carbon and alloy grades. Heat treatment, on the other hand, is a distinct possibility; it is already used for eyebars and may be applicable to built members.

Dr. Burgess then outlined some of the Bureau of Standards work, and described two new test devices. One is a remote-reading extensometer based on the principle that the resistance of a carbon contact varies with pressure; the instrument has been brought to thoroughly practical form and has been used in some important recent tests. The other device is a process for making strain lines (Lüder lines) readily visible on a steel surface, and consists of coating the strained surface with a white cement wash.

City Planning Session

A whole session was given up to city planning at which three papers were presented and discussed. The larger part of the paper on "Regional Planning," by Nelson P. Lewis, now director of the physical survey for the plan of New York and its environs being made under the auspices of the Russell Sage Foundation, was devoted to an outline of that work. The area under study includes 5,500 square miles located in three states and has a combined population (1920) of about 9,000,000. In this area there are nearly 400 different political units. The metropolitan division of the area, which includes all of New York City, together with Hudson County and Newark, N. J., has an area of 360 miles and has a population of 6,700,000. What is called the suburban division has an area of 1,170 square miles and a population of 1,360,000. The remainder of the region, classed as rural, has an area of 3,970 square miles and a population of 940,000. It is estimated that by 1960 the population in the entire region will be 20,000,000 and that in the year 2,000 it will be 37,000,000, the latter divided into metropolitan, 20,000,000; suburban, 13,000,000; rural, 4,000,000. The survey now in progress is a determination of the regional planning problem that needs solution.

Zoning and Planning—The general principles and practice of zoning were outlined by Morris Knowles, consulting engineer and chairman of the city planning commission of Pittsburgh. Zoning promotes municipal economy, facilitates city planning, simplifies traffic control, and makes for better health and sanitation. It is important that competent legal advice should be had in connection with zoning, since there are many snags to be avoided. A zoning consultant from outside the city is desirable. Publicity work cannot be overdone if the public support needed for the adoption of a zoning plan is to be secured. All zoning plans must show a fair relationship between public good and the reaction upon individual property owners.

In a paper entitled "The Engineer and City Planning" George H. Norton, city engineer and chairman of the city planning commission of Buffalo, N. Y., said that the "ills of the municipal body lie in its deformed and unguided growth rather than in its charter or ordinances" and added that the "beautification" of the city "should be in ordered arrangement and growth more than in surface embellishments." The city planning engineer has a threefold problem: (1) His plan must "appeal to the sound judgment of a large part of the citizens"; (2) he must co-operate with "the ever present public spirited citizens who are ready to assist in laying the matter fully before the whole electorate in such manner as to win their approval"; (3) when such public approval has been secured that of the city authorities must be obtained. Beyond this, the city planning engineer must always consider the human element. In conclusion Mr. Norton said:

> No other field today offers a fairer range for the highest development of engineering perspective or the formulation of new standards, and certainly none promises a fuller opportunity for the engineer to take his place as a leader of public thought, qualified to guide the development of our greatest institutions, the cities.

Discussion—The three papers were discussed together. C. W. Leavitt urged that in regional planning work one of the main objects should be decentralization, a distribution of population and industry so that as many as possible of the people may get to their work by walking. He also urged that real-estate developments be not permitted to block regional arterial routes. Frederic Delano, a member of the committee on the plan of New York and its environs and a former member of the Chicago city planning commission, said that city planning activities in Chicago were begun twenty years ago. No one man could ever make a city plan that would be adopted or if adopted that would be carried out.

E. A. Fisher, consulting city engineer and superintendent of city planning at Rochester, N. Y., said that the Rochester city planning bureau, which has been in existence for some five years, is a part of the department of engineering, where he believes such a bureau belongs because the bureau gets the benefit of the city engineer force, and the latter keeps in touch with what the bureau is doing. About four years ago the city was zoned as to use, but not as to area and height. Recently height and area regulations have been drafted.

Education Session

The session of Wednesday afternoon was held jointly with the Society for the Promotion of Engineering Education and was addressed by Prof. Charles F. Scott, president of the latter organization, Prof. William G. Raymond, dean, College of Applied Science, State University of Iowa, Magnus W. Alexander, managing director National Industrial Conference Board, and John L. Harrington, president Am. Soc. M. E.

Professor Scott outlined the new project of the Society for the Promotion of Engineering Education, whereby it is to conduct through its newly-appointed Board of Investigation and Co-ordination an intensive study of the needs of engineering education with respect not only to the conditions in the schools themselves but also to the requirements of industry. An abstract of the report upon which this project is based was given in *Engineering News-Record* of Sept. 28, 1922, p. 537.

The full functioning of the board, he declared, must await the securing of funds and the selection and appointment of a director and staff.

Dean Raymond reviewed the status of engineering education in the schools of the middle West, taking as the basis of his conclusions the information gleaned from a questionnaire which was answered by two foundation schools and twelve publicly supported schools in that regions. Although it was expected that because of the hard times that have come to the farmers during the post-war period there would be a falling off in college attendance in the Midwest this prediction has proved to be unwarranted.

The immediate outlook, Dean Raymond considers, is for smaller attendance, which, due to present overcrowded conditions, will not be displeasing to the officers of the schools. He suggests that it will be some time before the schools get on a really efficient basis unless the combined effect of some additions to staff, space, and equipment and a considerable reduction in attendance brings about a condition of balance. He referred also to the poor preparation of the graduates of secondary schools in the midwest territory although he could not say whether this poor preparation is peculiar to that region. There is a tendency, he declared, to make the secondary schools practical schools, training most of their students for business life rather than for college entrance. He notes also a distinct tendency away from those things that appear to be difficult—such as examinations to test the student's knowledge.

In discussing engineering research, Dean Raymond took issue with those who have held it to be the primary function of a university. On this subject he spoke as follows:

> There are those who do not hesitate to say that the primary function of a university is research; that its teaching work is incidental. It is believed that except with respect to those institutions created primarily for research, such a statement is wide of the fact, and certainly with respect to the state universities of the western and southern states it is not in accordance with the ideas in the minds of those who created these institutions.
>
> The state universities, standing as the capstones of the educational systems of the states, were created primarily to give what was commonly known as a college education to the youth of the states. The idea of research was hardly thought of by any one connected with the institutions when they were created. This idea in connection with these institutions is of modern growth.
>
> There can be no quarrel with the statement that research is an important function of a university, and that it may be, but is not necessarily, an important function of an engineering school. But it is believed to be fair to say that those schools in which engineering research of importance is being developed, are schools in which the signs of the times are being read aright; schools in which the students even though they do not participate in research work are brought into an atmosphere that is wholly beneficial; and it is also fair to say that in the engineering schools in the West, research is being developed with some rapidity.

Mr. Alexander set forth as the objective of engineering education the providing of society with men who have had a general education and who, in addition, have been trained in a knowledge and understanding of the exact sciences through which they are enabled to promote the physical well-being of the community, and by their habits of exact thinking and constructive outlook to serve as leaders in public and private affairs.

He pointed out the need in a society of increasing complexity for exact, clear thinking on a basis of ascertained fact and experience. The training of the engineer, he said, should particularly fit him for leadership in public service as well as in industry, animated as he is by a constant spirit of inquiry, a pioneering instinct, and an openmindedness born of his scientific bent. The enhancement of these qualities Mr. Alexander conceives to be a task of the engineering schools.

Mr. Harrington offered a plea for co-operation between the four founder societies in a plan for a general undergraduate engineering society, having chapters in the several engineering schools, rather than the present student chapters of the national engineering societies. He contends that in the student sections the tendency toward specialization is carried too far and that these are failing measurably to serve the purpose for which they were formed. In this connection he cites the results of a survey of the student branches made last year by Dr. William H. Kennerson, dean of the School of Engineering of Brown University, who concluded that most student branches were sustained by artificial respiration administered by members of the faculty.

Technical Divisions

Organizing sessions of four new technical divisions were held. Such divisions were authorized by the Board of Direction last June and provided with $4,000 in the current budget of the society. The present ones deal with the sanitary, highway, irrigation and power fields.

So far each of the divisions is feeling its way along toward organization guided only by the general rules laid down by the Board. Each of the sessions, therefore, established some form of temporary organization, outlined some of the problems which the section could profitably discuss, laid plans for the program to be followed at the New Orleans meeting next April and arranged for the enrollment, through a general letter to be sent out by the society itself, of those members who wish to join the divisions. Procedure in the four divisions was not identical, nor was the status of division affiliates or the amount of dues uniformly treated, but as in each case action was only tentative, it is probable that soon there will emerge some uniform procedure, after which the sections will begin to function technically.

Broader Sanitary Engineering—Following the dinner and organization meeting of the new sanitary engineering division of the society, H. P. Eddy, consulting engineer, Boston, read a paper on the "Present Status of Sanitary Engineering," which included some suggestions on the aims of the division. He held for a broader conception of sanitary engineering than has formerly prevailed so as to include not only works and measures for the protection of public health, but also matters affecting the general comfort and welfare of the people.

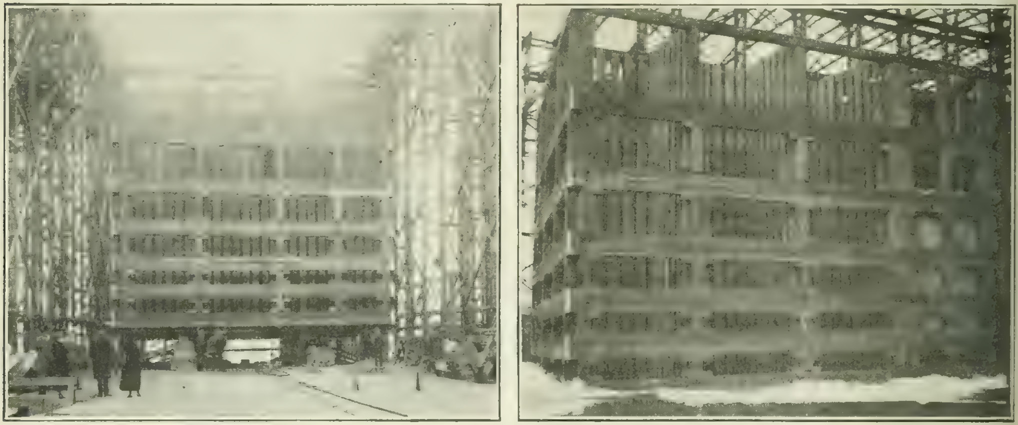
In the organizing session of the highway division a great amount of discussion as to the advisability of its establishment preceded actual formation. This argument arose from the fact that there already exist some twenty-odd organizations doing research in highway work or prescribing specifications. In the face of that knowledge, however, preponderance of opinion was to the effect that the society should form a highway division.

From Job and Office

Hints That Cut Cost and Time *For the Contractor and the Engineer*

Sinking a Large Cofferdam Crib

BRIDGING the West Waterway at West Spokane St., Seattle, by the construction of a modern bascule bridge was begun June 9, 1922, by the award of a contract by the city to the J. A. McEachern Co., Inc., for the substructure at a price of $265,000. The bridge is to cross the 400-ft. West Waterway at an angle of 47°45′, which requires a total length of steel bridge of 600 ft., including a double-leaf bascule span of 288 ft. c. to c. of trunnions, with roadway at El. +47, giving a clear channel between trunnion piers of 150 ft., and in order to get below the proposed future channel of 47 ft. depth of water at high tide the masonry for the main trunnion piers is to be carried to 53 ft. below high tide (El. 0).



FIGS. 1 AND 2—COFFERDAM CRIB ON THE WAYS AND ENTERING WATER

After entering the water, the crib, which is 87x42 ft. and 35 ft. high, heeled to an angle of about 45 deg. While it was being floated to the pier site a floating driver lifted the low side to bring the crib to even keel. The structure contains 223 thousand feet of lumber and 10 tons of steel. It will be surrounded by steel sheeting 62 ft. long, and the cofferdam thus formed is to be excavated to an elevation of 53 ft. below water.

The plans for the substructure call for a pair of piers for each trunnion support 98 ft. in height, from El. —53 to +45, each with its own concrete base and foundation of fir piling. These piers are spaced 50 ft. 4 in. c. to c. of bases, each base being 36 ft. 6 in. on the channel side, 23 ft. 6 in. on the shore side, and 42 ft. parallel to the bridge. The piles are to be driven to the considerable depth of 125 ft. below high tide at the east trunnion pier with cutoff at —47.

The contractors decided to construct on either side of the channel a large combined cofferdam enclosing the two trunnion pier foundations rather than two smaller cofferdams. The combined cofferdam, trapezoidal in plan, is built around a timber crib 87 ft. long on the channel side, 74 ft. on the shore side, and 42 ft. wide. The top waling timbers are at El. —1, the bottom set of two timbers at —36, the top of the steel sheet piling which surrounds the crib at +2, and the bottom at —64, which is 11 ft. below the masonry of the piers.

The west pier crib was built by the J. A. McEachern Co. at the plant of the Elliott Bay Marine Construction Co., one-half mile south of the bridge site on the West Waterway, where a number of wooden ships were built during the war.

Construction of the west pier crib began on Aug. 28, and was complete on Oct. 16. Its framing details may be judged from the view, Fig. 1, which shows the crib as it stood in the shipyard just prior to launching. It was launched Oct. 19 at flood tide, after launching ways had been extended well out into deep water to prevent the crib being strained as it entered the water.

A good view of the crib during the launching and just entering the water is shown in Fig. 2. As anticipated, the crib keeled over on one side at an angle of about 45 deg., the channel side floating highest.

No time was lost in towing the crib to the bridge site, and on Oct. 21, as soon as the falsework was in correct position, tugs towed the crib, with a floating piledriver lifting its low side to even keel, to the site of the west trunnion piers. Here it was floated into a berth of braced pile bents, which had been carefully located beforehand so that the crib would come to rest against vertical guide timbers. The open or channel end of the berth was promptly closed by driving a row of capped piles from side to side of the 87-ft. opening.

The area to be enclosed by the cofferdam had been excavated already to El. —37 with clamshell buckets, the material being loaded on barges and dumped in the outer harbor. As planned, the crib was grounded at this level by loading, at low tide. The load consisted of enough 66-ft. steel sheet piling placed on top of the crib to sink it and hold it down at all tide levels. The crib careened once, toward the channel, but mooring lines to shore held it secure and it was righted without any damage whatever being done to it.

Lackawanna 14-in. arch-web steel sheet piling 66 ft. long, which had been ordered by water shipment through the Panama Canal from the east coast specially for this cofferdam, was driven around the crib to complete the cofferdam. Each pile was picked up by a stiffleg derrick with 90-ft. boom and lowered into position, where it was driven by a drop hammer working in short leads suspended out from a floating piledriver. The channel and two side walls were driven in this manner. The shore side was driven with an ordinary land driver on skids. These sheet piles were driven without jetting, although provision had been made for a jet. Piles were driven through a fine sandy material containing some blue clay, to —64. The 217 sheet piles surrounding the cofferdam were driven in ten days, ending Nov. 3.

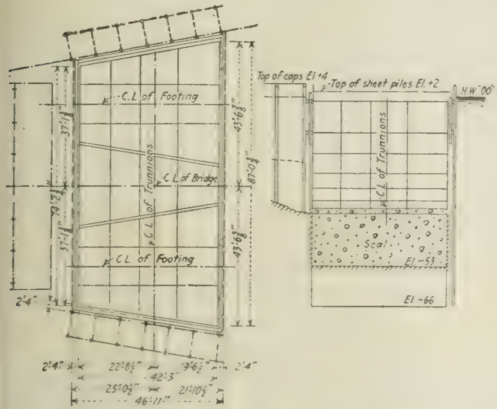


FIG. 3—WEST PIER COFFERDAM

Building a joint cofferdam for the two piers of the pair made necessary the large crib.

In order to divide the big cofferdam into two foundation areas with an unused area in the center, two division walls of 4x12-in. Wakefield sheet piling have been driven, between pairs of timbers previously framed in the crib to take them.

These piles, which were 62 ft. long and extended from El. +1 to El. —61, were driven by a land driver with drop hammer, using a jet to each pile. They were driven in ten days (part time). The cofferdam is now being excavated preparatory to driving the foundation piles.

The total material in the cofferdam is as follows:

12 x 12 fir timber and blocking	125 M. ft. b.m.
Ironbark bearing block	3 M. ft. b.m.
2-in. plank lining pockets	25 M. ft. b.m.
4 x 12 x 64 Wakefield sheet piling	70 M. ft. b.m.
Total lumber	223 M. ft. b.m.
Iron rods, bolts, etc.	10 tons
14 x 66 ft. steel sheet piling	288 tons

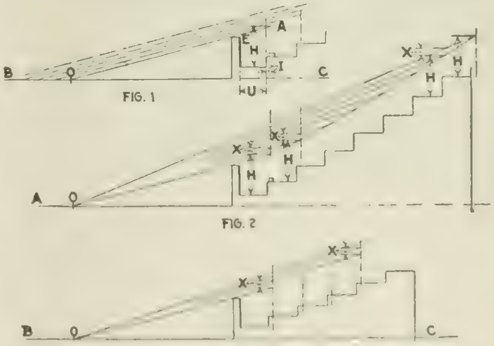
J. A. McEachern is president, B. H. Cooke general superintendent, and J. Samuelson engineer of the contracting company. The work is being carried on for the city under J. D. Blackwell, city engineer, F. A. Rapp, bridge engineer, and E. K. Triol, engineer in charge of construction.

Determining Sight-Line Factors in Stadium Design

IN THE design of a stadium it is essential to provide a good view of the arena or field from any angle or height. This desired feature can be secured only by the evolution of a proper cross-section of the structure, determined by a system of sight lines from the normal eye position of spectators in each bench to a predetermined point in the field. This feature in stadium design was described at a recent meeting of the Western Society of Engineers by B. M. Thorud, in connection with a paper on the new Chicago and University of Illinois stadiums by H. J. Burt, consulting engineer for Holabird & Roche, architects, Chicago.

To explain the sight-line system, the point *A* in Fig. 1 represents the average eye position for the first riser; *E* is the top of the field wall which the sight line must clear, and *O* is the point to which it is desired to limit the seated spectator's view. Where a running track is included it is usually around the side of the field and close to the stand. The point *O* usually then is at the height of the waist of a runner in the first or second lane of the track. This location is considered better than that wherein *O* is in the center of the track at field level. When no track is included, *O* is usually on the level of the field and somewhat outside the playing field or gridiron in order to allow a view of an "out of bounds" play.

A constant height of riser was used in the earlier structures but the later ones have variable heights. The width of tread, which is usually constant, is governed by the spectator's comfort and the number of benches necessary for the desired seating capacity in the space available for the depth of the stand. A 24½-in. width should be the minimum and 30-in. is considered ample for comfort, though for seats with backs a width of 31 to 32 in. gives better space for the knees. If any tread is to be used as a cross-aisle greater width is required.



FIGS. 1, 2, 3 DIAGRAMS OF SIGHT-LINES FOR STADIUM DESIGN

To determine the elevation of the first tread as in Fig. 1, *O* is first located and the height and width of the field wall *E* are plotted. The aisle width *U* is laid out and a vertical line is drawn at the normal position of the eye, at the distance *I* from the face of the riser. A sight line is then drawn through *O* and *E* to this vertical line, the intersection indicating the normal height for the eyes of persons sitting on the bench or tread.

With a constant width and rise of bench, the sight lines will be parallel, as indicated by the dotted lines. For each succeeding row the point of sight on the field *B* becomes farther away from the stand, so that the seat value diminishes proportionately. The advantages in convenience and simplicity of design are overbalanced by the disadvantages in poor seat values of the top benches and smaller capacity due to the limited number of treads.

If the point of sight *O* is constant and a constant clearance *X* is adopted for the height of head above the eye level, as in Fig. 2, the elevations of the risers are determined by sight lines radiating from *O*. By this method the height of risers increases successively.

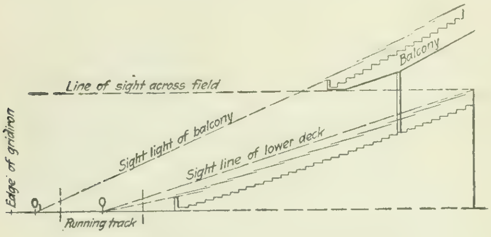


FIG. 4—SIGHT LINES FOR DOUBLE-DECK STADIUM
The effect here sought is to bring top rows closer to the field than they would be in a single deck stadium of equal capacity. Upward curvature being increased, heights of risers are greater.

It will be noted that a line drawn through the series of eye positions forms a curve. A clearance of 5 or 6 in. for *X* would give such a rapidly increasing curvature as to require an impracticable height of structure for the desired number of rows. For this reason a height of 4 in. has been used generally, giving risers of from 12 to 17 in. Each sight line is drawn from *O* to intersect its respective vertical line at a height *X* representing the normal height from the eye to the top of the hat of the spectator in the next seat below. The normal height of eye, *H*, is then measured downward from the point of intersection to give the elevation of the riser.

Since it would be impracticable to build a stand with risers varying exactly as determined by the above method, it is usual to assume a series of tangents to the curve of eye position, varying the slope of tangent to give risers differing in height by one inch.

A modification of this method is to determine the sight lines for a constant clearance *X* at each third row instead of at each row. This plan, shown in Fig. 3, is based on the assumption that a spectator can easily look between the heads of the spectators in the next two rows below him. In this way, with a clearance *X* of 5½ in. for each third row, it is possible to derive from the same point of sight *O* a curve of eye position having less upward curvature than that obtained in the previous method with a clearance of 4 in. for each row. The variation in height of risers will then be from 8 in. to 11 or 12 in. as compared with 11 in. minimum to 17 in. for the previous method shown in Fig. 2.

In a double-deck stadium, Fig. 4, the effect is to bring the top rows closer to the field than they would be in a single-deck stadium of equal capacity. Since this increases the upward curvature of the line through the eye positions, and consequently increases the slope of the tangent to the curve, a greater height of riser is required. Another consideration in a double-deck stadium is to fix the lowest elevation of the upper deck or balcony so that a line of sight from the top row of the lower deck will terminate at a point sufficiently high in the opposite stand to include a portion of the lower part of that stand and give a good view of an occasional punt. Since the upper deck is seldom used for track meets, its risers can be made smaller by locating the point of sight *O* at a distance from the edge of the football gridiron so as to include a view of a play out of bounds.

From Job and Office

Hints that Cut Cost and Time

Geophone Used in Locating Compressed-Air Leaks

An Arizona mining company has demonstrated a new use for the geophone by successfully locating leaks in compressed-air lines which were buried from 1½ to 2½ ft. in fine rock fill. The following information is abstracted from data sent to the U. S. Bureau of Mines and contained in a recent bulletin of that bureau.

The mining company has two parallel main compressed-air lines about 1½ miles long buried under an average of 2 ft. of fine rock fill. One of the lines is a 4-in. high-pressure (1,000 lb.) main, the other a 10-in. low-pressure (90-lb.) main. The two mains are separated by a 10- to 30-ft. interval. Several leaks developed in the mains. Various members would be shifted to ascertain the location of leaks and finally a Bureau of Mines geophone was secured. The first tests were conducted while the pumps were running, but so much vibration was recorded that it was impossible to detect the leaks.

A second attempt was made at the close of the day shift, when the compressors were not operating and when the pumps could be shut down. The valves in the far end of the surface line were closed and the lines were pumped to full pressure. Geophone readings were then taken at 7- or 8-ft. intervals directly over the line. Several leaks, some very large in the high-pressure line, were audible with the geophone at distances varying from 15 to 30 ft. A considerable leak in the low-pressure line was found at a distance of 10 ft. After their first detection leaks were easily located. Though the largest leaks were easily discoverable the superintendent of the mining company believes that the instrument cannot be depended upon to locate the small ones.

The geophone used by the Bureau of Mines is an improved type of the French military geophone. The instrument and its uses are described by Alan Leighton in Bureau of Mines Serial No. 2102, published as Report of Investigations, March, 1920.

From Job and Office

For Contractor and Engineer

Diagram for Designing Open Ditches With 1:1 Side Slopes

By F. T. Mewes
Kelker, DeLeuw & Co., Chicago

A GREAT decrease in the time and labor required to determine the velocity of flow and discharge of open drainage ditches may be effected by the use of the accompanying diagram, which has been designed by the writer and which applies to ditches with side slopes of 1 on 1. This diagram consists of two parts: (1) A logarithmic diagram to determine the hydraulic radius and cross-sectional area of ditch for a given bottom width and depth of flow; (2) a nomographic diagram to determine the velocity of flow for a given hydraulic radius, hydraulic gradient or slope, and roughness coefficient "*n*." Since the scales of hydraulic radii for the two parts of the diagram coincide, the velocity of flow in a given channel is determined by a continuous operation.

The nomographic diagram is based on Manning's formula for velocity, as below, in which the roughness coefficient "*n*" is equal to Kutter's "*n*."

$$V = \frac{1.486}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

This diagram is so arranged for $n = 0.035$ (which is a common value in designing dredged drainage channels) that one operation in the general solution is eliminated. This operation is *F-G* in the following example, which indicates the method of using the diagram:

Reference to Diagram	Item	Given	Found
A	Bottom width	16 ft.	
B	Depth of flow	6.0 ft.	
B	Cross-sectional area		132 sq.ft
C	Hydraulic radius	4 00	4.00
D	Hydraulic gradient	0 06%	
E	Velocity for $n = 0.035$		2 61 f p s
E	Discharge = 132 × 2 61		344 sec.-ft.
F	(General) $n = 0.030$	0 030	
G	Velocity for $n = 0.030$		3 07 f p s
G	Discharge for $n = 0.030$		402 sec -ft

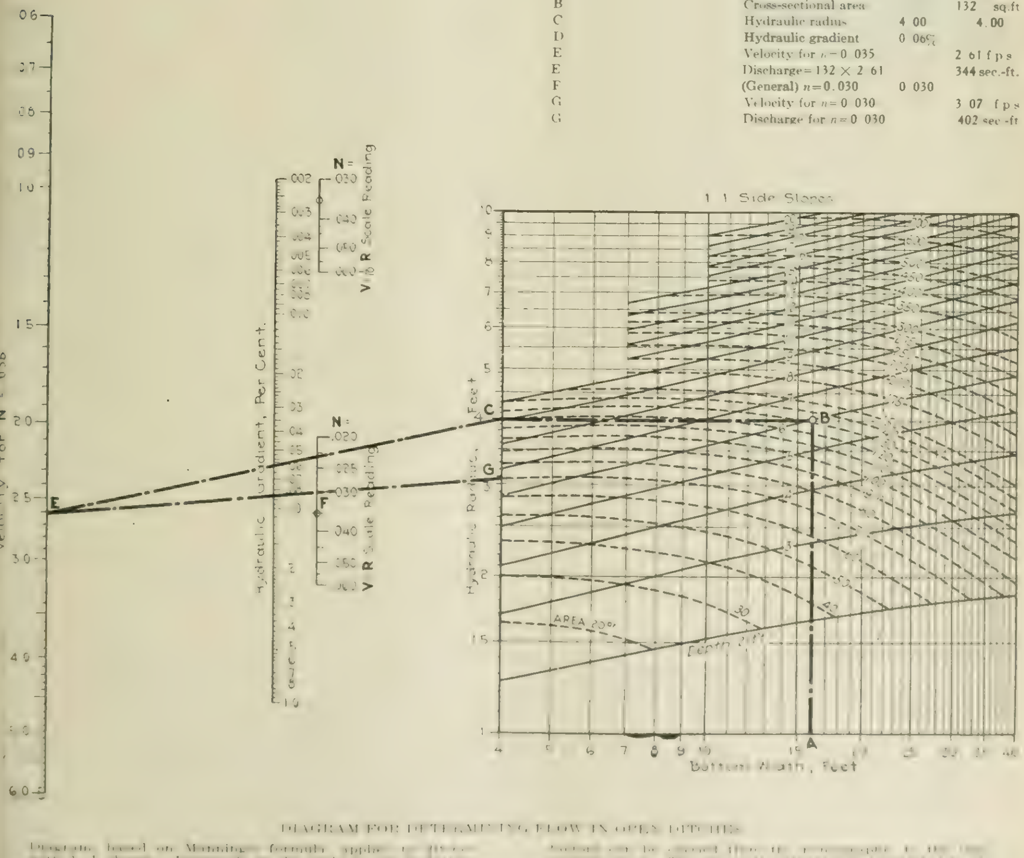


DIAGRAM FOR DETERMINING FLOW IN OPEN DITCHES

Diagram based on Manning's formula applies to ditches with 1:1 slopes. Inasmuch as the scale of the hydraulic radius is the same in both charts the determination [illegible]

For ditches with side slopes other than 1 on 1, only that portion of the diagram plotted on logarithmic paper will be changed, the nomographic diagram to the left of and including the hydraulic radius scale being the same for any channel.

From Job and Office

Hints that Cut Cost and Time

The Right Way to Pile Cast-Iron Pipe

By George C. Love

Chief Engineer, Newport News Light & Water Company, Newport News, Va.

In the accompanying view is shown a very satisfactory method of storing cast-iron pipe. Though simple and rather obvious the method, its advantages may be summed as follows:

1—Economy of space.

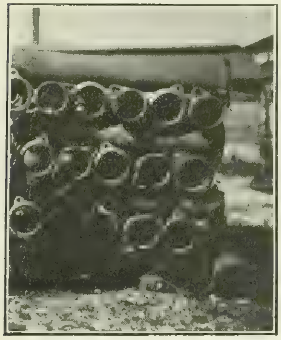
2—Accessibility for thorough inspection.

3—Ease of treatment of ends to prevent rusting of machined joints.

4—Ease of piling or rehandling.

5—Stability of the pile itself.

6—Facility in making inventories.



SATISFACTORY METHOD OF STORING PIPE

Dotted Maps Aid in Location of Railroads To Reach Timber

As an aid in locating the most economical branch railroad routes to reach standing timber, an engineer of Portland, Ore., uses maps on which dots indicate both location and quantity of the timber stand. This method, illustrated by the accompanying map, can be used to show location and quantity more accurately, and maps so made are said to be more conveniently read, than maps on which the timber stand is shown by colors.

The unshaded circles each represent 100,000 ft.-b.m. of Douglas fir, and the shaded circles represent a like quantity of Sitka spruce. Streams, section and quarter-section lines, divides and railroad lines are also shown. This map is used exclusively to locate standing timber, the topography being plotted on another map of the same scale which is used in conjunction with the timber map when locating the railroad.

The method has been found most useful along the Oregon coast where very heavy logs are handled and where the greater part of the cost in production of lumber is the cost of transportation from stump to mill.

The map was prepared by G. B. Herington, consulting engineer, Portland, Ore.

More on Setting Slope Stakes

This communication from an engineer in far-off Turkey was prompted by an article which appeared in the "From Job and Office" section of Engineering News-Record, *Aug. 24, 1922, p. 303, on a simple method of setting slope stakes.*—Editor.

By J. C. Brown

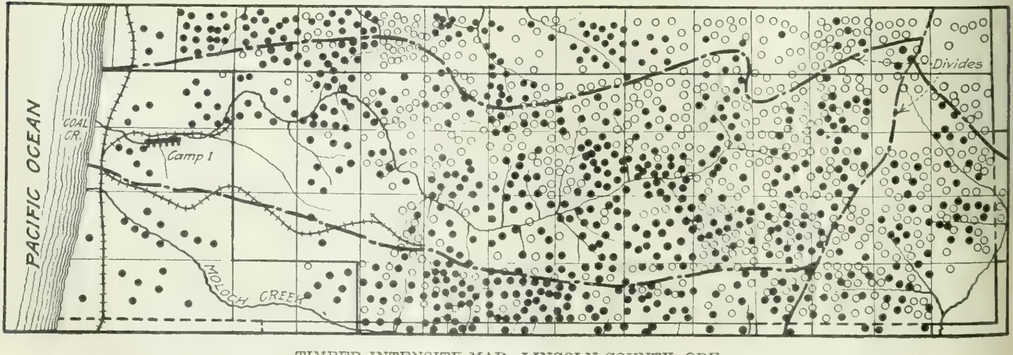
Chief Engineer, Anatolian Railway, Constantinople, Turkey

Several years ago I used a method of setting slope stakes in work in Canada, the method involving a special rod and a specially-marked tape. The rod consisted of a pine board about 10 ft. long with a roller and an iron guard at each end. To this was attached a canvas tape which moved freely over the roller. This tape was graduated in feet and tenths from 0 to 20.

The tape was an ordinary metallic one graduated to feet and tenths and on the back, beginning at a distance equal to one-half the width of the roadbed in fill, was graduated into spaces of 1½ ft. and these subdivided into tenths. A string or wire equal to half the difference in the width of the roadbed between cut and fill was attached to the end of the tape.

Setting Stakes in Fill—When setting slope stakes the level was set up in a position to take in as many stations as possible. The rodman read the fill from the center stake, and the instrumentman checked the reading with his notes. Next, the rodman, holding the rod at the stake, moved the tape on the rod as instructed by the instrumentman until the reading on the rod was the same as the fill on the stake. It followed, therefore, that wherever the rod was placed the instrument-man at once read the fill at that spot without any calculation.

The chainman then stood at the center stake with the end of the tape and the rodman went out to a point where he believed the slope stake might come. The



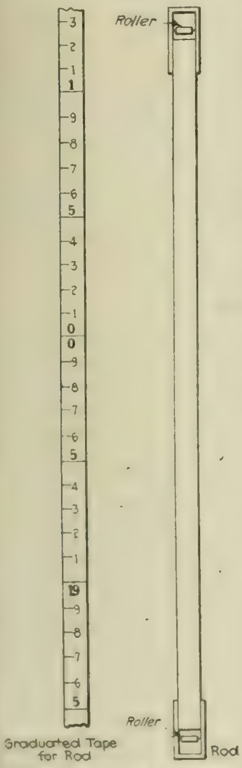
TIMBER INTENSITY MAP—LINCOLN COUNTY, ORE.

Accuracy in locating the timber and convenience in reading are advantages claimed. Each circle represents 100,000 ft.-b.m. Shaded circles refer to Sitka spruce; others to Douglas fir.

From Job and Office

For Contractor and Engineer

instrumentman read the correct fill at that point direct from the rod and called it to the rodman who consulted the back of his tape. If the amount of fill given by the instrumentman corresponded to that shown by the back of the tape that particular point was the correct one for setting a slope stake. If the rod and tape readings did not agree, the rodman had to manoeuver until the conditions were satisfied.



SPECIAL ROD AND TAPE FOR SETTING SLOPE STAKES

When the proper place was found the rodman turned his tape over, read the distance off from the center, and called it to the instrumentman who entered it in his notes. The process was repeated on the other side and the cross-section was complete.

Setting Stake in Cut—The procedure was the same in cuts, except that the rod was held with the reverse end up. The chainman, too, held the end of the string at the stake and the rodman added the amount of the string's length to his distance out before calling to the instrumentman.

The rod could also be used to good advantage in other ways. For instance, a line of levels could be run with only one column of notes; that is, the actual elevations could be read direct from the rod. Again, a ditch could be staked out to a given gradient without figures, the rodman shifting his rod at each station a distance equal to the per cent of grade and the instrumentman reading the consequent correct cut.

Two Drafting Room Devices

A DOUBLE pen, consisting of two pen points placed in one holder with the points overlapping, as shown in Fig. 1, is a time and effort saving device for work with India ink. The filling of a pen point with a quill dipped in ink is an annoying loss of time. A fountain pen would be ideal but it cannot be used with India ink. The double pen requires only occasional filling, serving somewhat as a fountain pen.

A feature in drawing and sketching which is undesirable is that of thumb-tacking the paper to a sketch board. The paper is continuously shrinking or expanding and necessitates shifting the tacks to have the paper taut. To avoid this, a sketch board made with a groove and a wedging slat at each end, as shown in Fig. 2, has proved of much advantage in placing the paper. With this arrangement no tacks or tack pullers are required and the corners of the paper are not mutilated or corners of the board so perforated that they fail to hold tacks after a period of use.

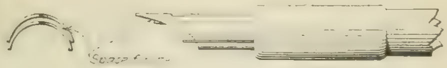


FIG. 1

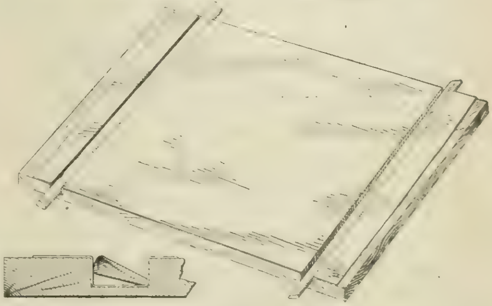


FIG. 2

SIMPLE IMPROVEMENTS IN DRAFTING ROOM PRACTICE

Fig. 1—A double pen that obviates incessant inking. Fig. 2—Drafting paper is kept taut without use of thumb tacks.

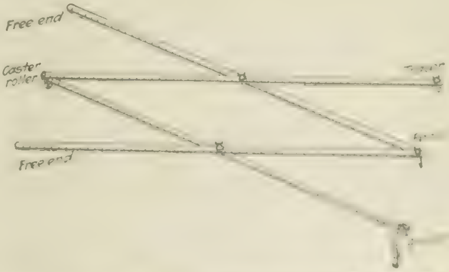
The paper is made taut by pushing one of the slats into the groove while the other is in place. For thin sketch boards, where the depth of groove is limited, brass strips can be advantageously used in place of wood slats. In either case the fastenings will be below the surface of the board and the T-square will slide freely over them.—*American Machinist.*

Pantograph Roller Made From Caster

By H. D. Hurley

Massachusetts Department of Public Works, Boston, Mass.

THE standard hardwood pantograph is equipped with a metal knob on which to travel, but this device is not satisfactory, because of the uneven motion due to varying friction.



FURNITURE CASTER MAKES EASY TRAVEL OF PANTOGRAPH

As a betterment the writer procured a ball-bearing furniture caster, value 5c., filed the shaft down to the proper size and substituted this roller for the metal knob.

This change resulted in a very decided improvement in the action of the pantograph.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

For Service without Profits

Sir—Your editorial comment in the issue of Dec. 14 relating to the address by Dean Kimball on "The Engineer and the Demand for Industrial Leaders," abstracted in the same issue, fails, as he apparently failed, to understand and express the real challenge to the engineer. This real challenge to the engineering profession is for it to shake off the yoke of the financiers, owners, and business executives that has long held its members bound as servants to the big interests and corporations paying their salary checks. Those possessing the technical knowledge and skill without which the so-called "captains of industry" would be helpless must unite with the productive laborer who is also essential in any industry, to serve the public not with lip service but with real service at actual cost. The plan of the Building Guilds of Great Britain, whereby the workers and managers unite to make the contracts and hire capital at a fixed rate of interest, is an example illustrating productive industry for service. The need for similar service in the building industry in this country is all too evident. There is no greater disgrace than the present wild orgy of profiteering in cheap, jerry-built houses being sold at great profit to the man trying to establish his family in a comfortable home.

Not "service first, then profits," but service first, last and all the time rendered by well-rewarded, keenly interested, and mutually co-operating workers, is the insistent call to the new industrial leader. The danger of confusing motives of service with motives of profits is too great longer to deceive the public with the old slogan "service first." A good example of this danger is contained in *Engineering News-Record* itself. On pages 35 to 57 inclusive of the advertising pages of the issue above referred to will be found a unique example of the clever commercial instinct. Anyone who has bought a page of advertising in the *News-Record* knows what it costs. Yet here are twenty-three full pages of reading matter regarding the forthcoming Annual Convention and Road Show of the American Road Builders Association, ostensibly donated by various advertisers. If this reading matter is of value to the reader, is it service so to hide it in the advertising pages? And if not of value to the reader, why mulct the advertiser? Does not the public ultimately pay all such advertising bills? The waste involved in modern advertising is tremendous, but the commercialized journals naturally foster it by every possible device.

Rather than adopting the deceitful slogans of business, engineers should attempt to transform business and industry so that control will center not in the hands of those who, if they see sufficient profit in an enterprise will give engineers and workers a chance to work, but in the hands of those who actually manage and do the work. Professional ethics must be extended into the realm of business and industry, rather than permit the doubtful ethics of "business is business" to gain entrance into professional fields.

J. P. J. WILLIAMS.

Flushing, N. Y., Dec. 18.

[Years of experience have convinced us that the advertising pages of *Engineering News-Record* are read quite as carefully as are the editorial pages, and this letter is but another indication that our conviction is well founded. In the instance which appears to have disturbed our correspondent, the manufacturers of equipment to be shown at the Road Show adjudged it sound business to lay aside for the moment their individual stories and to encourage attendance at the show by joint effort, believing that a successful show will make for the prosperity of the whole industry, including themselves.—EDITOR.]

Why Not Abandon the Word "Engineer"?

Sir—If it were not for the editorial approval and sympathy, A. W. Bedell's letter of Dec. 16 would attract no more than a passing interest. Why single out "sales engineer" for protest, any more than "valuation engineer," "designing engineer" or any of the other engineer titles.

We, of course, all know the cigar salesman who changes his line to electric light bulbs and immediately becomes a sales engineer, but the same thing happens in any other classification; and as a rule, the successful sales engineer must have engineering ability, if not as deep, certainly as broad, as the engineer with whom he endeavors to do business. Outside of the universities, and technical schools, the sales engineer, with his data and catalogs, is the largest quick educator of engineers that we have today.

Since the word "engineer" is the cause of so much discussion and frequently irritation, why not abandon the word altogether, and each man label himself according to the work he does; for example, bridge designer, valuator, constructor, salesman, etc.?

Scranton, Jan. 4. WILLIAM L. ACKER.

Curbs for Concrete Roads

Sir—Some remarks appear warranted on the advisability and in many cases the urgent necessity of flanking concrete road slabs with curbs or wheelguards. The practice of building reinforced concrete highways without curbing is very general and the objections to this practice may be stated as follows:

The chauffeur or the driver—for it is the automobile and motor truck which are the governing factors in modern highway construction—will carefully avoid the outer, unprotected edge of the slab and 18 or 24 in. of its available width on each side may reasonably be assumed to be lost. An 18-ft. concrete roadway, for instance, will thus be practically reduced to a width of 14 or 15 ft. The impress of the tires will show this tendency at a glance. With highways of moderate width, say of 30 or 40 ft., this more or less instinctive precaution on the part of the driver is a valuable safeguard, but it only reduces, does not do away with the great danger from what may be called derailments: the getting off of the wheels from the safe, even surface of the slag to the waterworn, sloping earth or macadam outer portion of the highway and toward the edge of the slope or trench.

In the article entitled "Highway Design, Maintenance and Finance," *Engineering News-Record*, Nov. 30, 1922, p. 942, the diminishing strength of the highway slab toward its edges is referred to and an increasing thickness of the concrete with heavier reinforcement is suggested as a remedy. That the roadway slab, in fact any reinforced concrete slab free along two edges offers less resistance to loading toward its edges is well known and can be explained through the lack of lateral adhesion between the different sections of the concrete, but in our case the fact that the outer portion of the slab rests on a less even or reliable foundation, owing to settling or washouts, is a more obvious cause. If we try to overcome this difficulty by gradually strengthening the slab toward the outside, we are left almost without guidance, inasmuch as the thickness of the concrete and the amount of reinforcement in a highway slab cannot be ascertained by calculations owing to the uncertainty of resistance from a supporting coil. Just as the railroad engineer chooses a certain section of weight of rail, not because calculations based on the moment of resistance, shear, etc., give such results, but because experience tells him so, so the highway engineer has likewise to rely solely on his judgment and experience.

The utter hopelessness of any attempt to obtain help from computations in proportioning a highway slab cannot be more strongly expressed than in the above mentioned article itself where even the location and direction of the reinforcing steel are left open questions.

Why not then, we may be justified in asking, instead of groping in the dark, give to all our highway slabs on each side the benefit of a substantial curb or wheelguard which is bound to act as an efficient longitudinal girder supporting the relatively weaker side of the slab? Such curbing will give the engineer a chance to work out an efficient drainage system for the roadway; it will, besides, as stated above, increase the available width of concrete wearing surface and, which is more important still, add greatly to the safety of the traffic.

St. Louis, Mo. CARL GAYLER.
Dec. 23, 1922.

Economical Highway Construction—A Query

Sir—In reading two articles that have appeared in *Engineering News-Record* recently one cannot fail to be impressed with the wide differences of opinion of the two authors as to the best method of reaching a common end, "economical highway construction."

In your issue of Dec. 7, 1922, p. 971, Geo. F. Syme, Senior Highway Engineer, North Carolina State Highway Commission, takes more or less credit for his commission, because they can put a highway locating party in the field, consisting of seven or more men, three of whom are or should be engineers, keep them there one month, pay their expenses, and the additional expense of such axemen as are needed for the work, and have them locate 9.7 miles of highway at a total cost of $892.40. Apparently good management?

In your issue of Dec. 14, 1922, p. 1030, A. R. Hirst, State Highway Engineer, of Wisconsin, muses on the "fundamentals of highway department organization." Speaking of the personnel Mr. Hirst opines that the State Highway Departments need "young men of education, of promise, of courage—men who really belong." Speaking of salaries Mr. Hirst declares, "the only way to insure these is to pay salaries adequate to the work." Apparently good logic?

The writer unfortunately, or fortunately, belongs to the great class of "been theres." He can almost see the North Carolina field parties working and slaving as only men interested in their work can slave, to hold down the "cost per mile" of the survey, and after several years of work with no reward save that always to be respected reward "well done thou good and faithful servant," they enter another field where it is, at least, possible to lay aside something for the inevitable rainy day.

I wonder which of the ideas will produce the most economical highway construction.

L. W. MASBURN.
Chief Engineer, Southern Engineering Co.
Clarksdale, Miss.
Dec. 22, 1922.

Relative Merits of Cast-Iron and Steel Pipe at Ogden, Utah

Sir—In C. E. Painter's letter published in *Engineering News-Record* of Sept. 28, 1922, p. 533, attention is called to Ogden, Utah, buying a small quantity of cast-iron pipe, whereas, steel pipe had formerly been used exclusively. Mr. Painter, I understand, is a representative in Salt Lake and surrounding territory, including Ogden, of one of the cast-iron pipe foundries.

In the Ogden *Standard-Examiner* of Sept. 1, 1922, the mayor of Ogden is quoted as follows: "One of the large determining factors in the selection of cast-iron pipe was that it affords an opportunity for comparative tests." Ogden has had excellent service from the Matheson joint steel pipe installed, much of the system being over thirty years old; and there is considerable doubt in the minds of many in Ogden and surrounding territory as to the wisdom of paying a large bonus for cast-iron pipe. The cast-iron line cost $10,434 more than galvanized and asphalted M. J. pipe, the lowest bid for the latter being $38,767.

The $10,434 which could have been saved represents 27 per cent of the cost of a new line of M. J. pipe at present costs. If this saving were capitalized and put at compound interest at the 6 per cent rate of Ogden bonds, it would amount to $41,736 in 23 years, or an amount that would replace the line entirely at that time. However, experience has demonstrated that Matheson joint pipe in Ogden will last much longer than 23 years; in fact very much of the system has already lasted 33 years with excellent prospects of its lasting that much longer, except possibly such portions as may be in soil impregnated with alkali. It would be much more economical to the city to replace the portions of lines failing because of alkali, than to go to the greater expense of cast-iron pipe whose life under such circumstances is problematical. On the other hand, Matheson joint pipe can be protected against such corrosion by means now available.

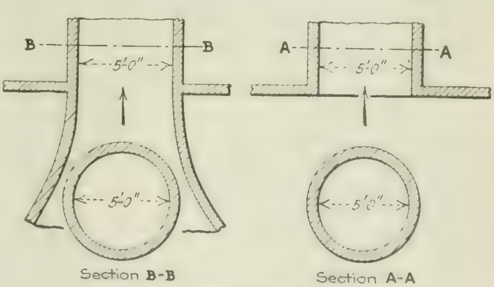
Matheson joint pipe is being used to a much greater extent, as it has been improved, and it is now regarded as a standard material by many engineers of the West. It is laid under pavement in many cities and towns, and is regarded by many as being preferable to cast iron because of its relative freedom from breakage, general reliability and greater carrying capacity.

The writer was city engineer of Ogden from 1916 to 1921, and is much interested in this subject, both from a professional standpoint and as a private citizen.

Ogden, Jan. 6. JOSEPH M. TRACY.

Relative Discharges Through Plane and Bell-Mouth Reservoir Outlets

Sir—The accompanying sketches show two reservoir outlets identical in every respect of design and operating conditions except that one extends into the reservoir in an enlarged bell-mouth shape. It is assumed that each opening is entirely submerged and has the same get away. With the same head would the flow of water through each form of outlet be the same? If not, which would discharge the most and what could be expected as the maximum variation of the constants used in computing the flow through the plane and the bell-mouth shaped opening?



Section B-B Section A-A

TWO FORMS OF RESERVOIR OUTLET

S. H. CHAPMAN,
Shoshone, Dec. 15. Watermaster, Idaho Districts

Permanence Antagonistic to Progress

Sir—In your issue of Dec. 28 there is an editorial dealing with "Building for Permanence." The writer cannot find himself in accord with the sentiments expressed therein. Permanence and progress are antagonistic terms. Permanence is stagnation.

Especially in the matter of dwellings does this hold true. New conveniences and comforts in living are being developed constantly, and it is vastly easier to incorporate these in new construction than to alter old construction to accommodate them, and the more permanent the construction the more difficult the task of improvement.

The present practice may entail some waste but this is the law of progress. We are constantly rebuilding our physical structures, and let us hope our mental structures as well.

J. B. CHESSINGTON.

Thermopolis, Wyo., Jan. 2.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Road Builders Hold Largest Convention in History

Practically Every State Represented—Many Delegates from Foreign Countries

OVER 500 delegates participated in the long program of six sessions and thirty technical papers presented at the annual convention of the American Road Builders' Association in Chicago, Jan. 16-19, 1923. This attendance—the largest, it is believed, at any of the full score of conventions held by the association—and the high quality of the papers marked the proceedings as notable among highway engineering conferences. In conjunction with the road machinery and materials exhibition, which is reviewed elsewhere in these columns, the professional papers and discussions constituted an educational effort of notable character.

It is as a source of education that one must look to the convention for its signficance. It was evident that the delegates came to listen and learn and not to contribute opinion or information. There was very little discussion of any of the papers. This fact and the fact that abstracts of the papers are published in this issue or will be published in future issues, reduces any report of the proceedings to short space. It is possible however, while lacking the discussions from the floor and the business transactions which usually make up the news of the conventions, to note salient lines of interest in highway activity which the delegates were most concerned in pursuing.

Six sessions of the convention or, perhaps more correctly, extending the sessions into the fourth day, proved questionable. Despite subjects of wide interest and their excellent presentation, attendance was not maintained at the closing session. The third day of convention was the end as far as the attendance and interest of the great majority of the delegates were concerned. This lent an atmosphere of indifference to the wind-up of the technical proceedings which was not warranted by lack of value in the papers themselves and which was partly overcome only by the efforts of the chairman to arouse discussion from the floor.

Besides the news report of the Road Builders' convention on this page, abstracts of a number of papers read will be found on pp. 153-157, inclusive. These papers relate to the most recent practice in all branches of highway engineering, and were read at the convention by both highway engineers and executives. In addition to the five pages of abstracts a comprehensive report on pp. 184, 185 and 187 describes equipment and materials exhibited by manufacturers at the Road Congress.

Each session was devoted to a different general phase of highway development: At the first session general policies, then design and research, construction, maintenance, traffic and finance. A part only of one session was devoted to the election of a nominating committee and the adoption of resolutions, since the annual business meeting of the association is held at another date and separately from the technical convention and the road show.

Outstanding interest was shown in the research records which were presented from the Bates Road, by Clifford Older, from the Pittsburg Road, by Lloyd Aldrich and from the Arlington test farm, by A. T. Goldbeck. Discussion, beyond mere query for further explanation, was confined to comment on the Bates Road tests by Prevost Hubbard who discounted the significance of the tests in indicating comparative merits of types of pavement. The same doubt was voiced by Will Blair, commenting also on the Bates Road records.

At the construction session the three papers on haulage—industrial railway by A. J. Parrish, heavy truck by Charles H. Fry and light truck by A. E. Horst—drew the largest attendance of any session. Largely a statement of conclusions and tabulations of statistics based on experience, these papers did not lend themselves to impromptu discussion and they will be published condensed in a succeeding issue. A paper by H. E. Kuelling on local gravel pit equipment and operation, outlined methods of field location, equipment, operation and costs as determined by actual experience in Wisconsin. The essential facts of this paper will be published in a future issue. Delays in highway construction by H. K. Davis and B. H. Piepmeier and Winter Construction by J. H. Mullen were lost-time questions excellently handled in three papers.

MAINTENANCE DISCUSSED

Maintenance was the subject of five papers by six authors, both W. A. Van Duzer and A. W. Muir writing on macadam road salvage and maintenance. Maintenance organization was discussed by Frank Page who recited the practice in North Carolina by which in a few months a state system was put under intensive maintenance. Results of five years patrol maintenance in Wisconsin analyzed and summarized by J. T. Donaghey were made the proof of perhaps the strongest argument which has been made for state maintenance through county organizations. An extensive abstract of the paper will be published. In the matter of maintenance detail, L. H. Nielsen spoke on gravel-roads and W. H. Root on earth-road maintenance.

In the closing sessions on traffic and finance, A. R. Hirst spoke on the development of tourist traffic, the methods of nurturing it and its valuation as a factor in highway development. J. N. Mackall and Harry Meixell, Jr., presented different phases of the traffic situation in papers on motor vehicle legislation. Speaking as a banker and a former superintendent of roads of Illinois, S. E. Bradt presented an encouraging paper on "Have Large Expenditures Changed the Public Attitude Toward Highway Development?" His conclusion was that generally there was no continued reaction to be feared.

At the single part-session devoted to business, a number of resolutions pertaining to the convention proceedings and to minor matters were passed and in particular a resolution urging Congress to give the authorization required for the United States to become a member of the Permanent Association of International Road Congresses.

Moffat Tunnel Suit to Go to Supreme Court

Opponents of the Moffat Tunnel project in Colorado have announced their intention to carry the case to the U. S. Supreme Court following the denial of the petition for a rehearing of the case by the State Supreme Court which rendered a decision favorable to the project.

In commenting on the delay the *Official Bulletin* of the Colorado Engineering Society indicates that the period of delay may be used advantageously to draw and execute contracts with those who may use the tunnel since the law provides that the Board may require any of such contracts to be entered into before the beginning of the construction or expenditure of funds if in its judgment it is deemed expedient. The engineers hold that the act of entering into such contracts would enlist the confidence of the people as to the sincerity of the railroad interests. Further they ask if there is any reason why the city of Denver should not arrange definitely to use the tunnel to bring water it needs from the Western Slope.

Commission-Manager Administration Effective at Astoria, Ore.

The commission-manager form of government went into effect at Astoria, Ore., on Jan. 1, with O. A. Kratz as city manager. All the administrative officers appointed by Mr. Kratz were confirmed by the commission, including the following: city engineer, Robert A. McClanathan; superintendent of waterworks, Albert Johnston; superintendent of streets, J. McAllister.

Railway Construction Authorized

The Florida East Coast R.R. has recently secured authorization from the Interstate Commerce Commission for the construction during the next five years of a 133-mile line between Okeechobee and Lemon City, a suburb of Miami, Fla. The cost of the project is estimated at close to $5,000,000.

New Administration Under Way in Am. Soc. C. E.

The new Board of Direction elected at the annual meeting of the American Society of Civil Engineers as noted in these columns last week, held its first meeting immediately following the business session of the society at New York last week. The new executive committee will consist of C. F. Loweth, Robert Ridgway, George S. Webster, Frank E. Winsor and Clifford M. Holland. The committee on technical activities and publications comprises Richard L. Humphrey, C. E. Grunsky, Joseph J. Yates, John P. Hogan and John N. Chester.

The annual convention for 1923 is to be held at Chicago sometime during June or July and the technical session probably will be devoted to a discussion of railroad terminal problems. The fall meeting will be held somewhere in District 5. Invitations have been received from Washington, Norfolk and Richmond and the matter has been referred to the committee on technical activities and publication, with power. As already announced, the spring meeting will be held at New Orleans on April 18, 19 and 20.

The committees appointed by the president to prepare the arguments that will accompany the referendum ballot as to whether the society shall join the Federated American Engineering Societies are: For the favorable arguments: R. L. Humphrey, G. G. Anderson and A. P. Davis; for the opposition arguments: C. M. Holland, F. E. Winsor and W. L. Huber.

S. T. Wellman Memorial Meeting

On the evening of Jan. 9 the Cleveland Engineering Society and affiliated technical societies held a meeting in memory of the late Samuel T. Wellman, one of the pioneers of the steel industry. The principal addresses were made by J. H. Stratton, Ambrose Swasey and John McGeorge. A number of other men long connected with Mr. Wellman's technical activities gave reminiscences of his career as steel manufacturer, inventor, and builder of industrial machinery. Special tribute was paid to his services to the world in making the openhearth steel furnace a practical success in the United States and in his invention of the charging machine for openhearth furnaces.

War Department Approves Chicago-Calumet Harbor

A permit for the construction of a municipal harbor in Lake Calumet has been granted to the city of Chicago by the Secretary of War. The plans, as outlined in *Engineering News-Record*, April 21 and Aug. 4, 1921, p. 673 and 209, provide for a broad basin with 21 ft. of water and having slips on either side. Filling the adjacent low-land and marshes will provide about 1,450 acres for terminal and industrial development. The state legislature has already granted the bed of the lake to the city and the U. S. government has dredged a deep channel in the Calumet River as an outlet to Lake Michigan. Dredging and dock construction is estimated to cost $3,500,000, exclusive of pier sheds and terminal facilities to be provided.

Am. Soc. C. E. Resolution Asks Speedy Trial of Alleged War Fraud Defendants

The full text of the resolution passed at the Jan. 17 session of the Am. Soc. C. E. expressing concern over indictments of some of its members for alleged war construction fraud follows:

Whereas, the Board of Direction of the Am. Soc. C. E. has been greatly shocked by the indictment of several of its members and the institution of civil suits to recover millions of dollars from others for alleged war frauds, especially in view of the stigma and other immediate serious consequences under which they are placed by the wide publicity given to these charges, and

Whereas, these and many other members of our society responded to the call of their government and rendered invaluable service throughout the Great War, and

Whereas, the Constitution of the United States guarantees to every accused citizen a speedy trial; therefore

Be it resolved, that this Board believes that every instinct of justice demands that these charges be immediately tried in order that the guilty may be punished and the innocent may be freed of the serious accusations which have been made against them; and

Be it further resolved, that copies of this preamble and this resolution be sent to the President and attorney-general of the United States and to the presiding officers of the Senate and House of Representatives.

Handling of Coal Traffic Reveals Railroad Deficiencies

Washington Correspondence

Railroad performance in the handling of coal since the close of the strike has been studied and analyzed more carefully than ever before. The conclusions that are being reached do not reflect credit on the railroads. When the figures are all compiled, it is believed they will prove conclusively that railroading efficiency is very low.

These figures will show also, it is believed, that in addition to the poor handling of cars the principal causes of transportation deficiencies will be found in the lack of motive power and in the inadequacy of terminal facilities. The railroads have enough open-top cars, actually engaged in the transportation of coal, to move the entire requirements of the country if each car will average thirteen trips a year. It is believed that even a better movement is within the range of good management. At present, the average railroad car in service is twenty days under-load and 2.2 days in movement, but it is earning revenue during only 1.5 days.

This year's careful scrutiny of transportation conditions will develop, it is believed, that bottle-neck and expensive terminals must give way to expanded facilities and the sale of high-priced, close-in terminals.

News Brevities

The third annual New Jersey State highway convention is to be held at the Stacy-Trent Hotel, Trenton, Feb. 14-17. In addition to technical papers and discussions there will be a highway industries exhibit.

The Northern Pacific Railway Co. has announced plans for the purchase of about $17,000,000 worth of new equipment to be delivered largely during the current year. The order consists of 5,280 new freight and express cars and 49 locomotives.

Two railroad systems with terminals in Chicago have announced proposals to expend an additional $22,000,000 for new equipment. The Illinois Central has asked bids on equipment aggregating $15,000,000, consisting of 50 locomotives and 4,670 cars. The Chicago & Northwestern has announced an appropriation of $7,000,000 for 3,000 additional cars to be delivered early in the spring.

To advise the directors of the Pueblo Flood Control District three consultants have been employed: P. D. Fitzpatrick, chief engineer, Vermont Central Ry.; Prof. S. M. Woodward, University of Iowa; and Prof. L. G. Carpenter, consulting engineer, Denver. The directors must adopt an official plan, which is being worked out by the Dayton-Morgan Engineering Co., and a period allowed for filing objections before arranging for finances or starting construction.

Col. Henry S. Graves, dean of the Yale School of Forestry, and chief forester of the United States from 1910 to 1920, has been elected president of the American Forestry Association. Dean Graves graduated from Yale in 1892. After graduate study of forestry at Harvard and the University of Munich he was associated with Gifford Pinchot, consulting forester. When Mr. Pinchot became chief forester in July, 1898, Mr. Graves became his first assistant. From 1900 to 1910 he was director of the Yale Forestry School.

Health lectures and demonstrations for officers and nurses given for five years past under the supervision of the New York State Department of Health are to be supplemented this year by short courses for sanitary inspectors and operators of water-works and sewage-works. The course for sanitary inspectors will be given on Feb. 5, 12, and 13, and for operators of water-works and sewage-works on Feb. 19 and 20. Both courses will be given at the Albany Medical College, located in Albany, N. Y.

The City of Detroit recently sold $20,163,000 of bonds for public improvements. Of these, $7,945,000 bear interest at 4¼ and $12,218,000 at 4½ per cent. The bonds sold at a premium of $61,900, making an average yield rate of 100.307. The bonds are to be used as follows: Water supply, $5,230,000; street railway, $3,280,000; sewers, $2,665,000; Belle Isle bridge, $2,100,000; lighting, $1,368,000; miscellaneous, $5,520,000.

Los Angeles Permitted to Empty Sewage in Ocean

Screens, Outfall 5,000 Ft. Long and Other Limitations Set By State Board of Health

The California State Board of Health has granted a permit to the City of Los Angeles for the disposal of sewage effluent in Santa Monica Bay provided:

(1) That within eight months all sewage reaching the ocean shall first be passed through screens with slots not more than $\frac{1}{16}$ in. wide and that within two years the discharge shall be from the outer end of an outfall extending at least 5,000 ft. from low-water shore line on the bay bottom.

(2) That disposal shall be so conducted as not to cause anything recognizable as of sewage origin on adjoining beaches.

(3) That the quality of water at adjoining beaches which, in the absence of Los Angeles sewage would be safe and suitable for public bathing purposes, shall not be brought below such bacterial standards for salt water bathing beaches as may be established by the State Board of Health.

(4) That no objectionable odors shall be caused at adjoining beaches.

(5) That the operation of the sewage works and the disposal of screenings shall not be a menace to health.

And (6) that additional treatment and changes or improvements in the outfall shall be made when required by the State Board of Health.

The restrictions applying to adjoining beaches do not apply to Hyperion Beach owned by the city and where the outfall enters the ocean.

Great Falls Power Unit Operates

The first power unit of the Manitoba Power Co.'s 56,000-hp. development at Great Falls has gone into operation and is working satisfactorily, relieving the power shortage experienced by the Winnipeg Electric Railway Co., and furnishing a surplus for sale.

Los Angeles Union Terminal Order Upset by Supreme Court

The California State Supreme Court recently annulled the order of the California State Railroad Commission which directed the principal railways entering Los Angeles to join in the construction of a union passenger terminal at what is known as the Plaza site. Announcement of final action by the Railroad Commission on this plan was published in *Engineering News-Record*, Dec. 22, 1922, p. 1039.

Last January the railroads instituted proceedings before the Supreme Court to annul the commission's order, contending that the commission had exceeded its jurisdiction in ordering a union terminal depot and that only the Interstate Commerce Commission had the authority to direct such activities by railroads engaged in interstate commerce. In the Dec. 19 decision the court upheld this contention and ruled that "We arrive at the conclusion that full power and authority over the matter of union terminal depot facilities of the railroads largely engaged in interstate commerce have been vested in the Interstate Commerce Commission and that the state commission has been divested of this power."

Grade crossing accidents were a potent factor in the demand for a union terminal and consolidation of rail facilities in Los Angeles included plans for the elimination of all steam-line grade crossings in the city. In case the court's decision applies only to the terminal itself, the city has announced that it will endeavor to have the grade separation program carried out.

The State Supreme Court is the final tribunal in the interpretation of state constitutional rights and if the decision, which has not yet been given out in full, is based on constitutional interpretation, no appeal can be made. The State Railroad Commission has announced that it will apply to the Supreme Court for a rehearing of the case and in the event that the decision is final, will place the matter before the Interstate Commerce Commission in an endeavor to accomplish the desired results.

92-Foot Poles Hauled 20 Miles on Two Motor Trucks

These poles were used by the Pacific Gas and Electric Co. on the Pit River Power Project. Two of these red fir poles were set up over the turbine pit at Pit River Power Plant No. 1 and used in erecting machinery. Thirty ton sections of the scroll case units were lifted into place and assembled by this equipment. The grades over which these poles were hauled by the motor trucks were estimated at about 10 per cent. The trucks had to work on about a 100-ft. radius in making turns The head driver drove the truck so as to clear the front end of the pole and the rear driver kept the rear end clear. The front driver signalled to the rear driver by means of a loud whistle. There was a false bolster on each truck, with a chain wrap and a screw jack over the pole to tighten the chain. The chain was attached to the bolster by a pin. There was just enough play over the top of the pole to enable the truck to swing on the bolster when rounding curves. Bolsters were securely bolted.

Ford Buys Plant Site Near Dam on Mississippi at St. Paul

The Ford Motor Company has purchased 167 acres of land in the southwestern part of the city of St. Paul, Minn., on the banks of the Mississippi River and has filed a petition with the Federal Power Commission for permission to develop the power now going to waste at U. S. Lock and Dam No. 1. The use of this power has been the cause of a long-drawn-out conflict between St. Paul and Minneapolis, as outlined in the *Engineering News-Record*, Dec. 28, 1922, p. 1135. The Ford company, in its petition, has agreed to pay a reasonable amount to the government for the use of that portion of the dam devoted to power purposes, estimated to be between $50,000 and $100,000 per year. It has also agreed to provide, at its own expense a modern hydro-electric experimental and testing station for the use of the University of Minnesota, and to make its shops available for the training of students in St. Paul and Minneapolis.

The Ford company has agreed to start work in the spring of this year on a plant for the distribution and assembly of its products, regardless of whether it obtains the water power. If it obtains this grant it will extend its plant at a cost of $10,000,000, for the purpose of manufacturing automobiles and farm tractors, and will employ about 14,000 men.

The Chicago, Milwaukee and St. Paul R.R. Co. has agreed to build a line from the point where its Iowa and Minnesota Division crosses the river to the Ford plant and to extend this line to a connection with an existing branch in Minneapolis, routing through trains over this new line.

The city of St. Paul is drawing the necessary ordinances to set aside an area between the new plant and the river on the south for park purposes; to obtain an extension of the trolley system to the new plant and extend the same across the river to Minneapolis; to do the necessary paving and improvements to make the plant accessible to vehicular traffic; and to vacate all streets in the area bought by Ford.

Ford proposes to build and equip a fleet of barges for the handling of raw and finished products on the Mississippi river. In that event, suitable wharves will be built south of the plant, with a tunnel connection between the two.

Dr. Brown Made Acting Director of U. S. Standards Bureau

Dr. Fay C. Brown, since the World War assistant director, has been appointed by Secretary of Commerce Hoover acting director of the U. S. Bureau of Standards. Dr. Brown was born in Washington, Ohio, in 1881 and was graduated from the University of Indiana. After graduate work at the Universities of Illinois and Chicago he took his doctor's degree at Princeton in 1908. For a time he was an instructor in physics and engineering at the University of Illinois and later joined the faculty of the University of Iowa. In 1917 he entered the military service in the Ordnance Department and was put in charge of testing and ballistic work on airplane bombs. While in the military service he attained the rank of major.

G. W. Buchholz to Leave A.G.C.

G. W. Buchholz, who for the past three years has been general secretary of the Associated General Contractors of America, will sever his connection with the association Feb. 15 to become eastern manager of the W. M. Sutherland Building & Contracting Co. of St. Louis. However, Mr. Buchholz' offices will be maintained in the Munsey Building, Washington, D. C.

Mr. Buchholz joined the A.G.C. Feb. 10, 1919, when headquarters of the association were in Chicago. During his three years' connection with the association he traveled and met with contractors in every state in the country and has gained a wide friendship.

Grand Trunk Agrees with City on Detroit Grade Separation

The Grand Trunk Ry. has signed an agreement with the city of Detroit providing for grade separation on Dequindre St. from Jefferson Ave. north to Erskine St., on the basis of the city's plan for depression of the tracks. The total cost is estimated at approximately $4,000,000. According to the agreement, the city will bear 25 per cent of the physical cost of making the depression and the railroad company 75 per cent. The city is to pay also the total cost of damages awarded to the abutting property owners.

The depression will vary from one foot at Jefferson Ave. to 20 ft. at Erskine St. in a distance of approximately 1½ miles. Twenty-two city blocks and six street railway lines are crossed. It is planned to begin work within a few months at Jefferson Ave. and it is agreed to have the first sixteen crossings made by Dec. 31, 1929, and the remaining separation program to Erskine St. completed by Dec. 31, 1933.

The agreement ends a long controversy between the city and the company. The company's plan favored elevation of the tracks and numerous hearings were held before the question was settled. The Michigan Public Utilities Commission, before which the final hearing was held, approved the city's plan.

John W. Reid, present city engineer of Detroit, was for several years grade separation engineer and worked out the plan which was finally agreed to.

Sixteenth St. Bridge in Pittsburgh Opened to Foot Traffic

Virtual completion of the new Sixteenth St. bridge across the Allegheny River in Pittsburgh was indicated on Jan. 1 when the footwalks across the bridge were opened to pedestrian traffic and a private ferry which had operated at the crossing since the old structure burned in 1920 was discontinued. Pavement is yet to be laid on the buckle-plate floor of the roadway, which work is not likely to be completed until summer.

The bridge comprises three steel arch-truss spans of the braced-rib type with tie in the plane of the floor. The spans are 229, 437, and 229 ft. long.

New Jersey Road Commissioners Removed by Governor

The New Jersey State Highway Commission has been removed by Governor George S. Silzer who states that he will not immediately appoint a new commission. In the message to the state legislature announcing his action, the governor asked that legislation be enacted providing for a commission of three instead of eight members.

Bridge Across Golden Gate Again Proposed

Plans have again been brought forward for a bridge across the Golden Gate at the entrance to San Francisco Bay, this time by J. B. Strauss of Chicago, who proposes a toll bridge to be erected by private enterprise at a cost of $17,500,000. The plans call for a combination cantilever and suspension span, 4,000 ft. long, of which 2,200 ft. would be a cable suspension section slung from the ends of two 900-ft. cantilever arms. The towers at either end of the main span would be 1,000 ft. high and there would be two shore spans, each 1,320 ft. long. A roadway 90 ft. wide is proposed with provision for two interurban tracks to carry 30-ton cars, two highways and two sidewalks. The clearance between the bridge and water level would be 200 ft. At this point the channel is about 300 ft. deep.

The San Francisco Chamber of Commerce has endorsed the project and the well known firm of McDonnell & Co., stock and bond brokers, has offered to undertake the raising of the $17,500,000 as a matter of public service without profit to the firm.

Morrow Tells of Panama Canal Maintenance and Operation

At a regular meeting of the New York Section of the American Society of Civil Engineers on Jan. 10, Governor Jay J. Morrow of the Panama Canal Zone described in detail the administration, maintenance and operation of the canal. His address, which was illustrated by lantern slides and motion pictures, was heard by a large audience which included many representatives of other local engineering societies, present as the guests of the section.

Governor Morrow touched but lightly the problems of construction, but dwelt upon the handling of ships, the canal terminals and their transfer and overhauling facilities, the water supply of the summit level and the plans to insure its adequacy, the struggles against the slides and the government and business administration of the canal zone. He referred briefly also to the perennial lock vs. sea-level controversy and pointed out the wisdom of the decision that gave us the lock canal.

In connection with the finances of operation Governor Morrow declared that it is now a fact that all the expenses for operation, maintenance and administration are about one-half the sum the canal turns into the Treasury, and that the canal nearly pays interest and amortization on the investment. Traffic has increased from 4,000,000 net tons in 1915 to more than 11,000,000 net tons in 1922. It is estimated that during 1923 it will almost certainly exceed 13,000,000 tons.

A. St. Laurent Elected President of Canadian Engineers

A. St. Laurent, who was appointed a year ago chief engineer of the Department of Public Works of Canada, was elected president of the Engineering Institute of Canada at the annual business meeting held in Montreal Jan. 23. Mr. St. Laurent has been in the Department of Public Works for the past 34 years, having been first appointed in 1888. He became assistant chief engineer of the Department in 1906 and two years later was made assistant deputy minister, which office he continued to hold until February, 1922.

Mr. St. Laurent was born in Rimouski, Province of Quebec, in 1859, where he received his early education. He was graduated from Montreal University. In 1885-6 he was engaged on railway location, construction bridge and trestle work in eastern Quebec. In 1888 he entered the service of the Public Works Department of Canada at Ottawa as principal draftsman and as principal assistant on harbor surveys, etc. In 1891 he was made assistant engineer in the Winnipeg office which was in charge of the departmental operations in northwestern Ontario, Manitoba, and the Northwest Territory. In 1898 he was transferred back to headquarters at Ottawa as principal assistant engineer in charge of designs and contract plans for a lock and dam at St. Andrews Rapids on the Red River. Other work over which he had supervision included a traffic bridge across the North Saskatchewan River at Edmonton, the lengthening of the dry dock at Levis, Quebec, and alterations to the dry dock at Kingston, Ont. In 1902 he was in charge of the construction of the Laurier bridge at Ottawa and of grain elevator No. 1 at Montreal Harbor. During that period he was acting as assistant chief engineer and in charge of the chief engineer's office on several occasions.

N. Y. Merchants' Association Completes Transit Study

Following an exhaustive analysis of the plans proposed by the New York Transit Commission and by Mayor Hylan for the extension of the New York transit system, a committee of the Merchants' Association of that city has reported strongly in favor of the Transit Commission's plan. The committee is headed by Col. F. A. Molitor and includes also Theo. Beran, Jules R. Breuchaud, William C. Demorest, Jacob M. Gidding, J. K. Robinson, Jr., and Walter Stabler.

The report, which has been approved by the board of directors of the association, recommends that the organization go on record in favor of the principles embodied in the Transit Commission's proposal and that, whether or not the new state administration may deem it wise to change the control of rapid transit matters, the experience and judgment involved in the commission's plan be preserved and utilized in the solution of the problem.

Extensive Flood Damage in Oregon

Floods in Oregon during the first week in January seriously damaged bridges and highways. The Willamette River reached the highest stage in 33 years, and because of drift accumulations against piers both the Burnside and the Morrison Street bridges across the Willamette in Portland were closed. The Morrison Street bridge was reopened after tugs had cleared log jams lodged against the piers, but Burnside bridge will remain closed pending inspection by divers to ascertain whether scouring occurred around piers.

Traffic over several main and branch line railroad routes throughout the northwest had to be diverted or discontinued. The Santiam River swept away bridge approaches and several hundred feet of Southern Pacific main line and Oregon Electric Ry. tracks. An acute water shortage at The Dalles was caused by a break in the principal water supply line. Oregon City's water supply was also cut off, with only two days' supply in the distributing reservoirs.

Extensive undermining of pavement occurred throughout western Oregon. Scores of small bridges have been damaged or swept away entirely, in some cases the piers also being washed out. Inconvenience caused by curtailment of motor stage service emphasizes the extent to which this means of transportation has become essential.

Damage in Washington is heavy in some quarters but in general it is much less serious than in Oregon. Olympia as well as other Washington cities were for a time isolated by breaks in power, telegraph and telephone lines.

Steamer to Pay for Wrecking Bridge Over Hackensack

Destruction of the Hackensack River drawbridge on the Lincoln Highway, near Jersey City, on June 22 (reported in *Engineering News-Record*, June 29, p. 1095) caused a loss to the state of $126,472, according to an estimate just completed by a board reporting to the State Highway Commission of New Jersey. It is expected that $100,000, representing about 80 per cent of the loss, will be charged to the company owning the steamer which wrecked the bridge, as settlement for the damage caused.

No Abnormal Unemployment

Washington Correspondence

There is no conflict between recent statements made by Secretary of Commerce Hoover and Secretary of Labor Davis as to unemployment. Secretary Hoover explains that he did not say that there is no unemployment. He did say that there is no unemployment problem. Secretary Davis at about the same time declared that there are 1,500,000 wage earners in the country who are "not attached to any payroll."

At Secretary Davis' office it is explained that this figure represents the normal unemployment. It is the irreducible minimum, he believes. There always is a floating pool of unemployed, due to the seasonal character of many industries and the fact that shifts from one type of employment to the other do not coincide precisely.

Western Society Convocation to Be Held February 1

The Western Society of Engineers will hold its second midwinter convocation on progress of engineering enterprises in Chicago, February 1. Speakers on sewers and sewage are: George C. D. Lenth, Harrison P. Eddy, and Langdon Pearse; on water supply, Dabney H. Maury, Louis R. Howson, and Myron B. Reynolds; on fire protection, Clarence Goldsmith; on central station development, past and future, Samuel Insull.

Engineering Societies

Calendar

Annual Meetings

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION, New York; Annual Convention, Cleveland, Feb. 19-20.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 13-15.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

The Engineers Club of Northern Minnesota at its annual meeting held at Hibbing on Jan. 8, elected the following officers: Edward Loye, engineer with Oliver Iron Mining Co., president; L. C. Moore and C. J. Galvin, both of Hibbing, vice-president and secretary-treasurer respectively.

The Buffalo Section, American Society of Civil Engineers, at the bi-monthly meeting on Jan. 16 was addressed by Major Geo. H. Norton, city engineer of Buffalo, on Buffalo's water front and harbor improvements. Plans are now under way for a comprehensive study of Buffalo's harbor by federal, state and municipal authorities and Major Norton outlined these efforts and described the work now under construction by the city of Buffalo. Major Paul Reinecke, Corps of Engineers, U. S. A., district engineer, was a guest at this meeting.

The Colorado Engineering Council has been widening its sphere of influence by increasing its representation. The Colorado Chapter of the American Society of Heating and Ventilating Engineers and the Rocky Mountain Association of Petroleum Geologists are recent acquisitions. With the Colorado Section of the American Chemical Society, which has applied for admission, the council will consist of twelve member societies.

The Seattle Engineers Club during the holidays played Santa Claus to 85 children from the Washington Childrens' Home. This is the fourth annual affair of the kind, and included a large Christmas tree, entertainment, banquet and presents for each child. C. W. Croasdill was chairman of the Christmas committee.

Personal Notes

George P. Coleman resigned as state highway commissioner of Virginia on Jan. 18, stating that he did so in order to be free to do those things which he thought "necessary for the proper advancement of the highway interests which mean so much to the development of Virginia." Mr. Coleman had been connected with the state highway department since its organization in 1906 and since 1912 had been state highway commissioner. During that time he had laid the basis of the state's highway system, advocated and seen enacted into law much progressive highway legislation, and constructed over 7,000 miles of highways. He has been president of the Virginia Good Roads Association, president of the American Association of State Highway Officials and president of the American Road Builders' Association. He served as chairman of the committee which prepared the federal-aid highway act.

O. D. Street, lately general manager of distribution of the Western Electric Co., has been elected vice-president of McGraw-Hill Co., Inc., in executive charge of a unit of six electrical journals published by the company.

Nelson F. Pitts, junior assistant city engineer of Syracuse, N. Y., has been promoted to deputy city engineer. He succeeds **William A. Gere**, retired under the new pension law for municipal employees. **William F. Kavanaugh** will probably be named engineer in charge of paving to succeed Mr. Pitts.

T. D. Claiborne, of Baltimore, Md., formerly with Claiborne, Johnston & Co., Inc., announces his withdrawal from that company and that with August Mencken and H. M. Gittings he has incorporated the T. D. Claiborne Co., Inc., to do a general contracting business.

James M. Cremin has been appointed for a four-year term as a member of the California State Reclamation Board, succeeding Grover C. Shannon.

F. H. Cothran, formerly division engineer of Southern Power Co., with headquarters at Charlotte, N. C., is now resident manager of the Quebec Development Co., Ltd., at St. Joseph d'Alma, P. Q., Can. This company is beginning the development of a 480,000-hp. hydro-electric development on the Saguenay River.

Edward S. Walsh, of Brooklyn, has assumed office in Albany, N. Y., as state superintendent of public works. He has appointed **James E. Doyle** of Syracuse as deputy superintendent of public works, and **Patrick J. Cawley** of Syracuse as assistant superintendent in charge of the middle division of the Barge Canal system.

Gannett, Seelye & Fleming, Inc., engineers, requiring more space, have moved their Harrisburg office from 204 Locust St. to the Caplan Bldg., 1 N. Market Square.

Weston & Ellington, architects and engineers, are opening an office in the Stroh Bldg., Detroit, Mich., for consultation on building problems. **William C. Weston**, architect, has had 24 years of experience in San Francisco, Birmingham, Ala., Chicago and Detroit. **Harold S. Ellington**, civil engineer, graduate of Armour Institute of Technology, Chicago, was formerly assistant engineer of the city engineering department of Chicago and has had 14 years' experience in construction of commercial and industrial buildings.

Harry C. Ash has been appointed executive secretary of the Duluth, Minn., city planning commission. Mr. Ash was at one time assistant city engineer of Duluth; he has been construction engineer on many projects in Michigan, Illinois, and Minnesota.

F. J. Keis has severed his connection with Norcross & Keis, Atlanta, Ga., to affiliate with Abbot, Merkt & Co., New York City.

Clyde Seavey, city manager of Sacramento, Calif., has been appointed a member of the California State Railroad Commission for a full six-year term.

Frederick L. Ford, former city engineer of New Haven, Conn., together with his brothers, Robert N. and Percy N. Ford, has incorporated the Ford Bros., Inc., with offices in New Haven. The firm will carry on a general engineering and contracting business, with a capital stock of $100,000, specializing mostly in public works contracts.

Philip Bond, of the engineering firm of Franz & Bond, Holyoke, Mass., has recently accepted the position of city engineer of Holyoke. Mr. Bond will resign from the firm which will be carried on in the future by **Fred H. Franz**.

Kenneth Moller, of Lockwood, Green & Co., engineers, Boston, was elected a director of the Boylston National Bank, Boston, at the annual meeting held last week.

Clyde W. Wood, chief engineer, South San Joaquim Irrigation District, resigned on Jan. 1 to open an office at Manteca, Calif., as engineer and contractor, specializing in irrigation and drainage engineering and general construction work. Mr. Wood has been engaged in this line of work for twelve years, of which six and one-half years have been spent with the South San Joaquin Irrigation District.

C. J. Bennett, who retires as state highway commissioner of Connecticut in July, was never employed by the Rochester Railway and Terminals Co. nor by the Terminal Railway of Buffalo as noted in these columns last week. Nor was he employed in N. Y. State Barge canal office. Most of his experience has been gained in Connecticut, where, prior to his being appointed to his present position he was superintendent of streets of the city of Hartford.

M. M. Willcox, former assistant engineer with the Pere Marquette Ry., has joined the engineering staff of the H. M. Byllesby Corp. He is stationed in Minneapolis.

Frank E. Peacock, until recently an instructor in mathematics and mechanics at the University of Minnesota, has joined the Simons Co. of Chicago, Ill., as designing engineer in paper mill engineering-construction work.

A. W. Wright, former structural engineer with the Eastern Steel Co., has become chief engineer of the Hamilton & Chambers Co., Inc., engineers, manufacturers, and contractors of New York City.

Edward M. Lynch, of Los Angeles, Calif., has been re-appointed city engineer of Taft, Calif. He will serve for a year.

Henry J. Christensen and **R. V. Woods**, construction and consulting engineers announce the opening of offices at 505 Seventeenth St., Oakland, Calif. The firm will specialize in reinforced-concrete steel and timber design and construction.

Andrew M. Jensen, formerly of the firm of **Jensen & Ross**, civil engineers of Fresno, Calif., has opened an office in the Griffith-McKenzie Building, that city, and will engage in practice for himself.

Arnold G. Chapman of Albany has been appointed deputy state engineer by State Engineer LaDu, to succeed **Roy G. Finch**. He is a graduate of Union college and entered the state service in the state engineer's department in 1905. He has held various civil service positions and was appointed deputy state engineer by John A. Bensel, holding this position until the change in administration in 1915, when State Engineer Williams appointed William B. Landreth to the position.

James R. Barber, division engineer of the Canadian Pacific Ry., Toronto terminals, during the past three years, has retired. Mr. Barber has been with the Canadian Pacific for many years, associated with the construction of the Credit Valley Ry., the Ontario & Quebec Ry., the Guelph Junction Ry., the Richelieu River bridge, double-tracking the St. Lawrence River bridge and the construction of the Sortin yard near Montreal.

H. E. Moses, chief of the water-works and sewerage section of the Pennsylvania State Department of Health for the last six years, has been appointed assistant chief engineer to the department. From 1908 to 1916 Mr. Moses was with the department as assistant engineer on water-works and sewerage. He graduated from Dickinson College in 1898 and studied at the University of Maryland and Johns Hopkins University, subsequently. From 1900 to 1908 Mr. Moses was with the Harrisburg Foundry & Machine Works as draftsman and chief checker on the Corliss type of engines. At the outbreak of the World War he was assigned on sanitary inspection work in connection with temporary National Guard camps, and during 1917 and 1918 had charge of extra cantonment work in civilian areas adjacent to Camp Colt at Gettysburg.

Thomas Smythe Scott, city engineer of Niagara Falls, Ont., has just been appointed city manager. During the early part of his professional career Mr. Scott was engaged on railroad work for the Grand Trunk Ry., later becoming associated with the Ontario Power Co. as field engineer in charge of construction work. Since 1904 Mr. Scott has been in charge of many important engineering works at Niagara Falls, Shawinigan Falls, Vancouver, and other places, as well as being assistant to the city engineer of Toronto. He was also assistant professor of civil engineering at Queen's University, Kingston.

Charles A. Burn has severed his connection with the Pennsylvania State Highway Department with which he was employed as resident engineer, and has become associated with the Dexter-Geare Corp., manufacturer of concrete products of Miami, Fla. Mr. Burn is plant superintendent.

Ray E. Behrens has been appointed county engineer of Waukesha County Wis., to succeed W. G. Caldwell who has opened up an office in Waukesha for the practice of civil engineering.

Obituary

William Zumwalt, a road contractor well known in the Island Empire, died Jan. 9 at Newport, Wash., aged 61 years. He had recently been doing state road work in the northern part of Washington.

Edwin W. Sanborn, who for ten years had been connected with the civil engineering department of the Lackawanna R.R., died Jan. 4 at Newark, N. J., of pneumonia, aged 39 years. He was a graduate of Illinois College, class of 1906, and had lived eight years in Newark.

Colonel Louis H. Knapp, until recently a consulting engineer and for 28 years superintendent and engineer of the water-works of Buffalo, N. Y., died in that city Jan. 16 aged 74 years. He built the reservoir and intake tunnels in the Niagara river and other construction connected with Buffalo waterworks.

Hon. William C. Kennedy, Canadian Minister of Railways and Canals, died in Naples, Florida, Jan. 17, aged 55 years. He was born in Ottawa and during the earlier years of his business career was largely engaged in the development of the oil and gas industry in southwestern Ontario.

Peter Stipp, building contractor, who had lived in Scranton, Pa., more than 35 years and had erected many of the city's and valley's largest churches, schools and manufacturing plants, died in that city on Dec. 27, at the age of 64, from pneumonia. Mr. Stipp's facilities for construction work included his own brick yard and two stone quarries.

Hugh Steele, vice-president of the James S. Lang Engineering Co. of Waltham, Mass., died recently in Hyde Park, Mass., at the age of 70. He was at one time construction engineer of the Boston-Providence R.R., and superintendent of grade crossings for a section of the old New England R.R. As superintendent of the South Terminal yards, Boston, he aided in the enlargement from 60 to 600 trains daily, and later he was superintendent of South Station, Boston.

John Criswell, a civil engineer of the Pennsylvania State Highway Department, was killed Jan. 11 when the automobile in which he was riding on the Lincoln Highway between Downington and Woodbine, Pa., was thrown into the ditch in a collision with a limousine which went on without stopping. Mr. Criswell and **Dave Bowman**, driver of the car, were on their way to Pughtown where they were supervising the erection of a bridge on the West Chester-Pottstown highway.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Road Show Brings Out Wide Range of Improved Construction Equipment and Materials

More Than 200 Exhibitors Fill Chicago Coliseum with Heavy Plant—Many Details of Design Changed for Better Operation

With construction equipment and materials valued at $1,500,000 occupying 79,000 sq.ft. of floor space in the Coliseum and adjoining buildings, the Good Roads Show held in Chicago Jan. 15-19, in conjunction with the convention of the American Road Builders' Association, presented to a record attendance of highway engineers, contractors, federal, state, county and city officials the products of 217 manufacturers. Embodied in the design of these machines were scores of new or improved features developed during the greatest road-building year in the nation's history.

Highway Industries Exhibitors Hold Annual Meeting

At the annual meeting of the Highway Industries Exhibitors Association held in Chicago Jan. 17 plans were discussed and a committee appointed to investigate the possibility of building, either independently or in co-operation with other organizations, a permanent structure large enough to house future road shows. This action resulted from conditions created this year by lack of space in the Coliseum and adjoining buildings to take care of the exhibitors desiring to display their products.

In his annual report President S. F. Beatty, Austin-Western Road Machinery Co., suggested that the Good Roads Show might be held during summer, at which time the spacious Municipal Pier in Chicago would be adequate for handling all demands for exhibit space. The heating of the pier for winter exhibits also was discussed. Opposition to this proposal developed on the ground that no representative attendance of highway contractors and engineers could be secured during the summer months when work is in full swing. The executive committee of the association will take under consideration the projects for a permanent building and a show during summer.

The association now has 173 active and 27 associate members, making a total of 200. This year's officers were re-elected for another term. They are: S. F. Beatty, Austin-Western Road Machinery Co., president; John B. Hittell, Asphalt Association, vice-president; C. N. Leet, Milwaukee Locomotive Co., treasurer; and H. R. Snow, Autocar Co., secretary.

The newly elected board of directors consists of the four officers previously named and H. B. Baker, Holt Manufacturing Co.; C. R. Dodge, Northwest Engineering Co.; Frank Dunn, Dunn Wire-Cut Lug Brick Co.; C. R. Ege, Portland Cement Association; H. S. Greene, Barber-Greene Co., F. G. Hudson, *Engineering News-Record;* C. F. Messinger, Chain Belt Co.; and K. N. Talbot, Koehring Co.

An executive committee, consisting of the four officers of the association and C. R. Ege, Frank Dunn and K. N. Talbot, was chosen at a later meeting.

The demand for exhibit space so far exceeded the area available that many manufacturers had to limit their displays and others could not be accommodated at all. This condition led to the passage of a resolution at the annual meeting on Jan. 17 of the Highway Industries Exhibitors Association creating a committee of seven to report on the feasibiltiy of financing and building, either independently or in co-operation with other national organizations, a permanent structure large enough to accommodate future road shows. It is significant of the growth of the highway industry that the facilities for display offered by the huge Coliseum have already been outgrown.

Trend of Design

This year's display of road building equipment offers opportunity for a few generalizations on the trend of design. Heavier machines of larger capacity than in former years are being produced. C. W. Kelly, director of exhibits, estimated the tonnage of products in this year's show at 120 per cent more than that of last year. In road-construction plant a greater degree of mobility is being secured by the use of crawler and motor truck mountings. To speed up moves of equipment within city limits rubber-tired wheels are being widely employed. Even on heavy slow-moving machines, such as cranes and elevating loaders, a range of two or more speeds is now provided instead of a single speed.

Gasoline engines as a source of power for road-building equipment have scored a big gain and tractor operation of graders, scarifiers, patrol maintenance equipment and dump wagons in trains is becoming general. For accurate measuring and batch-loading of concrete aggregate from bins into motor trucks or industrial cars, gravity-operated plants have passed the experimental stage and one of the newer developments is a device for measuring and loading cement into containers on motor trucks, thus eliminating all labor in handling sacks at the mixer.

Operation of equipment is being simplified and improved by such means as enclosed gearings, more convenient grouping of levers, heavier parts at points of greatest wear, cast-steel instead of cast-iron. New details in finishing machines permit the strike-off to operate, at different levels and subgraders now produce the new form of base for concrete pavements with thickened edges to meet the revised specifications of Illinois and other states.

In the trench-excavating field two new types of machines were introduced, one a "trench hoe," consisting of a power-shovel type boom and dipper which digs towards, instead of away from the machine, and the other an endless chain of digging buckets with a self-cleaning feature mounted on a vertical, instead of an inclined, boom.

Manufacturers making several different types of road-building equipment have made progress in standardizing parts to facilitate rapid assembly in the shops and repairs in the field. Graders are being provided with scarifier attachments and extension wings on blades. In this field, as well as that of the elevated loader, features have been introduced to adapt equipment to snow-removal work.

Road forms are being built of heavier metal, riser strips have been introduced to utilize old forms for thicker pavement slabs without discarding old forms and an entirely new type of road rail with curved top and two-part joint wedging device was shown for the first time, its feature being the complete absence of bolts, rivets or stake holes. Industrial haulage equipment, for batch boxes has been increased in capacity by the introduction of multiple-unit trucks holding as many as five batches. A great variety of traffic regulating devices in the form of illuminated signs on standards and mushroom lights for street intersections were on display.

This year the participation of the state highway departments and the U. S. Bureau of Public Roads was on a far larger scale than in any previous year. In addition to an elaborate display by the federal government, occupying 4,000 ft. of floor space, booths were occupied by the highway departments of Illinois, Georgia, New Jersey, North Carolina and Wisconsin.

In the space available for this report it is impossible to detail the features of each piece of equipment exhibited by each manufacturer. Many of the machines have been standardized by long periods of successful operation and their design is well known to the road-building field. The following notes, therefore, deal in the main with improvements in established types or with new types of equipment and materials.

Many Design Details Improved

Concrete Mixers—A larger charging skip, with double cables as insurance against accident, is one feature of the Koehring 32-E paver, on crawler traction, weighing 65,000 lb. On the 21-E machine the new feature is two derricks, one on either side of the charging skip, to facilitate handling of batch boxes. Double water tanks and rubber-tired wheel mountings are supplied.

The Ransom 21-E mixer has a new power discharge mechanism and the bull wheel for moving the skip has been replaced by bevel gears and vertical shaft forming an all-gear drive. On the discharge boom the former rod and turnbuckle support has been replaced by wire rope and pulleys for quicker and more accurate adjustment. Two traveling speeds of 60 and 175 feet per minute have been introduced.

The equipment of a small mixer, the

4-S, with a power loader, instead of a hand-operated device, was shown by the Chain Belt Co. On the larger crawler-mounted pavers a new safety feature is a skip guard while on the bottom of the discharge bucket a steel blade, adjustable in height, has been added to spread the dumped concrete. Another feature is the enclosure of transmission and reduction gears.

On the Smith 21-E crawler-mounted paver a new automatic measuring tank was shown. Another improvement is a worm boom swing. To facilitate railway transport on flat cars the height of the frame has been cut down 9½ in. to insure adequate clearance under all conditions of rail transport.

The Archer Iron Works has secured great mobility for its 1-bag mixer by mounting on a Ford truck chassis. A similar trend was noted in the Jaeger mixers which are being mounted on rubber tires; this company also manufactures a rubber-tired trailer mixer.

A new low-charging 7-cu.ft. mixer was shown by the Austin Machinery Corp.; its principal feature is a simplified discharge spout operated by a hand lever. On its ½-bag mixer the Marsh-Capron Co. has increased the size of the discharge opening.

The Foote Concrete Machinery Co. exhibited a low platform rubber-tired trailer for rapid transport of large paving mixers.

Grading Equipment — In the road-grader field developments took the form of a hinged double-ender attachment for extending the width of the blade on the Austin Machinery Co.'s grader and of scarifier attachments which are raised and lowered with the blade. This company also showed a road maintainer with adjustable blades on a steel frame hauled by a roller or tractor. The Russell Grader Mfg. Co. and others exhibited a variety of light patrol maintenance graders with blades 6 ft. in width. A new feature of that organization's elevating grader is a conveyor belt 42 in. wide. On the Adams leaning-wheel grader a back-sloper attachment was shown designed for building ditches and shoulders to specifications on concrete road contracts. Tractor operation is provided for in the Wehr one-man road maintainer. Both light and heavy graders were exhibited by the Good Roads Machinery Co., the smallest of these having a 5-ft. blade and the largest a 10-ft. lathe. Tractor operation of the Maney self-loading scrapers was featured by the Baker Mfg. Co. On the Avery tractor-operated power-lift road "razer" a recent improvement consists of a blade in three sections to fit any road curve or crown.

In the subgrader field a new Lakewood machine is supported on a steel frame and equipped with scarifier teeth and V-shaped blades. Additional sloping blades have been introduced on each side to form the new subgrade section required by the Illinois highway department's specifications for a paving slab with thickened edges. Another new Lakewood machine is the Graderooter; this machine, equipped with seven scarifier blades, is designed primarily for the preparation of subgrade and is operated with a tractor or roller.

Power Shovels and Cranes — Interchangeability for dragline, clamshell bucket or power-shovel work was a feature of the crane and shovel exhibits. A new attachment called the "trench hoe" was shown by the Northwest Engineering Co.; it consists of a shovel scoop mounted on a short dipper arm and operated toward, instead of away from, the machine. In its operating principle it embodies features of both the power shovel and the dragline. This equipment will dig a trench 14 ft. deep and from 27 to 48 in. wide, depending upon the width of the dipper used.

Improved three-lever control, power steer from the cab, two propelling speeds and independent operation of throttle and ram by a single lever were featured by the Bucyrus Co., in its 20-B three-quarter yard shovel; this machine has a two-part hoist and improved crawler mounting. The Brownhoist combination crane and shovel, with 40-ft. boom and 1-yd. bucket, is also equipped with two-speed drive; to secure a lighter bearing on soft ground the width of the crawler links has been increased from 15 to 19 in.

The Byers Machine Co. extended its line of cranes this year by the introduction of the Truckrane, an adaptation of a standard model with altered base designed for mounting on a standard motor truck chassis. It operates a ½-yd. bucket and its particular feature is the great mobility secured by the motor-truck mounting.

Other shovel and crane manufacturers, including Erie, Pawling & Harnischfeger, Osgood, Thew, and Fairbanks had exhibits featuring a variety of detailed improvements designed for increasing the strength and simplifying the operation of their machines.

Industrial Haulage—Four speeds, forward and reverse, are provided for in the new gear-drive Fate-Root-Heath 7-ton industrial locomotive. The same number of speeds is incorporated in a lighter model, 4-ton, manufactured by the George B. Whitcomb Co. One of its models designed for road contract haulage was exhibited by the Milwaukee Locomotive Mfg. Co. The feature of the Koppel exhibit was a muntiple-batch narrow-gage car mounted on two four-wheeled trucks carrying 5 batch boxes of 37-cu.ft. capacity each. This model represents an increase in size over former types.

(Continuel on p. 187)

THE ROAD SHOW—FROM THE BALCONY OF THE COLISEUM, CHICAGO

More Suggestions—

For Better Equipment and Repair Parts Service

IN THE Dec. 14 issue was begun a discussion of "Better Equipment Maintenance and Repair Parts Service." Its object is to show how some of the misunderstandings between maker and user of construction machinery can be avoided. This week's contribution is a recital of experiences by a manufacturer of locomotive cranes and buckets.

From a Manufacturer of Locomotive Cranes and Buckets

WHEN a locomotive crane leaves the manufacturer's plant it has been thoroughly tested and is in good operating condition. Usually it has to be dismantled for shipment to meet railroad clearances and requires reassembling to a certain extent after it reaches its destination. If the purchaser is familiar with this type of equipment, he should have no difficulty in reassembling the crane and putting it in operation.

Sometimes, however, a contractor who is purchasing his first machine, assumes that any man who has operated a donkey engine is qualified to set up and operate a locomotive crane. He does not appreciate that the service he can get from such a machine is more than 50 per cent dependent upon the operator. If a capable man is put in charge of a machine such as a locomotive crane, and he is interested in keeping his machine in first class shape and taking care of minor adjustments as they are needed, the life and service of the machine are unquestionably very much prolonged and better. A man who knows only enough to put fire in a boiler and perform the various motions necessary to operate a machine, can never get the best service out of it, whereas a man who is interested in his machine and takes pride in keeping it up, will also take pride in getting the most work out of it, and should be worth, in a season's run, more than double the wages paid to a man of the other type.

Manufacturers of locomotive cranes usually have a stock of spare parts on hand that, in an ordinary season's run, can be called upon for quick shipment. If the owner of a locomotive crane will allow his operator to make the necessary adjustments and order such parts as may show signs of failing in advance, he will ordinarily be required to shut down only a small portion of his time during a season's run. If, however, adjustments are not made at the proper time, one part after another will fail, and the contractor usually assumes that the machine is poorly built, whereas in nine cases out of ten, it is the fault of the operator, or a system which does not allow him to make the necessary adjustments and repairs.

Furthermore, the average contractor, when ordering repairs from the manufacturer, considers he is being abused if the part he requires is not shipped immediately. He does not realize that in a large organization a certain amount of time is necessary to see that he gets the part he wants. Usually his order is not specific. He orders the part by its popular name, as he has become accustomed to call it, and does not take the trouble to consult his files to see what the manufacturer calls this part. Changes are constantly being made in the construction of such machinery, and the newer cranes do not have the same details as the old ones, so that orders for repairs should specify the serial number of the crane for which the part is required. This serial number is always plainly stamped on the name plate, and, unless covered with grease and dirt, should be plainly visible.

Only the manufacturer appreciates the difference in customers. One man orders his repairs as he sees they may be needed, and if he obtains shipment within a reasonable length of time, is entirely satisfied. Another man will allow his machine to run until it is ready to fall to pieces, and then blames the manufacturer because he cannot get all the parts he requires within a few hours after he is obliged to shut down. Common sense and courtesy are big helps in ordering repair parts as well as in the operation of any equipment.

One big help in maintaining equipment such as a locomotive crane, is in keeping the machine clean. Some operators allow grease and dirt to accumulate until it is difficult to distinguish between the various parts. If a machine is operated by steam, a short piece of steam hose connected to the boiler will assist materially in washing off the grease and dirt that accumulate on these parts. If the machine is operated by gasoline, a reasonable amount of this fuel applied to the operating parts with a piece of waste will keep these parts in much better condition.

(To be continued)

Concrete Mixer Association Elects Officers

The Concrete Mixer Association of Chicago, an organization of manufacturers, at its annual meeting Jan. 18 elected the following officers: Lion Gardiner, Lakewood Engineering Co., Cleveland, president; G. Jaeger, Jaeger Machine Co., Columbus, vice-president; A. T. Scannell, Archer Iron Works, Chicago, secretary and treasurer.

Mead-Morrison Engineer Dead

Walter L. Cowles, structural engineer of the Mead-Morrison Mfg. Co., Chicago, died recently at his home in Oak Park, Ill. He was born at Wallingford, Conn., in 1859 and after graduating from the Sheffield Scientific School of Yale University in 1878 he gained a wide experience in bridge and structural engineering. Beginning in 1878 with the Clark Bridge Co., of Baltimore, Md (of which he became a member), he went to the Plant Railroad System in 1884-1885 as engineer of bridges. From 1885 to 1899 he was with the Morse, King, Atlanta and Keystone bridge companies, the Illinois Steel Co. and the Pottsville Iron & Steel Co. In 1899 he went to the Brown Hoisting Machinery Co. as structural engineer and some years later took a similar position with the Mead-Morrison Mfg. Co. At one time he was with the Holman Railway Tracklayer Co.

Prizes Offered to Improve Lumber Manufacturing Methods

The National Lumber Manufacturers' Association, Washington, D. C., has again offered a series of prizes which will be awarded to those who contrive the best method, the newest machine or device, which, in practical application, will result in an appreciable saving of labor, time, material or expense in the lumber manufacturing industry.

Heretofore a single prize of $1,000 was offered each year to the successful contestant. At the present time the National Lumber Manufacturers' Association is offering prizes amounting to $2,000, which will be divided as follows: First prize, $1,000; second prize, $500; three prizes of $100 each; four prizes of $50 each.

Owing to changing economic conditions it is becoming feasible to utilize certain by-products of wood that would not have been possible a few years ago. The elimination or reduction of waste incidental to the process of manufacture is becoming increasingly important.

A sawmill concerned only with obtaining merchantable lumber from a log, can utilize only about 25 or 30 per cent of the entire tree as it stands in the forest. This leaves a wide margin for the development of by-product utilization.

Three Marine Salvage Companies Merged Into Single Corporation

The formation of what will probably be the largest wrecking and salvage company in the world was consummated recently by the combination of the T. A. Scott Co., of New London, Conn., the Merritt & Chapman Derrick & Wrecking Co., of New York City, and the Overseas Salvers, Inc., of New York City, consolidated into a firm to be known as the Merritt, Chapman & Scott Corporation, with general headquarters in New York City. The new corporation will have a capital stock well into the millions and will operate along the entire Atlantic Coast, taking in the field formerly covered by the firms separately. The Scott company, formerly worked almost exclusively north of New London, and Merritt & Chapman south of New London.

The company will have headquarters in New York City and offices in New London, Conn., Boston, Mass., and Kingston, Jamaica.

The board of directors will consist of the following: I. J. Merritt, New York; J. R. Merritt, New York; Thomas A. Scott, New London; I. E. Chapman, New York; W. L. Chapman, New York; H. M. Pendleton; R. A. Fones, Clinton E. Roe, Richard H. M. Robinson, president of the United American Lines; S. F. Fales, R. L. Hague, G. P. DeWald, Herbert F. Boyston, G. H. Walker, Paul H. Harwood, J. W. Van Dyke, J. W. Powell, and Homer L. Ferguson.

The officers chosen are as follows: I. J. Merritt, chairman of the board; Thomas A. Scott, president; I. E. Chapman, vice-president; W. L. Chapman, secretary; R. A. Fones, treasurer. J. R. Merritt will be assistant to the chairman of the board; H. M. Pendleton will be second vice-president; and Clinton T. Roe, a lawyer, will be the company's attorney.

Road Show Brings Out Wide Range of Equipment

(Concluded from p. 185)

Elevating Loaders—Features of the Haiss elevating loader included improved crawler traction, enclosed mechanism and a special device for raising and lowering the boom; the clearance height at the discharge end has been increased from 8½ to 9 ft. The Link-Belt Loader is equipped with power swiveling mechanism and buckets arranged alternately with straight and curved cutting edges. For the Barber-Greene loaders snow-handling attachments are now furnished in the form of a 32-in. rubber belt instead of buckets, a longer and flatter boom and 6-ft. side plates on the receiving end to divert piled snow toward the belt. A type of open-top car unloader for sand and stone new in the East, was exhibited by the Edward Bacon Co., of San Francisco; it is a light, portable bucket-elevator device mounted on wheels running on railway cars.

Aggregate Plant—As a supplement to its Batcherplants for storing, measuring and delivering measured quantities of sand and stone from bins to trucks or cars, the Blaw-Knox Co. showed a model of a new cement-measuring and loading device. It consists of two parts, a sliding bottom dump trough on an elevated platform and a light steel box with hinged covers at top and bottom mounted on the bodies of motor trucks. Cement is delivered by gravity into the box compartments on the trucks and discharged into the mixer skip simultaneously with the sand and stone. The device eliminates labor in handling sacks of cement at the mixer.

Other types of batch-measuring hoppers were shown by the Butler Equipment Co., the B. S. Johnson Co., and the Erie Steel Construction Co.

New Road Form

Road Forms—An entirely new design of steel form for concrete roads was shown by the Lakewood Engineering Co. It is made of $\frac{3}{16}$-in. metal and contains no bolts, rivets or stake holes. The joint is formed by two locking wedges and the top of the rail is curved to produce a line point surface on which no concrete or pieces of stone may lodge. This feature insures an even slab thickness when a finishing machine is used.

A 2-in. riser was displayed by the Metal Forms Corp. to increase the height of forms for thicker slabs. It fits under the bearing boxes of the rails, forming a single unit of increased height. On the Blaw-Knox forms new features are the one-piece stake strap and increased stiffening.

Finishing Machines—The new Heltzel finishing machine offers a combination of controls with independently operated strike-off, tamp and belt; other features include an adjustable-height strike-off, hinged wings of steel plate at each end to prevent concrete overflowing the forms, and the use of the weight of the machine to prevent concrete from raising the strike-off to a point higher than that set by the operator.

The new Lakewood finisher also has an adjustable strike-off; it may be operated at the level of the tops of the forms or at a point 4 in. below. For moving from one job to another transportation wheels are supplied.

The chief feature of the Maxon finisher is a divided strike-off; its two independently operated parts move back and forth in opposite directions to reduce the shove of concrete against the side forms. The Ord finisher made by the A. W. French Co., is designed with two heavy strike-off beams with wide under surfaces whose action kneads and compacts the concrete; the second beam gathers up and spreads excess mortar over which the first beam has passed.

Crushers—The new feature of the Smith gyratory crusher is the use of cast-steel instead of cast-iron. The company's exhibit at the show included a complete working model of a crushing and screening plant equipped with miniature primary and secondary breakers.

Gasoline Engines—The increased use of gasoline engines for operating construction equipment was reflected in the exhibits of 18 manufacturers. These ranged in size all the way from small units of 2 hp. weighing only 115 lb., as exemplified by the Evinrude exhibit, to the multiple cylinder types designed for operating power shovels and cranes. The Novo Engine Co. lays stress upon the development of its power units for construction purposes rather than the adaptation to construction work of automobile motors. The gas engines were shown in a wide variety of portable pump and compressor rigs.

A 60-hp. oil engine of the semi-Diesel type, according to claims of the Fairbanks-Morse Co., operates a 1½-cu.yd. dragline at one-quarter the expense of steam or gasoline rigs.

Compressors and Air Tools—For municipal and public utility work involving rapid moves from one point to another the Ingersoll-Rand Co. has mounted one of its portable type air compressors on a 1-ton Ford truck. In addition to its jackhamers and paving breakers there was a demonstration of the company's pneumatic clay digger.

A portable compressor, designed for operating two drills, a pneumatic paving cutter weighing 65 lb., a clay spader and a 6½-hp. Turbinair hoist weighing 285 lb., were featured by the Sullivan Machinery Co.

Vertical Boom Ditcher

Excavating Equipment—A new type of ditcher was shown by the Barber-Greene Co.; its feature is a vertical, instead of the usual inclined, boom carrying an endless chain of buckets equipped with a self-cleaning device which throws off earth by positive action. The ditcher can dig a 5-ft. trench 15 in. wide. The Chas. T. Topping Co. showed its new light weight pony ditcher.

On its back filler the Austin Machinery Corp. has improved control by a re-arrangement of operating levers.

Supplementing its cableway excavator, Sauerman Bros. showed a model of the power scraper, a wire rope and drag bucket device designed to be operated by power from a tractor.

Motor Trucks—Road-building requirements are reflected in motor truck features designed especially for this field. The necessity for traveling on the subgrade has led some manufacturers to equip with large pneumatic tires and to produce chassis with a comparatively short wheelbase.

A 72-cu.ft. batch-compartment body with swinging gates was shown on a Mack truck of the 2-2½ tons type. The cylinder bore on this machine has been increased from 4 to 4¼ in., resulting in greater power (29 hp.) and the body is made of only two sheets of No. 7 gage metal with rounded corners to facilitate the discharge of material. The increasing use of gravity loading devices, with the resulting shock of material dropped from a height, has led to the strengthening of the body by an electrically welded seam along the center.

On the Hug speed truck, equipped with 1½-yd. body, pneumatic tires are used and the weight distribution places the heavier load on the front axle.

On the General Motors truck a two-range transmission has been introduced to provide extra pulling power on bad roads and speed for smooth surfaces.

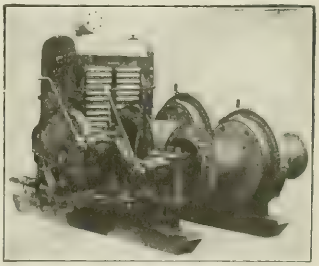
Miscellaneous—A new type of Elastite joint for concrete pavements, involving a tongue-and-groove feature instead of the straight-faced joint formerly used, was one of the novelties at the Philip Carey exhibit.

For rolling subgrade the Austin Machinery Corp. has designed a light-weight roller (3-ton), gasoline operated; it is called the Austin Pup and may be equipped with grader and scarifier.

Equipment and Materials

Gasoline Engine Hoist Designed as Equipment Unit

Designed as a gasoline hoisting *unit*, as opposed to a hoist coupled to a gasoline engine often unsuited for such purposes, the four-cylinder outfit (Type AF-DH) developed by the Novo Engine Co., Lansing, Mich., is intended for use in connection with heavy construction operations. The power unit is completely housed. In addition to its compactness, other advantages are claimed.



One of the features is a full rectangular base and extra large main bearings which take care of side thrust resulting from transmission at right angles. With a speed of approximately 1,000 r.p.m. the engine delivers 20 hp. and is designed to operate under constant load that approximates its capacity, whereas the automotive or tractor modifications of engine types are under full load perhaps 25 per cent of their operating time. The speed of the engine is slower than that of the automotive type and two fly-wheels are furnished to insure uniform power output.

An automatic governor of the fly-wheel type is employed and in addition a hand-throttle within easy reach gives the operator, within the setting of the governor, the same control that exists with a steam outfit. All accessories of this unit are on one side for convenience.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Freight Car Pool Suggests Government Ownership

Adoption of Proposed Plan, According to Railway Association, Quickest Way to Induce Federal Control

Acceptance of the plan recently proposed to the Interstate Commerce Commission for the pooling of freight car equipment is the quickest way to bring about government ownership of the railroads if the shippers want it, Donald D. Conn, manager of the Public Relations Section of the Car Service Division, American Railway Association, told the Milwaukee Traffic Club on Monday night, Jan. 15, in Milwaukee, Wis. Speaking at the annual dinner of that organization, Mr. Conn, who was formerly chief of the Transportation Division of the Joint Congressional Conmission of Agricultural Inquiry, said in part as follows:

"To take one of the principal instruments—the freight car— by which the individual railroad maintains its livelihood under private and competitive operation away from that railroad and place it in the hands of an agency created by Federal Charter and financed through government funds, represents the initial step towards government ownership. If the shippers want government ownership of these railroads, the adoption of such a plan as is proposed is the quickest way to get it. If you want private operation and the maintenance of competition, you want to stay just as far away from it as possible."

SCHEME WOULD REDUCE NUMBER OF CARS IS CLAIMED

"The scheme now proposed for pooling freight cars is presented as a panacea for all of our transportation troubles but it means the creation of a meddlesome, additional agency, backed by $100,000,000 of government funds and, as designated in its own program, it gives the country less cars five years from now than there are today. A careful analysis of its practical application shows that the actual results thereunder are not only contrary to the claims being made, but also produce an actual increase in operating expenses. I want to stress the absolute fallacy of expecting any agency created under Federal Charter, which means by legislative act, and with government money, purporting to represent a desire and intent to perpetuate private ownership of the railroads."

Contrary to statements that have been made, Mr. Conn said the report of the Joint Congressional Committee which was compiled under his supervision, did not contain any recommendation which could "be used for the purpose of passing all of the freight cars of the country over to an agency which would be irresponsible for the financial or operating result of any single railroad system." The recommendation in that report urging "prompt consideration and adoption of a comprehensive

(*Continued on p. 190*)

Structural Steel Sales Begin Upward Swing

"Continuation of the building boom this spring is forecast by the upward swing in sales of fabricated structural steel in December," states the United States Department of Commerce. The report of the Department obtained through the Bureau of the Census, continues as follows:

"The increase of about 20 per cent over November marked the turning point from a series of seasonal declines in fabricated steel orders and occurred a month earlier than last winter, when December was the month of minimum orders. December sales amounted to 58.3 per cent of shop capacity, as against 48.4 per cent in November. Estimated total sales of fabricated structural steel in 1922 amounted to 1,929,400 tons or 64.3 per cent of shop capacity, as against 997,200 tons in 1921, or 35.1 per cent of shop capacity."

Table I shows final revised figures from April to November, 1922, based on reports of 158 identical firms having a capacity of 220,790 tons per month, together with the preliminary report for December, based on 141 firms. December figures are compared to the previous final figures by prorating to the estimated total capacity of structural fabricating shops, namely, 250,000 tons per month.

TABLE I—MONTHLY BOOKINGS OF STRUCTURAL STEEL TONNAGES

1922	Actual Tonnage Booked	Per Cent of Capacity	Estimated Total Bookings
April..........	198,529	89.9	224,800
May..........	180,558	81.8	204,500
June..........	162,139	73.4	183,500
July..........	152,023	68.9	172,300
August..........	150,700	68.3	170,800
September.....	141,418	64.1	160,300
October.......	126,535	57.3	143,300
November.....	106,315*	48.4	121,000
December.....	125,479†	58.3	145,800

* Two firms missing out of 158.

† From 141 firms who reported in time for this report.

Table II shows yearly figures of structural steel sales, based on new estimated capacities as the result of the special survey of the industry recently conducted by the Bureau of the Census, and the percentage of sales to shop capacity as reported by the Bridge Builders and Structural Society to April, 1922, and by the reports to the Bureau since then.

TABLE II—YEARLY SALES OF STRUCTURAL STEEL

	Estimated Monthly Tonnage Capacity	Per Cent of Sales to Capacity	Estimated Tonnage Sales
1913..........	190,000	50.3	1,146,800
1914..........	191,000	50.4	1,155,200
1915..........	194,000	70.0	1,629,600
1916..........	200,000	69.4	1,665,600
1917..........	207,000	60.2	1,495,400
1918..........	218,000	55.6	1,454,500
1919..........	224,000	53.4	1,435,400
1920..........	232,000	53.8	1,496,500
1921..........	237,000	35.1	997,200
1922..........	250,000	64.3	1,929,400

Use of Cement in Road Building Increased 41 Per Cent in Year

"The growth of the use of cement for highways is evidenced by the total yardage of concrete pavement awarded during 1922," states the Geological Survey in its statistical report on cement shipments, released Jan. 13. "These awards," the report continues, "for the total United States amounted to 79,000,000 sq.yd. or 7,900 mi. of 18 ft. roadway, as compared with 5,600 mi. of roadways awarded in 1921.

"Base mill price of cement in the Lehigh Valley district is $2. per bbl., ($10.00 per ton), compared with $2.10 ($10.50 per ton) in the Hudson District, and $1.80 ($9.00 per ton) around Pittsburgh, plus 10c. per bag for container which is repaid upon return. These prices represent a decline of 25c. per bbl. from ruling quotations up to the middle of October. During August, owing to railroad and coal strikes and increased cost of fuel, prices were advanced 45c. per bbl., and some smaller producers were forced to close mills on account of coal shortage. These mills reopened later and contributed to the heavy Fall production and shipments.

"Coal for which companies were paying $1.40 per ton in April rose to $8.25 f.o.b. mines plus $3.10 for freight in August. This involved an increase of over 60c. per bbl. in production costs, against an increase in price of 45c. Dropping of coal costs in October was reflected by a decline of 25c. per bbl. in mill price. Average net price received in the Lehigh Valley district, where a large number of mills supplying the eastern market are, was $1.78 ($8.90 per ton) in 1921; $1.91 ($9.55 per ton) in 1920, and $1.64 ($8.20 per ton) in 1919."

Business Failures Decrease

Decreases in all sections of the country except the Pacific states are shown in the number of failures reported to R. G. Dun & Co., and the total for the week ending Jan. 20, is 482, as against 546 for the preceding week. A year ago the figure was 639.

A substantial decrease is also evident in the aggregate of insolvencies with liabilities of more than $5,000 in each instance, which total 280 in the week of Jan. 20, compared with 335 in the previous period; the smaller figures also represent a smaller proportion of the total, being 58.0 per cent, as against 61.3 per cent for the week ending Jan. 13. Similar defaults in the corresponding week of 1922 numbered 385, being 60.2 per cent of the total.

Canadian failures, during the week, declined to 90 from the 108 reported for the preceding period; last year the figure was the same as for the week of Jan. 20, 1923. Defaults involving over $5,000 in each case number 47; Jan. 13, the figure was 46, and a year ago it was 44.

Bids Wanted—Apartment, Philadelphia, Pa., for Lincoln Drive Apartment Assn., $2,500,000.

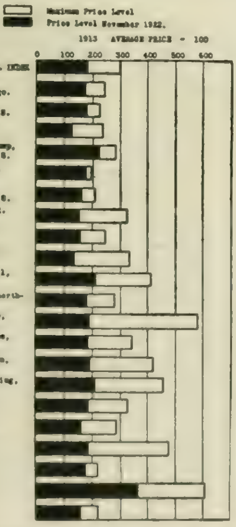
Rise in General Wholesale Prices Halted in December

Although the tendency of wholesale prices was upward in December, no change from the general level of the previous month is shown by the weighted index number compiled by the United States Department of Labor. This index, which includes 404 commodities or price series taken in representative markets, and which is weighted according to the relative importance of such commodities, rounds off to 156 for December, the same figure as announced for November.

INDEX NUMBERS OF WHOLESALE PRICES, BY GROUPS OF COMMODITIES.
(1913 = 100.)

	1921 December	1922 November	1922 December
Farm products..........	120	143	145
Foods	136	143	144
Cloths and clothing......	180	192	194
Fuel and lighting	199	218	216
Metals and metal products	113	133	131
Building materials.......	158	185	185
Chemicals and drugs.....	127	127	130
Housefurnishing goods...	178	179	182
Miscellaneous..........	121	122	122
All commodities.........	140	156	156

To offset these price increases, there were decreases among important fuel and lighting materials and among metals and metal products. Fuel and lighting averaged almost 1 per cent and metals 1½ per cent lower than in November. No change in the general price level was reported for building materials or for miscellaneous commodities.



The accompanying chart, prepared by the United States Department of Commerce, shows the relative declines in various building materials since peak. Steel shapes reached peak prices in June, 1917; reinforcing bars, in July, 1917. Window glass, touched the maximum in August, 1918, and linseed oil in August, 1919. All the other materials reached peak levels in 1920, except sand and gravel, which commodities touched highest marks in January, 1921.

Building Permits and Contracts Last Year

Value of building permits in the United States last year was $2,514,435,467, which was 52 per cent higher than for 1921. The average of the two years is $1,860,000,000.

Value of contracts awarded for large commercial buildings and industrial works last year was $900,000,000, as reported by *Engineering News-Record's* Construction News. Residence building amounted to a billion and a half. Thus total building contracts in the country aggregated $2,400,000,000.

Number of important projects of all kinds reported by Construction News last year for the United States and Canada was 28,320, of which 11,425 were for buildings and industrial plants. Following is a comparison of the number of projects as reported at different stages, during the last four years:

	Contracts Awarded	Bids Desired	Proposed Work
1922..............	8,140	7,118	11,280
1921..............	7,047	6,831	11,699
1920..............	9,249	6,028	11,709
1919..............	6,993	4,789	13,861

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 43 to 54, are the following large projects:

Hotel, Detroit, Mich., to **Lynch Construction Co.**, New York City, $5,000,000.

Manufacturing plant and addition, Camden, N. J., to **Stone and Webster**, New York City, $1,300,000.

Apartment, Detroit, Mich., to R. Appelman, $1,250,000.

School building, Baltimore, Md. to **J. H. Miller, Inc., $1,124,420.**

Materials Prices Today Compared With Other Times

Of the twenty basic building materials listed in the accompanying table, but three, (paving stone, flagging and curbing) are higher in price at the present time than in June, 1920. The other seventeen, including the principal building, concreting, road and paving materials, and pipe, are all from 13 to 64 per cent below the 1920 peak. The price of flagging advanced steadily from January, 1913, to the present level; that of bluestone curbing, from November, 1915 and paving stone, from September, 1916. These three passed through the peak period without undue rises in price as compared with other construction materials, which rose from 1913 levels to maximum points occurring approximately in June, 1920. Current sand and asphalt prices, f.o.b., New York, are the same as those in effect one year ago; but with recent advances in crude oil, higher asphalt quotations are anticipated. Lime and crushed stone are the only two items, of those listed in the tabulation, to show declines from last year's prices. Prevailing prices of the remaining thirteen commodities, are relatively higher than a year ago; particularly pine lumber, common brick, hollow tile and cast-iron pipe.

PRICES OF PRINCIPAL CONSTRUCTION MATERIALS CURRENT, AT PEAK AND PRE-WAR

Building Materials	Current	One Month Ago	One Year Ago	June, 1920	January, 1913
Structural shapes, 3-in., f.o.b., New York, per 100 lb..................	$3.14	$3.14	$2.78	$4.47	$2.25@$2.30
Reinforcing bars, ¾-in., f.o.b. New York, per 100 lb.....	3.04	3.04	2.68	3.52@5.00	2.05
Structural rivets, ¾ in., f.o.b. Pittsburgh, per 100 lb.....	3.00	3.00@3.15	2.25@2.40	4.50	2.10@2.20
Pine, 3x12 to 12x12, 20 ft., f.o.b. New York, per M. ft. b.m..................	54.00	54.00	44.00	70.00	41.00
Common brick, alongside dock, New York, per M...	20.00	15.00@15.50	14.00@15.00	25.00	6.75@7.00
Lime, common lump, f.o.b. cars, New York, per bbl. (280-lb. net)............	2.75@3.13½	2.75@3.13½	3.00@3.49	3.30	1.37
Hollow partition tile, 8x12x12, on trucks, Perth Amboy, N. J., per block...	.2147	.2147	.1789	.3411	.105
Concreting Materials					
Cement, delivered, New York, without bags, per bbl ..	$2.60@2.70	$2.60	$2.20@2.30	$3.30	$1.18
Sand, alongside dock, New York, per cu. yd. .	1.00	1.00	1.00	1.50	45
Gravel, ¾-in., alongside dock, New York, per cu. yd... .	2.00	2.00	1.75	3.00	85
Crushed stone, ¾-in., f.o.b., New York, per cu.yd......	1.75	1.75	1.80@1.90	2.15	.90@1.00
Pipe					
Wrought-steel pipe, black, 2½ to 6-in., lap weld, discount from Pittsburgh basing card	63%	63%	68%	42%	79%
Cast-iron pipe, 6-in. f.o.b., Birmingham, per ton	$44.00	$43.00@43.50	$35.00	$76.30	$22.50
Sewer pipe, standard, 6-in., f.o.b. Pittsburgh, per lin. ft.......... .	.1575	.1575	.1305	.29	.072
Road and Paving Materials					(Previous to 1920)
Road oil, 45% asphalt, at terminal, New York, per gal .	$0.06	$0.06	$0.05½	$0.13	$0.065 July, 1917
Asphalt, in bulk, f.o.b. New York, per ton	16.00	16.00	16.00	45.00	20.00 Nov., 1917
Paving stone, 4x8x4 dressed, f.o.b. Chicago, per [illegible]	3.35	3.35	3.35	3.25	2.15 Sept., 1916
Flagging, 4 ft. wide, f.o.b. New York, per sq. ft.	.35@.40	.35@.40	.26	.25	.19@.20 Jan., 1913
Curbing bluestone, 5x16 in., f.o.b. New York, per lin. ft.	.77@.85	.77@.85	.77	.70	.40 Nov., 1915
Wood block paving, 3½-in., 16 treatment, delivered, New York, per sq. yd.	[illegible]	[illegible]	[illegible]	3.75	2.00 Nov., 1917

(Concluded from p. 188)

plan for the central control and distribution of freight cars" was "never intended to support any plans calling for the pooling of freight cars or for a central financial agency," he said, adding that the recommendation made in the report is now being carried out by the Car Service Division of the American Railway Association.

"Under the program which was set down before the Interstate Commerce Commission last year by the advocates of such a plan, a definite program was proposed to retire 890,000 cars with a capacity ranging from 30 to 35 tons within the next five years, and replace them with 540,000 steel cars of 50-ton capacity. An analysis of the details of this proposal indicates that the total retirements at the end of five years would be 890,000 cars, the total replacement 540,000 cars, the total number of new cars built 250,000 cars, or an actual net decrease in the number of cars available for the use of the public at the end of five years of 100,000 cars. Not only does the plan contemplate a reduction in the actual number of cars available to the shipping public, but also that the capital expenditures that are made must be made for 50-ton cars. Are the trade units in this country, storage capacities, and the consuming capabilities of the country ready to utilize 50-ton cars and nothing else? While the railroads are generally adopting a standard of 40 and 50-ton box cars, I do not believe that any experienced railroad man or shipper is ready to say that all cars should be on a 50-ton basis. The average today is 42.2 tons, and this includes the high capacity coal cars. Those who advocate car pooling prey upon the car shortage conditions of the past fall and offer it as a remedy. It is contended that if such a plan is put in effect, cars can be moved around the country any time and in any way to suit the demands of the shipper. 'transportation shortage,' rather than car shortage is the term which correctly implies a lack of transportation to meet the demands of the shippers."

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of January 4; the next, on February 1.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb	$3.14	$3.95	$4.40	$3.02½	$3.15	$3.85	$3.25	$3.70	$3.50
Structural rivets, 100 lb	3.85	4.60	5.25	3.75	4.00	4.80	4.75	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb	3.04	3.85	3.15	2.92½	3.05	3.62½	—3.30	3.70	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	54%	52.50%	45%	59½%	57-5%	41%	39.2@51.8%	40%	22.50
Cast-iron pipe, 6 in. and over, ton	—54.50	—46.82	—56.00	+51.20@53.20	—55.16	—64.61	—54.00	—54.00	55.00
Concreting Material:									
Cement without bags, bbl	2.60@2.70	2.54	2.25	2.05	2.29	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd	1.00	1.32	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd	1.75	2.00	1.80	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	59.00	36.00	50.00	52.00	42.75	51.50	+36.50	25.00	90.00
Lime, finishing, hydrated, ton	16.80@17.10	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	2.75@3.13½	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	10.00	+11.00	11.00	18@19	12.00	15.50	—13.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0859	.115	....	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1230	.0859	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal	.93	+1.03	1.07	.98	+1.04	1.10	1.04	.86	1.02
Common Labor:									
Common labor, union, hour	.60	.35	.30@.50	......	....	.50@.55	.56¼	.50@.60	......
Common labor, non-union, hour	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.50	....	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quanties are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations delivered, except sand, gravel and crushed stone alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.00). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $22.50; 6-in., $108.

Changes Since Last Week

Cast-iron pipe down $1 per ton at Birmingham; drop reflected in similar declines in New York and Chicago warehouses. Iron and steel scrap prices higher; coke steady. Minimum of $2.10 per 100 lb. quoted on steel shapes and plates f.o.b. Pittsburgh. Minimum on bars, however, still placed at $2. Mill capacity rapidly filling up with heavy tonnage orders for railway and building materials, also plates for boiler, oil tank and ship construction. Steel mills operating at about 85 per cent of capacity. Unfilled orders on books of United States Steel Corporation, Dec. 31, 1922, totaled 6,745,703 tons, a drop of over 1 per cent since November.

Lumber market continues firm. Douglas fir up $1.50 per M. ft. in San Francisco during week. Demand unusually heavy for this season of the year; orders now about 26 per cent and shipments, 5 per cent above normal. Production, however, is 22 per cent below normal, as compared with 30 per cent below, Jan. 12, 1923.

Brick prices generally firm throughout the country. Seattle, however, reports drop of $1 per M.; slight advance in Dallas.

Linseed oil market strong. Both Atlanta and Minneapolis advanced prices 3c. per gal. during week.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 90 — NEW YORK, FEBRUARY 1, 1923 — Number 5

Status of British Sewage-Works

PILGRIMAGES to British sewage-works have been undertaken by American engineers with profit to themselves, the profession generally and their municipal clients for many decades past. The latest of these was made last month by George W. Fuller—by no means his first, it will be understood. With no loss of time on Mr. Fuller's part or that of *Engineering News-Record* our readers are to have the benefit of Mr. Fuller's well digested conclusions on "The Present Status of Sewage-Works in England." The present installment, which deals with questions of administration and policy, will be of value to all who are giving careful thought to a number of questions in the fields of municipal economics and central government control. The second article, on older methods of treatment, will contain many observations and conclusions bearing upon American problems. The third article, on the activated-sludge process in England, will be eagerly read in view of the growing American interest in what for years past has been one of the most interesting, and promising, but in some of its details the most baffling, process of sewage treatment that has ever been brought to the front.

Noted Without Enthusiasm

AGREEMENT between the operators and the United Mine Workers to continue the existing wage scales and working conditions for another year represent simply an extension of the truce declared last year after the victory of the miners. By it we are assured peace and a continued supply of fuel until the President's commission can complete its study and perhaps suggest some plan of readjustment for the industry whereby the consumer may be freed from the present burden of excessive costs. The consumer knows, of course, that until this has been done he must continue to submit to this burden as an alternative to a fuel famine, so the announcement of the agreement has been received without enthusiasm.

Labor in Banking

NO NEW departure is heralded in the news that the Brotherhood of Locomotive Engineers is to open a new bank in New York and that it has bought an interest in the Empire Trust Co. in that city. For nearly three years organized labor has used its resources in this fashion to the benefit both of labor and of the community, and today labor banks are in operation in several industries and in several cities. These further developments, however, have suggested a variety of comment, some of which appears to be puerile, but some of which appeals to us mightily. It is gratifying, for example, to reflect upon the opportunity here offered for employers and employees to get their feet under the same table in order to consider economic problems from the same viewpoint. Frequently heretofore they have met to adjust conflicts of interest. Out of such meetings has grown a measure of mutual understanding and respect that has been good for both; but not by that process alone can there be developed that sense of community of interest and of purpose that becomes more and more essential to the working out of our industrial destiny. Is it too optimistic to hope that the extension of this new relationship will help toward strengthening in both parties convictions as to their common interests that will be reflected in the conduct even of those matters in which there may be temporary and superficial conflict?

Three Hundred City Managers

THE growing favor of the city manager plan is shown by the fact that last year alone it was adopted by 74 municipalities, compared with 52 in 1921 and 36 in 1920. Altogether the plan has been adopted by 304 cities, according to the *City Manager Magazine* (Lawrence, Kan.) for January. Since the city manager plan is based on the sound principle of separating legislative from executive functions and making one man responsible for the latter, and since experience shows that the plan makes for increased municipal efficiency and economy, its rapid progress is encouraging. The city manager plan has a direct appeal to engineers for the reason just stated and also because a large percentage of the managers are engineers and because whether engineers or not the engineering and other technical staffs of a city under the manager plan obtain a larger measure of just recognition than under the older plans of municipal government.

City Managers in New Jersey

WHEN it is considered that the city manager plan is the natural and frequent outgrowth of the commission plan and that New Jersey has a large number of commission governed cities, it seems strange enough that year after year the legislature of that state balks at proposed legislation which would do no more than permit the voters of the municipalities of that state to vote for or against having a manager. New York on the east and north and Pennsylvania on the west have many manager cities and the manager plan has been adopted in two-thirds of the states of the Union, Michigan leading with 33 adoptions, California following close after with 29, Virginia and Texas having 23 each and Florida 22. The only explanation of the repeated defeat of a city manager enabling act in New Jersey that we have seen or heard, aside from the well known opposition to reform measures on the part of politicians, is that the commissioners in the commission plan cities are opposed to a change that would rob them of all their executive powers and their corresponding titles as administrative department heads and cut down their salaries as well. In most of the New Jersey communities or of those of any other state under the commission as contrasted with the commission manager plan, the personal losses to a few commissioners would be a great gain to the whole body of citizens and taxpayers, through substituting trained for untrained administrative heads of departments and paying salaries accordingly.

Precast Concrete Flumes

FLUME design and construction in the irrigated country of the West seem ever to be in a state of flux, so far as type is concerned. One of the latest developments noted elsewhere in this issue is the utilization of short precast units of flume cast in an inverted position in a continuous line paralleling the final position. Joints similar to those used in concrete pipe expedite the erection, taking up easily the irregularities of the unit-built trestle members on which the flume rests. This type of precasting a whole section is a step in advance of the work done on the King Hill Project by Reclamation Service engineers (See *Engineering News-Record* Dec. 8 and 22, 1921, pp. 926 and 1014) where the bottoms were cast monolithic after the precast sides had been set up. The cases are not quite comparable because the Klamath flume is on trestle while the King Hill sections all rest directly on the earth. Furthermore, the restricted space for work on the steep side hill of the latter location would have precluded the decided advantage of stringing out a casting yard parallel to the existing flume. Transportation equipment heavy enough to carry in the full sections over the flume subgrade probably could have been installed at King Hill but it would have been decidedly cumbersome in such cramped quarters. The tightness feature in the Klamath work is not at all surprising considering the ease with which pipe under pressure made with similar joints has exceeded the rigid guarantees at Denver, Kansas City and Norfolk.

Hoping Against Hope

HOPEFULLY, but with misgivings, the American people have been watching developments in the Ruhr. There can be no doubt as to where their sympathies lie. There can be no doubt as to their conviction that Germany should be made to expiate the crime of 1914 and to pay the price by which she bought off an allied advance to Berlin in 1918. Nevertheless, there persists a disturbing doubt as to whether the present course is likely to achieve even those limited ends. Although it would be risky to estimate the eventual prospects of French policy solely in the light of the set-back it necessarily has incurred at its beginning, many are wondering uncomfortably whether a great moral advantage may not have been surrendered for the sake of an ephemeral and insignificant triumph. And few will contend that the events of the last two weeks have contributed towards a solution of the overshadowing problems that beset humanity. Far and away beyond the material chastisement of the Germans, a distracted world demands the restoration of industrial and political relations that will cool the wasting fires of class and race hatred, stimulate the productive instincts and re-awaken in humankind the almost-forgotten habits of individual ambition and thrift. The misgivings that oppress those who feel affectionately and sympathetically toward the French people may rise from an intuition that the present measures, however sorely provoked and however resultful in material returns, are out of harmony with the more essential and more universal requirements.

Some Doubts About Concrete

IN ANY science or philosophy an honest skepticism is the beginning of progress. Too easy and general acceptance of theories and practices results in marking time and then retrogression. Engineering, being a live and progressive science, is full of skepticisms; if it were not, technical societies would soon perish of inanition, for the mere reading of descriptions of work done would lose its interest unless flavored with the salt of controversy over what theories and facts should be accepted. Last week at Cincinnati the proceedings of the American Concrete Institute revealed many skeptics, so far as the science of concrete is concerned. Never before, it seemed, in the nineteen years of that society, were there brought out so many doubts as to theory and practice or so many questions which could not be answered satisfactorily. This merely reflects, we believe, the general situation in the field of concrete and is a healthy rather than a morbid indication.

Some of these doubts and questions are worth setting down here, not in the hope of getting or giving answers but to mark wherein future study lies and to discount, perhaps, a certain smugness of attitude that concrete practitioners are apt to affect. There are so many things on which there is disagreement that it ill becomes any one to claim complete knowledge.

First, there is a very general concern over the behavior of outdoor concrete. For some years this has been a matter of individual expression, of secret whisperings glossed over in open discussion and explained on the easy ground of improper materials and manufacture. More and more bad concrete is being brought to light, however, and the policy of suppression of facts—though policy and suppression may be too strong words—is retreating before a demand that the cards be thrown on the table and that the committees of the proper engineering societies frankly admit that there are all too many examples of five to fifteen year old concrete, placed by competent contractors and engineers, which are far from permanent and which if examined and classified might reasonably yield some information that would help in future structures. The more recently expressed principles of good concreting have been based on widely published tests tempered with the information gained from too frequently suppressed failures. When the failures have as much publicity as the tests the reasons for the principles laid down will be better appreciated, especially by those who consider tests somewhat impractical and who demand proof from the actual structure.

In the same category comes the well-worn subject of sea water concrete. For years this has been the plaything of the theoreticians, but except for one minor and over emphasized set of tests and one extensive tour of field examination made by two men we have progressed little beyond the theories of cement chemists of two decades ago. Concrete goes to pieces in sea water more frequently than not, but the fact that sometimes it does not points to need of a study comprehensive in scope and particularized in examination. The doubts that exist are not going to be exorcised by the questionnaire method.

Doubt as to the value of tests because of variations in test results were made much of at the Cincinnati meeting. This, however, is a fault being cured with time. As the materials that go to make up concrete are being improved and as the methods by which tests are being made become standardized the tendency for uniformity of test results increases and the relation between test and performance tends to become closer. The present doubts are held by those who expect more from tests than tests can ever give. The man whose business it is to make them has more respect for their potentialities of variation than the man who only uses them.

In concrete construction several questions are not definitely answered. One is the matter of integral waterproofing—complicated by commercial considerations and the peculiarities of contractor psychology—and another the desirability of chuting—in which also the matter of dollars and cents is so large a factor. It is common among those who may be properly called the "concrete intelligentsia" to decry integral waterproofing, to claim on the basis of many tests that nothing is added by the use of such materials that can not be just as cheaply and effectively achieved by the proper procedure of normal concreting—and yet integral waterproofing continues to be made and used in large quantities. Must pragmatism retreat before pure reason or shall we have a final orderly theoretical and empirical examination of the question which will settle it or at least arrive at a fair compromise? In chuting, on the other hand, theorizing has no place. It is a matter of examination of each job and a balancing of opinion, which in the end must be individual, as to the quality of concrete that can be produced by this method. The unsuccessful attempt at Cincinnati to get some registration of opinion one way or the other on the chute problem shows why there are doubts on this question.

Skepticism as to rational methods of proportioning is far less than it once was; there are signs that we are approaching some sort of solution. For years a number of different investigators have been striking out into new fields of investigation, all directed to the same end of finding the optimum mix and most of them along different paths. These paths seem to be nearing convergence and a single way partaking somewhat of all the approaches may soon be reached. The problem now is to popularize the methods which necessarily in the making became a little cumbrous and which need simplifying and broadcasting so as to reach the man at the mixer or at least the man who bosses the man at the mixer. Doubts here are no where near as great as they were five years ago.

These are the more important of the debatable phases of concrete. They indicate that in spite of the fact that the country is dotted with well made, durable concrete structures the practice of producing such structures is by no means reduced to a formula, easily stated and easily learned. Foreman, superintendent or contractor can make or mar a job for which designer and material manufacturer have furnished the best the art affords—and vice-versa. There must be a wider distribution of the knowledge we already have so that each factor in the production of concrete is equally well informed and there must be more intensive and distributed study so that that knowledge is increased.

Within a certain limited group, a group represented fairly well by the American Concrete Institute and a part of the American Society for Testing Materials, there is going on an intense study of concrete but there are times when such doubts and questions as are noted here lead one to believe that the men of this group unintentionally form a very close corporation outside of which is the vast body of concrete users, picking up such crumbs as fall from the table but placing concrete in the main just as it was placed a decade ago. Both within and without that group there are skeptics, those within because they know so much, those without because they know so little. That their collective doubts may be resolved by more and wider study may sound paradoxical but it is offered as a fact. Contrary to a view once widely held, concrete is an intricate material. We are only just beginning to learn how to make it and how it behaves when made. No effort should be spared to increase our knowledge.

As to Student Activities

ALTHOUGH the discussion on engineering education at the annual meeting of the American Society of Civil Engineers produced little that could be considered as helpful in the practice of teaching, there was some stimulating talk with regard to the extra-curricular interests and activities of the undergraduate. John L. Harrington, president of the American Society of Mechanical Engineers, was most explicit perhaps, in his contention that the student sections of the national engineering societies are failing in their purpose and that they should be replaced by a self-governing undergraduate engineering society of general rather than specialized scope.

Faculty guidance and supervision should always be available for undergraduate activities, but it is axiomatic that if those activities are to be of the greatest value to the student they should be in the highest possible degree "self-starting." Student sections that are kept active mainly through the efforts of faculty members are of questionable value either to the students or to the parent societies. Whatever may be the merits of the substitute suggested by Mr. Harrington, his criticism of the student sections as at present constituted and conducted deserves the consideration of the national societies of which they are a part.

All this has implications beyond the question of student chapters for we are inclined to wonder whether we do not often fret ourselves unduly over the mental attitude of the undergraduate toward his work and his career. As Dean Ketchum put it, we are sometimes in danger of "losing our heads in our desire to make a man out of a boy." To insure a thorough and systematic covering of the prescribed courses of study it is essential, of course, that the faculty exercise a complete and unquestioned control of curricular work; but when it comes to the outside activities of the student body, intellectual as well as physical, the wise faculty remembers that after all, most engineering undergraduates are youngsters still with many interests and enthusiasms aside from the serious business of their intellectual training. In this respect, indeed, they are little superior to their elders, who have contrived all sorts of devices whereby they may now and then get away from "shop" and forget the serious business of life.

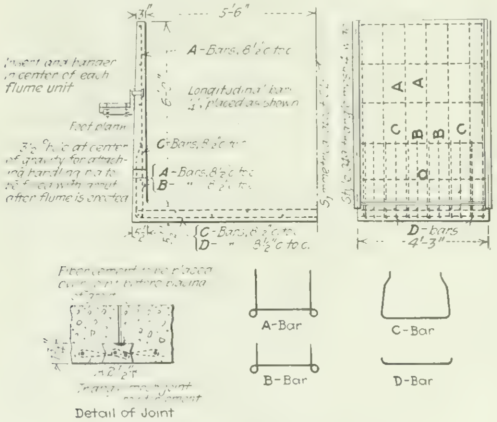
And so long as these activities are so restricted and supervised as not to interfere with the essential business of the institution we are inclined to think that the undergraduate will derive from them a benefit that will be directly proportional to their "self-starting" qualities. Student activities should live just so long as they are kept alive by student interest, without recourse to a faculty pulmotor.

Precast Concrete Flume on Klamath Project

Of Six Comparative Designs Precast Type Chosen at Lowest Capitalized Cost—Short Flume Sections Constructed Along Old Flume with Traveling Concrete Equipment

By E. C. Koppen
Engineer, U. S. Reclamation Service, Klamath Falls, Ore.

Forces of the U. S. Reclamation Service on the Klamath Project have recently completed between two irrigation seasons the construction of a precast concrete flume in an inverted position in a continuous line of sections parallel to the 13-year-old timber structure replaced. After removal of the existing flume the sections were turned over and set on precast bents and stringers. Low capitalized cost was the controlling factor in determining the use of the precast type. A combined mixer-and-derrick traveler straddled the forms for the precast flume sections and delivered concrete by chute to the forms for the trestle members alongside the positions they were finally to occupy. The new flume, including inlet and outlet transitions, is 4,316 ft. in length and has a capacity of 335 sec.-ft.; at the lower end the flume connects with a concrete-lined canal 7,600 ft. in length.


5'-6"
3"
A-Bars, 8½" c to c
Insert and hanger in center of each flume unit
Longitudinal bars ¼", placed as shown
Foot plank
3½" hole at center of gravity for attaching handling rod, to be filled with grout after flume is erected
C-Bars, 8½" c to c
A-Bars, 8½" c to c
B- " 8½" c to c
C-Bars, 8½" c to c
D- " 8½" c to c
Symmetrical about center line
A
A
C
B
B
C
D
D-bars
4'-3"
Detail of Joint
A-Bar
B-Bar
C-Bar
D-Bar

STANDARD PRECAST FLUME UNIT

The precast work of 2,600 cu.yd. consists of 990 flume sections; 335 sets of stringers, 3 stringers to a set; 55 solid bents from 1 to 5 ft. in height; 268 framed bents from 5½ ft. to 11½ ft. in height and 14 framed bents from 15 to 15½ ft. in height; the latter are braced diagonally. The flume units are 11 ft. wide, 6 ft. high and 4 ft. 3 in. in length.

The precast work was begun on April 27 and completed on Aug. 13, 1921. Water was turned out of the canal on Sept. 15 and dismantling the old timber flume was begun on Sept. 20. Erection of the new flume was begun on Sept. 29 and was completed on Jan. 10, 1922.

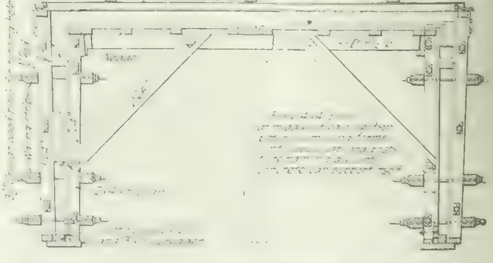
On May 10, 1922, water to a depth of 4 in. was turned into the new flume; and the depth was gradually increased with the demands for irrigation until at the end of the month the water in the flume was 4 ft. deep. Throughout the length of the flume only a small amount of leakage developed. At several points a small stream about $\frac{1}{16}$ in. in diameter appeared and a large number of sweat spots, usually near the lower part of the side of the flume, developed. At some of the sweat spots sufficient leakage occurred to cause occasional dripping; generally however, the leakage was only sufficient to show moisture on the outside of the flume. Practically all of the sweat spots dried up in a few days and most of the larger leaks within 30 days.

Selection of Type—The replacement of the old timber flume was considered during 1919 and again in 1920, but due to abnormal conditions following the war actual construction was deferred until 1921. Comparative designs and estimates were prepared for three types of flume construction and for three types of pressure pipe as follows:

Flume semi-circular, metal.
Flume semi-circular, wood.
Flume precast concrete.
Pressure pipe, concrete, monolithic.
Pressure pipe, lockjoint precast concrete with cradle.
Pressure pipe, lockjoint precast concrete without cradle.

The new structure was to be built without interfering with the old flume during the irrigation season of 1921, and was to be ready for service prior to the irrigation season of 1922. The design for the precast siphons contemplated the construction of the pipe during the irrigation season. The pipe was to be laid in a trench 6 ft. deep either on line with the timber flume or at an offset from it. For the monolithic siphon it was contemplated that it would be constructed during the irrigation season and at an offset from the timber flume. The several designs provided for building the new flume on the same line as the old flume. For the metal and wood stave types a new foundation was to be constructed consisting of masonry piers or pedestals, two to a bent, the bents to be at intervals of 16 ft. The masonry piers were to be constructed during the irrigation season and the flume to be erected immediately following the irrigation season. For the precast type of flume, the design contemplated using the old foundation, which consisted of three masonry piers to each bent, with the bents at 12-ft. centers. The precast type also contemplated the construction of the precast units during the irrigation season and the erection of the precast units immediately following.

An estimate was made of the cost and also of the probable life of the various types of construction, also



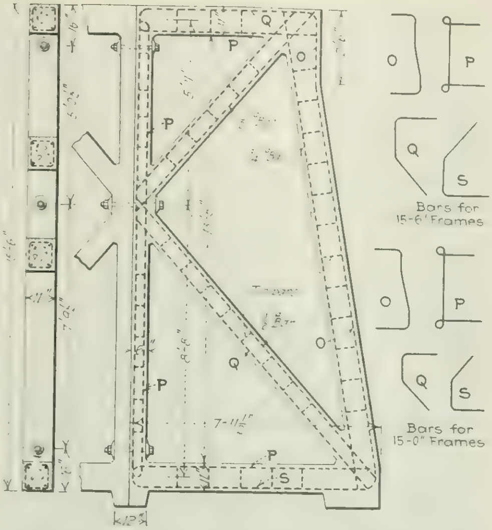
CROSS SECTION OF FLUME FORMS ASSEMBLED

of the annual cost to maintain the structure in perpetuity. To make the estimated costs of the several types of construction directly comparable the annual cost to maintain the structure in perpetuity was capitalized, using a basis of 6 per cent.

The precast concrete type of flume was finally adopted, the decision being based almost wholly on the capitalized cost. The advantage over the metal and wood flumes is probably much greater than shown by the capitalized cost. It is doubtful if either the metal or wood flumes would have a dependable life of twenty years. On the other hand, there is every reason to believe that the precast concrete flume with reasonable care will have a longer life than estimated.

Construction Planning—As a preliminary to the design of forms and the plant layout, a study was made of construction methods. Concreting was to begin about May 1, the number of forms and the plant layout were to be such that the precast work would be completed during the latter part of August. The flume sections were to be cast continuous and to be left in place until they were to be erected. Use was to be made of a simple and economical joint and end form which could be left in place. The interior flume section forms were to be constructed and braced in such a manner as to permit the use of portable track and small flat top cars for moving the forms ahead. The concreting machinery was to be mounted on a traveler and the concrete mixer to be set at a sufficient height to permit of chuting the concrete directly to the forms. The steel units for the stringers and flume sections were to be tied ahead of the forms. The work of dismantling of the old timber flume and the erection of the new flume was to be treated as one job.

Form Requirements—Accurate formwork and casting of all precast units were of the utmost importance to insure close fitting in the completed structure. Of almost equal importance was the matter of securing forms that would fit in with the general construction plan. The requirement was for simple forms that could be easily and quickly moved and assembled. For the flume sections it was deemed essential that the method of interior bracing be such as would permit the use of portable track and low flat cars for moving the forms ahead. The forms used gave excellent service and required but few measurements in assembling.



PRECAST BENT FRAME FOR 17 FT. 6 IN. UNIT

Flume Sections—The outer and inner forms were 8 ft. 7½ in. long and corresponded in length to two flume sections. Twenty-four sets of inner and eighteen sets of outer forms were provided. The forms were used from twenty to thirty times and were still in good shape when the job was completed. For each setting the forms were thoroughly scraped and sprayed with oil.

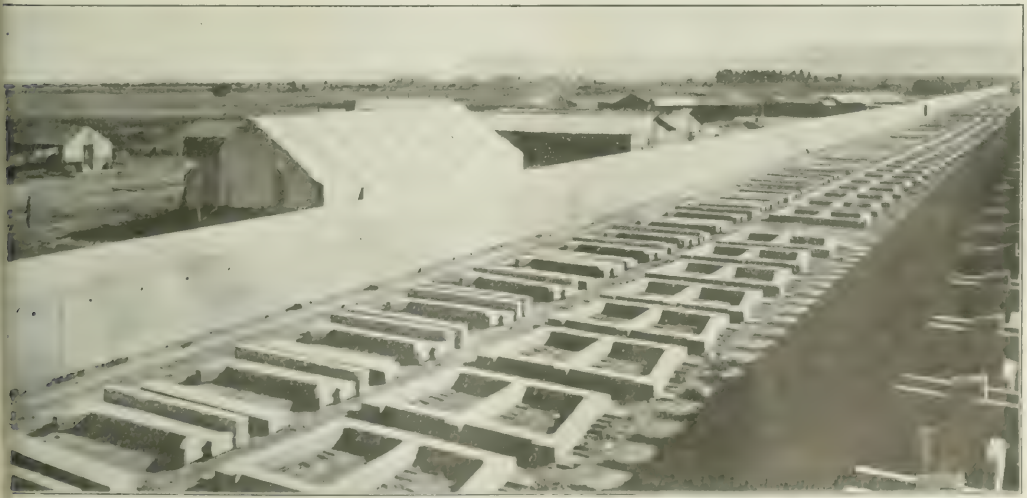


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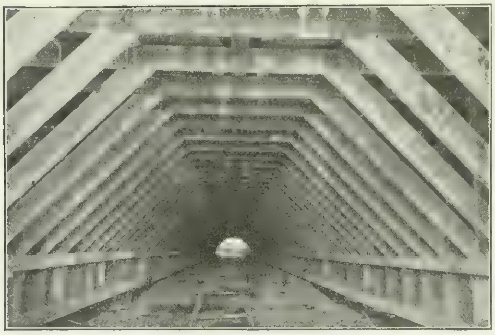
TABLE I—REPLACEMENT OF "C" CANAL FLUME—COMPARATIVE COSTS FOR DIFFERENT TYPES OF CONSTRUCTION

	Flumes			Siphons		
	Semi-circular				Precast Lockjoint Pipe	
	Galvanized Metal	Wood	Precast Concrete	Monolithic	With Concrete Cradle	Without Cradle
Assumed total life of structure . . .	20	20	50	50	50	50
Estimated total construction cost, overhead and contingencies not included .	$129,440	$109,300	$134,892	$190,460	$171,520	$175,220
Yearly interest on first cost at 6 per cent	7,766	6,558	8,093	11,428	10,291	10,513
Annuity required to replace at end of estimated life at 6 per cent compound interest	3,518	2,971	464	655	590	603
Annual allowance for maintenance and repairs	1,000	800	400	200	200	200
Total annual cost of structure	12,284	10,329	8,957	12,283	11,081	11,316
Present capitalized cost to maintain in perpetuity at 6 per cent .	204,700	172,100	149,300	204,700	184,700	188,600

Note: The estimated costs do not include the intake, outlet or other special structures.

The studding for the forms was placed at intervals of 18 in. with 2 x 4-in. material used for the inner forms and 3 x 4-in. for the outer. For the top forms the studding was placed flat. The lagging consisted of 1-in. surfaced material and was covered with No. 26 gage black sheet metal. The roof beams consisted of 5-in. 6.5-lb. structural steel channels. They were spaced the same as the studding and were bolted to the inner forms. The forms and roof beams were held in position by corner braces, two to each roof beam. The roof forms were made in two parts, leaving an 8-in. gap at the center which was closed by a strip of sheet metal and a 3 x 4-in. timber cap. Bolt holes in the braces, studding and roof beams were carefully bored to permit interchanging the various parts. All bolt holes in the studding and braces were protected by strap washers nailed in position. Square-headed bolts ¾ in. in diameter with winged nuts were used throughout.



UNRESTRICTED SPACE IN INTERIOR OF FORMS

The interior flume section forms were constructed to permit the use of track and small flat cars for moving the forms ahead. The side wall forms were held together by three tie rods passing through the forms and waling strips at each joint. The roof beams consisted of 5-in., 6.5-lb. structural steel channels. When this picture was taken the forms had been used fifteen times.

For setting the flume section forms continuous 2 x 12-in. sills and 3 x 3-in. separators were placed first, usually several hundred feet in advance of the forms. The sills and separators were placed on previously established line and grade, the latter being approximately the natural slope of the ground. The 3 x 3-in. separators were set with a gage and spiked to the sills, the distance between the separators corresponding to the width of the flume.

The inner forms were placed first, the bottom of the wall form being set on the 2 x 12-in. sills and against the 3 x 3-in. separator. The forms were then wedged up to the desired height. The previously tied units of reinforcement, the joint forms and the form for the 3-in. hole at the center of gravity of the section, for turning, were placed next. The outer forms, waling strips and top ties were then placed in position and the forms drawn tightly against the joint forms. The reinforcing steel was suspended from 2 x 4-in. stringers placed over the top ties.

Three sets of waling strips and a tie across the top were used to hold the inner and outer forms together; for interior bracing two corner braces were used for each roof beam. The side wall forms were held together by three tie rods passing through the forms and waling strips at each joint. The tie rods were made of ½-in. square and round iron with a loop and shoulder at one end, the round part being only long enough to permit the necessary threading. The holes for the rods marked the ends of the flume units; the tie rods passed through the slots in the joint forms and came in contact with the end separator, thus preventing the bending or buckling of the joint form while concreting. The top ties consisted of 3-in. I-beams, adjustable at one end. Holes, ⅛-in. in diameter, were bored in the flanges of the I-beams at intervals of 18 in. The top ties were placed directly over the top joint form, and the vertical member of the joint form was prevented from tipping by nailing through the small holes in the I-beam.

The outer forms were usually removed in two days and the inner forms in three days after concreting. The outer forms were tipped out and loaded directly on small flat cars. Before removing the inner forms, a 4 x 4-in. post was set directly under the continuous cap, supporting each flume section at the center. The inner forms were then removed, the parts being carried beyond the posts and loaded on flat cars. The posts and continuous caps supporting the roof of the flume sections were removed about fifteen days after pouring.

Joints—The joint forms were built of specially machined material, the pieces forming the joint being hollowed out to take the wire mesh. The inner part of the form was reclaimed in about fifteen days, the remainder of the form being left in place until the units were erected. Slots were made in the pieces forming the joint to permit the tie rods to come in contact with the end separator; this prevented the joint forms from bending while the concrete was being poured.

Bents—The solid and framed bents were built to fit the elevations of the old pedestals. For the framed bents standard heights varying by intervals of 6 in. were adopted. The standardization of the bent heights greatly simplified the forms and the work of bending and placing the reinforcing steel. The tops of the old pedestals varied in elevation by odd amounts; frequently those in the same bent varied in elevation by an inch or more. The difference between the standard bent height and the height required to fit the pedestals was made up by casting three concrete footings, varying from 2 to 6 in. in height, on the bottom of the bent sill. By building the bents to fit the height of the old pedestals, shimming during erection was reduced to a minimum. This arrangement was in accordance with the general plan of dismantling the old flume and erecting the new flume at the same time, using only one hoisting rig.

The Casting Yard—The casting yard occupied a strip of ground 100 ft. wide, parallel to and adjacent to the old flume. The old flume leaked badly and considerable work was necessary to properly drain, fill in and level the casting yard. For a distance of 3,000 ft. the waste dumps of conveniently located drainage ditches were used to fill in the casting yard. The drainage of the yard was accomplished by digging a small ditch parallel to the old flume and close to the pedestals.

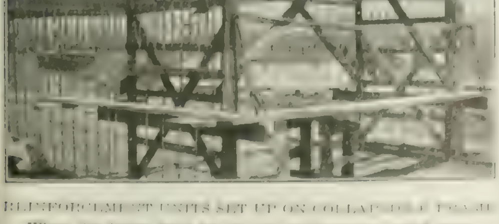
A slough 150 ft. wide and the diversion canal were crossed on pile trestles. Due to leakage and spray from the old flume, no casting was done within 12 ft. of the nearest pedestal. During unfavorable winds the spray was kept away from the work by canvas curtains temporarily nailed to the old flume.

Reinforcing Steel—The thickness and shape of the precast units was such as to require the accurate bending and placing of all reinforcement. The work of bending was remarkably well done, the various bars fitting into place almost perfectly. The reinforcing steel was cut to length before shipment. The benders and other tools were made on the job.

For the flume units the reinforcing steel was bent on a table into which pins were bolted at the required intervals. For the looped bars, short pieces of pipe of the required diameter were placed over the pins. Ordinary right and left-hand hooks were used for making the bends. As gages were set for each bend, no measurements were made after the gages had been set, except to check the overall length of the bars. Two men working together averaged about 500 of the *A* and *B* bars per day. For the *C* bars two men bent about 300 per day, only one man bending at a time. For the *D* bars one man bent about 250 bars per day.

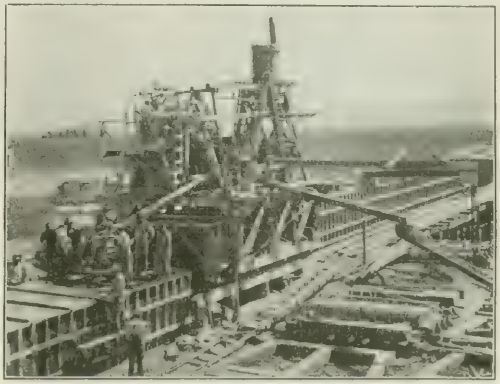
The hooks and other bands for the stringer steel and also for the bent steel were bent on an ordinary bench bender, a pipe vice being used for holding the bars where no creep could be permitted. The looped bars for the framed bents were bent around the hub of a wheel, the diameter of the hub being varied as required. On the wheel bender the wheel revolved on a vertical axle. With this rig three men bent 200 of the double looped bars per day.

The steel units for the flume sections and for the stringer units were prepared well ahead of the concreting and were lifted into position as the forms were placed. The steel units for the flume sections were tied on a collapsible frame directly on the sills ahead of the forms. Four men tied about twenty complete units per day. For the framed bents the reinforcing steel and hoops were tied directly over the forms and when completed were lowered into position. The use of patented tie wires and tying tools greatly expedited the work of preparing the reinforcement units.



REINFORCEMENT UNITS SET UP ON COLLAPSIBLE FRAME

When the forms were set up the reinforcement units were lifted into position



TRAVELING CONCRETE EQUIPMENT POURING SECTION

The concreting equipment was mounted on a traveler which straddled the flume section forms. The traveler was rigged with an A-frame and booms and chutes for chuting the concrete directly to the flume forms at the back or to the stringers and bent forms at the side.

Concrete Plant—The plant consists of a traveling platform on which were mounted the 10-cu.ft. concrete mixer, water tank and a 6-hp. reversible gasoline hoist for moving ahead. The traveler straddled the flume section forms and was rigged with an A-frame and booms and chutes.

A material supply track for charging the mixer was laid parallel to the line of the flume. Sand and crushed rock were delivered in piles placed at intervals of about 50 ft. The concrete materials were shoveled into small cars and dumped into the charging skip. Water for mixing was pumped from the old flume. Cement was hauled from the storehouse.

Materials—Sand shipped in from Marysville, Calif., about 400 miles, was of medium coarse uniform grains, the particles consisting of a hard siliceous material, well graded as to size. The crushed rock was procured from a local quarry, 12 miles away, and was furnished in two sizes, No. 1 passing a screen of ¾-in. mesh and No. 2 passing a 1½-in. mesh and held on a ¾-in. mesh. The rock used is a hard tight-grained black syenite. The cement and sand were delivered on cars, 4 miles from the job. The hauling was done by motor truck, under contract. Transportation of sand cost $2.25 per cubic yard including loading. Other freight cost from 32 to 35c. per ton-mile for hauling. The crushed rock was delivered on the job by motor truck by a local contractor.

Mixing—Concrete proportions were one part cement, hydrated lime, 10 per cent by weight of cement, one and one-half parts of sand and three parts of crushed rock, consisting of about 30 per cent of No. 1 and 10 per cent of No. 2. The minimum amount of water was used in mixing and each batch was kept in the mixer about

LIFTING THE FLUME SECTIONS INTO PLACE

two and one-half minutes before dumping. The mixed concrete was always of a jelly-like consistency and flowed slowly down the chutes, which were set at an angle of about one vertical to three horizontal.

Placing—In pouring the flume sections, considerable care was necessary, particularly with the thin side walls. The main considerations were to secure maximum density and to avoid cracks, particularly at the intersection of the floor and side walls, and also to secure a smooth surface at the inner and outer faces. The concrete in the side walls was brought up in 1-ft. lifts on several sections to give ample time for working the concrete.

The concreting layout and the number of forms were planned for a monthly progress of 1,200 ft. Usually from 40 to 60 ft. of completed flume were poured each day, but the high run during the job was 105 ft. of completed flume.

The bottoms of the flume sections were screeded to true lines by means of a 3-in. beam, worked across the tops of the outer wall forms. The flume sections were then finished with a steel trowel but the bents and stringers were rough finished. All corners of the precast units were rounded.

Curing—The flume section forms were removed in two or three days, but the side forms for the bents and stringers were usually removed in one day after pouring. The bents and stringers were kept moist by spraying for a period of ten days.

For the flume sections the top was covered with burlap immediately after finishing and the sides after removing the outer forms. The burlap was used in strips about 7 ft. wide and 100 ft. long and left in place for about 10 days. It was kept saturated by two lines of 1-in. perforated pipe laid along the top of the flume sections.

For the inside of the flume sections the air was kept moist at an even temperature for 10 days by steaming during the night, the steam being supplied from a 30-hp. boiler mounted on trucks. A low-pressure wet steam was used, the object being to create a dense fog containing a maximum amount of moisture at a low temperature. The steaming process was usually confined to a length of 300 ft. Canvas curtains used at the ends of the section being steamed, were shifted daily.

Dismantling and Erecting—The work of dismantling the old timber flume and of erecting the new precast concrete flume, which was treated as one job, progressed at the rate of about 65 ft. per day. The crew consisted of a hoistman, fireman and five hookers and erectors. The equipment consisted principally of a traveling stiff-leg derrick and special lifting rigs for handling the precast units. The derrick was equipped with a 72-ft. boom and had a lifting capacity of about 10 tons.

In dismantling the old timber flume the waterway was sawed into 20-ft. sections and lifted to one side. The old flume was cleared away to the limit of reach of the derrick before beginning the erection of the precast units.

In erecting the precast units the bents and stringers were set up to the limit of reach of the derrick, after which the flume sections were lifted into position. The bents were lifted into position on the pedestals and plumbed, levels were then taken on each end of the bent cap to determine the amount of shimming necessary to bring the top of the bent up to grade. The bent was then removed. Where no shimming was necessary, the tops of the pedestals were treated to a thin coating of grout and the bent placed in position. Where shimming was required, metal shims, 1½ x 8 in. and of varying thickness, were used to support the bents until the grout had set. More than one-half of the bents required no shimming. Where shimming was necessary, it usually amounted to about ⅛ in. and occasionally as much as ¼-in. was required. Little trouble was experienced in settling the stringers. Occasionally one was found where the top and bottom faces were not parallel to each other and a small amount of shimming was necessary.

The rig for lifting the bents and stringers consisted of two pairs of heavy iron tongs, one pair being fastened to each end of an I-beam spreader 8 ft. long. For lifting the bent clear of the bottom form a sling fastened to the middle of the spreader was passed around the cap, the bent was then lifted to a vertical position, the sill resting on the ground, the hoisting rig was then lowered and the tongs clamped under the cap.

THE PRECAST CONCRETE FLUME IN OPERATION

Walkway at side supported on inserts at center of each flume section. Leaks were negligible, most of them closing in thirty days.

For lifting the flume sections the rig consisted of two side pieces of steel of sufficient length to permit turning the flume sections. At the upper end the side pieces were fastened to a spreader and to chains for hooking.

TABLE II—FIELD COSTS OF THE PRECAST UNITS

Item	Unit	Unit Cost	Cost per Cu.Yd. of Concrete
Sand	cu yd.	$5.50	$2.47
Sand hauling			0.38
Crushed rock	cu.yd.	6.64	6.45
Cement and hauling	bbl.	4.65	7.42
Reinforcing steel and hauling	lb	0.043	9.60
Reinforcing steel bending and placing	lb	0.0089	1.94
Forms, material			3.27
Forms, constructing			1.80
Forms, moving and assembling			4.20
Labor concreting			2.71
Curing			1.14
Water, fuel, lubricants and power			0.29
Laying track			0.60
Equipment and plant charges			4.53
Total per cu.yd.			$46.80

At the lower end, 2½ x 10-in. trunnions were bolted to the side pieces. In lifting the flume sections the trunnions were inserted in the 3-in. hole cast at the center of gravity of the flume sections; the ends of the trunnions were then hooked together with a chain. The flume section first was lifted a few inches and cleared from the adjoining units. It was then lifted to a height of several feet and turned right side up by four men. The wood joint and end forms were removed and the section swung into position.

Joints—The joint used gave no trouble in erecting and was well adapted to take up slight variations in the thickness of the stringers or in the thickness of the floor slab. When the sections were set up most of the joints fitted so closely as to preclude the insertion of an ordinary table knife.

In making the joints watertight the wire mesh was first bent out and the joints thoroughly cleaned; the joint was then covered with a mixture consisting of about 60 per cent of petrolastic cement and 40 per cent rubberoid plastic cement. The wire mesh was then bent back into position and the joint grouted. At first it was intended to cover the joint with the rubberoid plastic cement only. The process of placing the rubberoid, however, proved to be laborious and expensive, particularly on the vertical joints. After some experimenting, the rubberoid plastic was mixed with sufficient petrolastic cement to make the combination liquid when heated in a small portable 20-gal. heater.

TABLE III—SUMMARY OF TOTAL COSTS OF "C" CANAL FLUME

Class of Work	Unit	Quantity	Unit Cost	Total
Excavation	cu.yd.	100	$2.70	$270.96
Mfg. precast units	cu.yd.	2,600	46.80	121,698.31
Leveling precast yard				7,468.47
Dismantling old flume	lin.ft.	4,226		2,007.41
Erecting new flume	lin.ft.	4,226	2.20	9,268.87
Highway crossing	cu.yd.	73	53.60	3,955.85
Grouting flume joints	each	990	4.00	3,961.75
Diversion canal crossing:				
Metal work	lb	6,400	0.155	992.90
Concrete reinforcement	cu.yd.	9	35.95	323.34
Concrete, plain, piers				91.50
Backfill, dry	cu.yd.	100	1.19	118.80
Grouting stringers				1,949.77
Concrete struts	cu.yd.	40	47.80	1,896.97
Parallel walk, metal work				1,117.96
Parallel walk, wood work	M b.m.	5.98	27.20	162.43
Turnout gates, metal work	lb	2,790	0.29	800.56
Turnout gates, concrete reinforcement	cu.yd.	10	35.86	358.65
Right of way				231.87
Camp maintenance				6,979.05
Engineering and inspection				3,312.38
Sub-total				$166,967.80
Flume, inlet				1,884.57
Flume, outlet				[illegible]
Flume, wasteway				[illegible]
Sub-total				$174,756.70
Superintendence and accounts				8,891.93
General expense				14,621.75
Total				[illegible]

For pouring the joints, an iron pot resembling a coffee pot was used. The bottom joints being level were easily poured. The vertical joints were poured from the top, the stream following down the joint and pouring being continued until the stream had nearly reached the bottom. Pouring was then stopped and the mixture smeared over the joint with a hot iron from the bottom up. A second pouring was made and flattened similar to the first. The asphaltic covering over the joints averaged about 1¼ in. wide and about ¼ in. in thickness. The spreading irons which were bent in the form of the letter "J" were made from an old Ford spring and were fitted with a wooden handle. With a pouring crew of three men about sixty joints were completed per day.

Grouting—Before grouting the joints were thoroughly cleaned with an ordinary blacksmith's hand blower with a short section of hose. The vertical joints were poured from the top and were spaded between the wood form and the wire mesh with a thin piece of strap iron.

The precast concrete flume was constructed and erected by government forces working under the direct supervision of J. C. Whitney, superintendent. The work of surveys and inspection was performed mainly by E. L. Stephens, assistant engineer.

An average force of about 100 men was employed from May 1 to August 15. Quarters were furnished free to the men, also spring cots and mattresses. Meals were charged for at the rate of 45 cents each. The wages paid were as follows: Sub-foremen, engine operators, blacksmith and carpenters, $4.96 to $6.72; carpenter helper and special laborers, $4 to $5, teamsters, $4; common labor, $3.60; waiters, $60 to $65.

The replacement of the Klamath flume was done under the general supervision of A. P. Davis, director, U. S. Reclamation Service, F. E. Weymouth, chief engineer, J. L. Savage, designing engineer, H. D. Newell, project manager, and the writer as engineer.

Oil and Steam Engine Costs for Small Towns

COMPARATIVE costs of oil and steam engines for furnishing a water supply and electricity in small towns were given recently in a paper by George T. Prince, consulting engineer, presented to the Iowa Section of the American Water Works Association. Mr. Prince assumed towns of 1,000, 2,500, 5,000 and 10,000 population and gave unit costs as follows, based on his own observations and various other sources:

		Cost of Power Plant		Annual Maintenance and Operating Expense		Unit Cost per Kw.-Hr.	
Population	Probable Annual Output in Kw.-Hr.	Steam	Oil	Steam	Oil	Steam	Oil
1,000	198,000	$35,300	$31,500	$13,874	$8,992	$0.070	$0.045
2,500	648,000	[illegible]	53,200	19,798	[illegible]	.030	.0234
5,000	1,300,000	82,000	[illegible]	30,405	26,492	.023	.0204
10,000	2,700,000	117,500	103,000	49,348	39,303	.0183	[illegible]

The above maintenance and operating expenses include labor, fuel and lubricating oil, repairs, 6 per cent interest on investment, depreciation based on 4 per cent sinking fund. Life of oil engines is assumed as 15 years, all other property, 25 years. Price of coal is taken at $8 per ton for 1,000 and 2,500 population towns; hand firing; evaporation, 6-1. Price of coal, $7.50 for 5,000 population; mechanical stokers; evaporation, 8-1. Price of coal, $7 for 10,000 population; mechanical stokers; evaporation 8-1. Price of fuel oil, 6c per gallon. Price of lubricating oil, 60c per gallon.

Road Grading Costs Reduced By Tractor Hauling

Plant Investment and Operating Costs Itemized for Two Heavy Grading Operations in Iowa and Missouri

By E. R. Wiggins
Holt Manufacturing Co., Peoria, Ill.

A COMPARISON of tractor-operated elevating graders with tractor-hauled four-wheel scrapers is afforded by two road-grading operations recently studied by the writer. It is possible also to give actual plant costs and estimates of the earth moving costs which are informative. In general it may be noted that these completely-motorized grading operations are becoming increasingly common in the roadbuilding of the Mississippi valley states.

Elevating Grader Outfit—In Crawford County, Iowa, a five-mile road requiring 180,000 cu.yd. of excavation is being built with elevating graders and tractors (see Fig. 3). This road, located two miles west of Manilla and forming the main thoroughfare between Manilla and Dennison, is very hilly and has grades as steep as 20 per cent. When completed all the hills will be cut down, fills made and a balance so arrived at that no grade will be more than 6 per cent. Representative cuts are 25 ft. deep, while the corresponding fills are 22 ft. high. The first estimates gave the dirt to be moved as 30,000 cu.yd. to the mile, but the actual work shows that this figure is being overrun by 20 per cent. One hill alone had over 30,000 cu.yd. to be moved. The Shirley Construction, Omaha, Neb., has the contract for this work. It is using three 10-ton caterpillar tractors, one of which is operating an elevating grader, while two are pulling 4½-cu.yd. dump wagons, two wagons to a train. A Cletrac tractor is also being used at times to pull a blade grader for smoothing and for doing odd jobs about the camp.

The average haul is very close to 700 ft. and, considering a full cycle of operations from the time of one load to the next, by the same train, takes ten minutes. Allowing for some delays that occur, 1,000 cu.yd. are hauled a day. The work is being carried on in the conventional elevating-grader manner, the 10-ton tractor pulling the grader takes a maximum cut in both directions, up and down grade. Loading is done at low speed, while the hauling to and from the dump is on high.

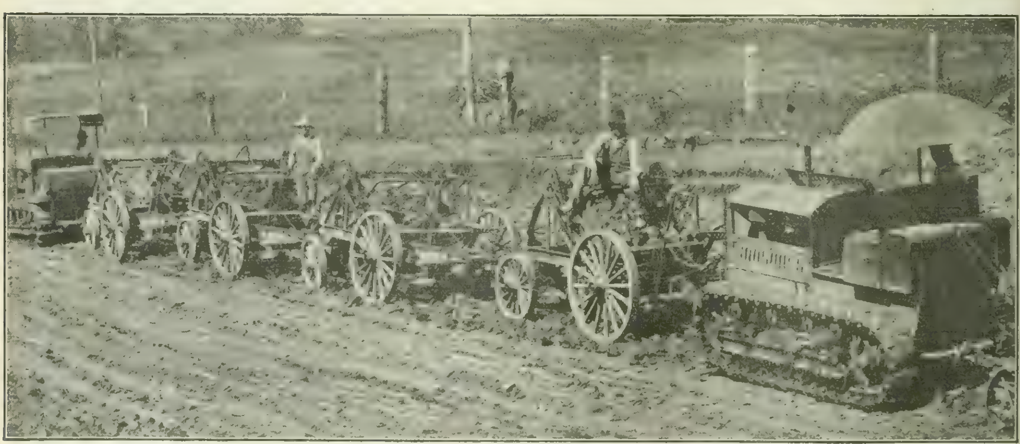


FIG. 1—TRAINS OF WHEEL SCRAPERS PULLED BY 5-TON TRACTORS

Including Paul Shirley, one of the firm, who acts as timekeeper, there are 12 men. The list besides Mr. Shirley follows: One foreman, who is also a specialized tractor service man; three tractor operators; one blacksmith; one cook; one plow holder; one dump man; one "skinner"; one tripper and one sloper. Mr. Shirley estimates the value of the equipment on the job to be $27,360. This is made up as follows:

3 10-ton tractors	$18,150
1 Elevating grader	1,400
4 Wagons	3,400
1 Small tractor	1,450
1 8-ft. blade grader	700
2 Mules	400
1 Tongue scraper	25
1 Ford car	400
1 Wagon for the office, has desk, beds and supplies	250
1 Wagon for the kitchen and dining room	250
1 Bunk shack	250
1 Blacksmith shop and equipment	300
1 Large tent for the mules and where the tractors are stored on rainy days	200
1 No. 5 plow	25
1 No. 2 slip plow	10
1 Incidentals, such as beds, kitchen equipment, etc	150
Total	$27,360

The equipment directly concerned in the movement of the dirt includes the three tractors, an elevating grader, four 4½-cu.yd. wagons, the blade grader and the tongue scraper, which in total value amounts to $23,675.

An analysis of the daily dirt moving costs on the Shirley job is as follows:

Depreciation 20 per cent on dirt moving equipment	$31.57
Interest on the investment at 6 per cent	9.47
Wages, board and lodging of operators	22.80
120 gal. gas at 22 cents	26.40
2¾ gal. lubricating oil at 80 cents	2.20
Upkeep 25 per cent depreciation	7.89
Foreman	7.50
Total	$107.83

Added to this sum is the expense of dumping the blade grades and of a man and team, $6.97, making a total for a day of $114.80. On the basis of 1,000 cu.yd. of dirt moved a day, the cost per yard is 11½c. Daily depreciation is calculated on 150 working days per year and is 20 per cent of the original value. A tractor's life is figured at four years, and at the end of the fourth year the machine is worth an amount equal to the depreciation for one year.

Wheel Scraper Outfit—In Missouri, F. L. Bondurant is completing a contract for a 5½-mile road near Unionville in Putnam County, which is a project involving the straightening of many turns, the cutting down of hills and the making of extensive fills. He is using four 5-ton tractors. Two of these are operating trains of four to six 1-yd. wheel scrapers; another is used with a rooter plow, keeping well ahead of the scrapers, plowing the road, and the fourth is attached to an 8-ft. blade grader.

TABLE I—COST OF TRACTOR OPERATED WHEEL SCRAPER OUTFIT GRADING ROAD

Equipment:	
4 5-ton tractors	$15,900
12 wheel scrapers	5,100
1 10-ft. blade grader	1,350
1 8-ft. blade grader	
1 7-ft blade grader	700
1 tractor rooter plow.	150
1 bulldozer scraper....	325
1 Fordson tractor	425
1 water wagon .	90
1 tool wagon . .	400
1 gasoline wagon	300
1 walking plow.......	25
Total ..	$24,765
Personnel:	Per Day
1 foreman at $150 per month	$6 00
4 drivers at 40 cents per hour	16 00
1 dump boss at $125 per month	5 00
6 scraper men at 35 cents per hour	21 00
Total ...	$48 00
Operating expense:	Per Day
120 gal. gasoline .	$25.20
3 gal. cylinder oil at 82 cents	2 46
Transmission oil.....	.90
Cup grease........	1.40
Axle grase.	1.50
Total. . .	$31.46
GENERAL:	
Depreciation at 20 per cent..	$33 00
Int. on investment at 6 per cent	9 91
Repairs ..	10 00
Insurance 3 per cent payroll.	1 44
Bond	3 00
Total. ...	$57 35
RECAPITULATION:	Per Month
Payroll ...	$1,248.00
Operating expense	817.96
Depreciation at 20 per cent	858.00
Int. on investment at 6 per cent	257.66
Repairs. . . .	260.00
Insurance 3 per cent payroll	37.44
Bond .	78.00
Total	$3,557 06

In operating the tractors pulling the wheel scrapers, the loading is handled on low gear, and as all the hauling is down grade, most of the hauls are made on high. The daily output on the average is very close to 650 cu.yd. During the month of June, 1922, this outfit worked 23 out of 26 working days, and moved 17,000 cu.yd. The average haul, from turning point to turning point, was from 800 to 1,000 ft. The loading of the scrapers is close to full capacity. According to one actual count, out of 13,300 loads, 12,400 cu.yd. of earth were moved, a difference of but 8 per cent. This figure on some counts ran as low as 3 per cent. According to one observation of time, it took 8 minutes to make one complete circuit with 800 ft. haul. Under similar conditions but with a haul of 1,600 ft. the trip was made in 10 minutes. Records for one day show that one train made 59 trips, while the other made 58 trips per 10-hr. day. On the other hand, one day's run showed that 964 scraper loads were hauled. In a month's run, the average number of wheel scrapers used per day is nine.

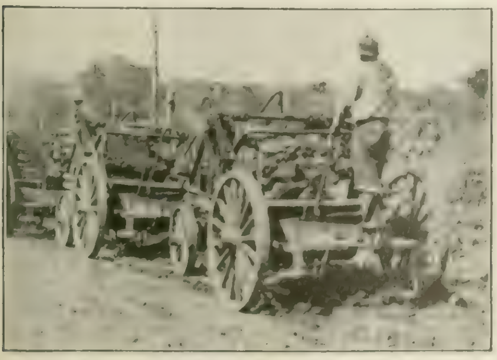


FIG. 2—REPRESENTATIVE WHEEL-SCRAPER LOADS

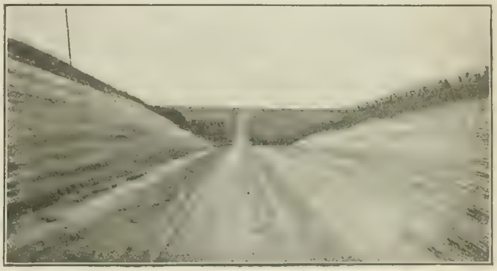


FIG. 3—REPRESENTATIVE CUT, MANILLA, IOWA

Table I gives the equipment with its value, personnel and wages, daily operating expense and general daily expense. The final figures sum up the various daily costs into a monthly cost sheet, from which the unit cost on the basis of yardage hauled is calculated. The cost for moving this dirt is calculated from the figure of 26 days per month, because this is believed to be a fair average. If dirt was not being hauled on rainy days, other work was being done.

A.R.E.A. Committee on University Relations

In order to develop closer contact between the railways and the technical schools the board of direction of the American Railway Engineering Association has authorized the appointment of a committee for co-operation with universities and colleges. As a preliminary a special committee of the board wrote to about a hundred universities and colleges in the United States and Canada requesting suggestions as to the names of alumni to represent these institutions on the committee. The main purposes of the new committee are: (1) to arouse greater interest among railway officers in assisting the universities to turn out men with the most efficient training; (2) to give the universities the results of the work of the association's committees; (3) to acquaint employers with the qualifications of the graduate in entering railway work; (4) to stimulate greater interest in the study of railway engineering; and (5) to establish co-operation between university laboratories and the association's committees for the benefit of research work. E. H. Ford, assistant chief engineer of the Chicago, Rock Island & Pacific Ry., is chairman of this committee.

Surveying Without Instruments on Siberian Railway

Some Hints on How Topographic Work May Be Done With Reasonable Accuracy By Improvised Plane Table and Other Devices

By William Ewald
Civil Engineer, Sao Paulo, Brazil

SEVERAL times on surveys in Siberia for the Siberian Ry. and along various Siberian rivers, surveying instruments reached their destinations entirely unfit for use, in spite of precautions taken to transporting them by reindeer and dogs. In some instances, the boxes containing the instruments were even filled with tallow or wax, but even such provisions proved inadequate. There was no assurance that a duplicate set of instruments would not suffer the same fate and on the other hand valuable time would have been lost in waiting for them, so in order to avoid complete cessation of the whole work, it was decided to make surveys without any precise instruments or even without an exact unit of measurement.

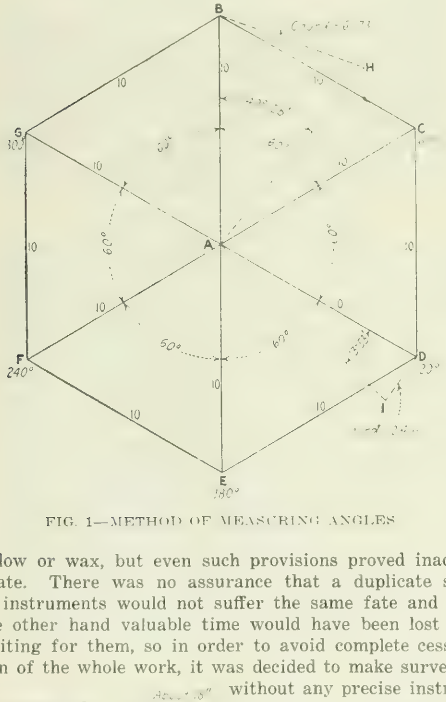


FIG. 1—METHOD OF MEASURING ANGLES

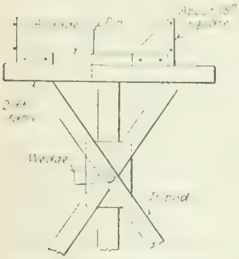


FIG. 2—HOMEMADE PLANE TABLE

A great amount of photographic work in the region above mentioned was actually done by homemade devices which included a plane table and other rude instruments.

Linear Measurements—First, a unit of measure was established in the following manner: A rod about 5 m. long was cut from a young pine tree and subdivided into small equal parts, the smallest subdivision being about a millimeter in length. After one was available, this unit of measurement was checked up against the official Russian measuring tape and all calculations on plans reduced to the Russian standard, the sajène. For measuring longer distances a cord made of horsehair was used. Hemp or cotton was found to be subject to too much change through dampness.

Angular Measurements—Horizontal angles were measured by measuring the chords. A maximum error of two minutes was allowed. The method in which the angles actually were measured is indicated by Fig. 1.

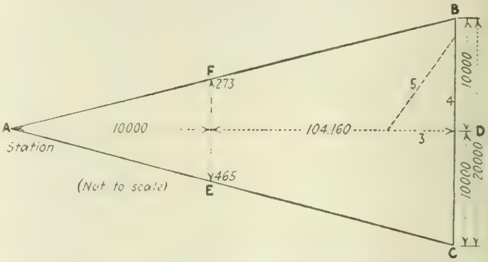


FIG. 3—METHOD OF LINEAR MEASUREMENT

A triangle of wire of equal sides, each of 10-unit length, was made with a thin rod, large nail, or a piece of thick wire placed at each corner. By placing one point of the triangle on station *A*, points *C* and *B* were established and in like manner points *D*, *E*, *F* and *G*. On this large limb it was found easy to measure chords of any angle around station *A* within the two-minute limit.

For instance, in order to measure angle *BAH*, the ten units from *A* to *B* were taken in the direction of one of the sides and *AH* is the direction of the other side, then the length *BH* marked by thin pegs was found to be 6.173. By a simple trigonometric calculation this chord is found to subtended by an angle of 40 deg. 28 min. For a larger angle, such as *BAI*, the chord from *B* to *I* was measured, the angle calculated and added to the known angle *BAD*.

Another manner in which angular measurements were made was by the use of a homemade plane table. This plane table was composed of a tripod modeled after the field seat used by landscape painters surmounted by a plane table about 2 ft. square laid loosely on the tops of the tripod legs. A wooden alidade without any slot or sighting hair, but with two exactly equal wings, allowed horizontal angles to be measured along the vertical sides of the wings and vertical angles along the tops of the wings. A sheet of Whatman paper was pasted on the table, a pin set in the table on the station point, and pencil lines traced along the edge of the paper through the entire table's width.

Measurement of distances with the alidade without using stadia methods was affected in the following manner: Referring to Fig. 3, on both sides of the point *D* mark the points *B* and *C* at ten units each. The right angle *BDA* is secured by a wire or tape and the 3—4—5 method. Short rods with black and white targets capable of being seen a mile distant were placed at *B* and *C*. At ten units from *A*, a scale with small graduations about a millimeter in length was held horizontally on a wire the other end of which was attached on the peg at *A*. In order to avoid this rule shifting horizontally, it rested on two rods in the ground. Readings were taken across this horizontal scale from *A*, sighting at the targets *B* and *C*. Points on the scale intersected by these sights were the readings, say 273 and 465, whose difference (192) was the quantity corresponding to the distance 104.16. In the calculation of these distances, a simple use is made of the geometric relationship existing between similar triangles. Should this distance be measured on an inclination, it must be reduced to the horizontal by multiplication of the cosine of the angle as obtained by the leveling process hereinafter described.

Leveling—Level readings were usually taken with a homemade plumb device which consisted of a rectangular wooden frame (see Fig. 4) *ABCE* resting on a triangular wooden pivot *D* and weighted so as to be normally in a perpendicular position. The upper face of the device was planed so that readings could be accurately taken along the edge. The pole supporting this rectangular frame was driven into the ground firmly but still free enough so that it could be revolved at will. By sighting first at the top of the rod (which in this case was 5 m. long) the rod reading was established. Then by a scale held ten units from the level device a reading was first taken with the table in a horizontal position and then at the top of the rod target, with the rod resting on the ground. The distance thus intercepted on the scale, together with the known ten units distance of the scale from the level and the height of the horizon above the target top, established the necessary ratios so that by simple trigonometric calculations all wanted data were secured.

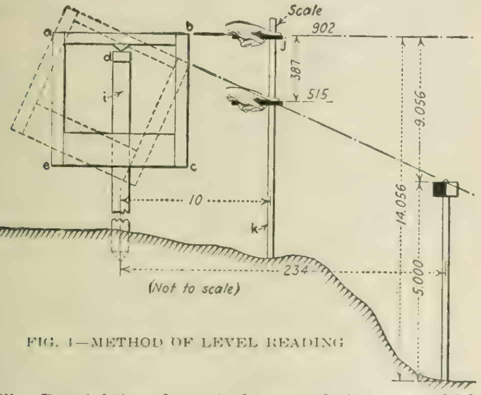


FIG. 4—METHOD OF LEVEL READING

Inasmuch as the sights along the edge of the plumb device might not be exactly horizontal, second sights were taken with the frame turned in a reverse position.

Canadian Water Power Report for 1922

A statement issued by the water power branch of the Canadian department of the interior shows that during 1922 approximately 3,000,000 hp. of electricity was developed from Canadian waterfalls. Of this total, about 1,330,000 was in Ontario; 1,100,000 in Quebec, 310,000 in British Columbia, 110,000 in Manitoba and the remainder in Alberta, New Brunswick, Nova Scotia and Prince Edward Island. The total capital invested in these enterprises is $620,658,731, and the estimated revenue is $81,600,000. The equivalent coal consumption at 9 tons per annum per installed hp. would be a little over 26,725,000 tons, which at the average price of $10 per ton would cost $267,250,000. The use of the water power is divided as follows: central stations, 2,165,000 hp.; pulp and paper mills, 484,288 hp.; other industries, 320,561 hp.

Milwaukee Activated-Sludge Plant To Use Vacuum Filters

By T. Chalkley Hatton
Chief Engineer, Sewerage Commission, Milwaukee, Wis.

FOR reasons stated below, vacuum filters are to be used as a part of the dewatering equipment of the Milwaukee activated-sludge plant. The sludge will be conditioned by heat and sulphuric acid before it goes to the filters and will pass from the latter to driers. The contract for the filters, receivers and condensers has been let to the Oliver Filter Co. for $324,047. It calls for 15,000 sq.ft. of effective filter surface, which will be provided by 30 drum filters, each 12 ft. in diameter by 14 ft. long.

For five years we have been testing out various types of apparatus for removing the water from the activated sludge. This apparatus has consisted of presses of several types: the Berrigan, Simplex, Johnson low-pressure and Johnson high-pressure and the Worcester. Three types of centrifuges have been used: the Sharples separator, open laundry centrifuge and the Besco-ter-Meer.

Filter cloths of many kinds have been tried, grading from coarse India hemp to fine cotton twill. We have used pressures from zero to 6,000 lb. per square inch. The sludge, prior to dewatering, has been conditioned in many ways, such as increasing the temperature, adding sulphuric and sulphrous acid, sulphate of alumina, Sil-O-Cel, peat, ground garbage clinkers, and a few other things. Records have been taken to determine cost and applicability.

Finally, a year ago, after experimenting with vacuum filters in the laboratory, and a vacuum pan, we installed an Oliver filter, 36 in. in diameter, and operated it up to Oct. 1, of this year under the immediate supervision of George S. Backus, engineer for the Oliver Filter Co.

It took several weeks to ascertain how to condition the sludge to get any promising results from the vacuum filter. This filter had been tried out at Champaign, Ill., under Dr. Edward Bartow, and had been abandoned. It was learned at Milwaukee that when the sludge was properly conditioned by raising its temperature before reaching the filter from its normal (whatever that might be) to from 120 to 180 deg. F. and keeping its pH value within the limits of 3.3 to 4 by means of sulphuric acid the filter would produce about 65 lb. of sludge per 24 hours per square foot of filter cloth surface, reducing the moisture content from 99 to 80 per cent, and that it would do this all the time regardless of the character of the raw sludge. The filtrate produced had a bacterial content of about 100 per c.c. which permits its discharge into the river without further treatment. It was also ascertained that the life of the filter cloths used in the vacuum filters was much greater than that of the filter bags used in the presses and that the cloths could be cleaned mechanically without being removed from the filters, and that the operation of the filters required fewer men than either type of press.

The Oliver filters require two different vacuums—22 and 11 in. The first is used for pick-up and the other for water withdrawal. That is, as the filter drum revolves through the sludge one vacuum pulls it to the surface of the cloth whereas the other withdraws the water from the film of sludge after it leaves the wet sludge. This requires two separate sets of vacuum pumps, receivers and condensers. The conditioning of the sludge before filtering is effected by discharging sulphuric acid in the raw sludge as it enters the centrifugal pumps. This is automatically controlled from predetermined standards.

The hot filtrate at a temperature of between 110 and 130 deg. F. is returned from the filters by gravity and passes through heat exchanges on the outer surfaces of the tubes, whereas the cold acidified sludge passes through the tubes and thence through pre-heater tubes around which the exhaust steam from a 1,250-kva. non-condensing steam-turbine-driven generator passes. By this means the heat used in the conditioning is preserved so far as possible and the extra heat required is secured. The current produced by the generator is used to drive the motors in the filter house and drier house, the balance being sent to the main bus bars in the power house to which are connected three 625-kva. condensing turbine generators.

As the sludge cake leaves the filters it is to be conveyed directly to the drier house immediately adjoining the filter house where it is ultimately mixed with partly dried sludge, or that which has once passed through the drier, and goes from thence to the driers.

Experiments on Formation of Floc for Sedimentation

Factors of Velocity and Time Studied at Baltimore With Hydrogen-Ion Concentration Held Constant

By Edward S. Hopkins
Chemist, Montebello Filters, Water Department, Baltimore, Md.

WHAT is the proper velocity of flow and time of passage of water through a mixing basin, after adding the coagulant, to produce good sedimentation? Results are given in this article of experiments made to obtain some information as to the little known conditions favorable for the formation of floc for sedimentation. One factor, the pH value, for good control has been fairly definitely established. (See Baylis—*Journal* American Water Works Association, Vol. 9, No. 3, 1922; Buswell—*Journal* Industrial Engineering Chemistry, Vol. 14, No. 9, 1922, and others.)

Studies and observations suggested by James W. Armstrong, filtration engineer, were carried out in the concrete-covered mixing basin of the Montebello filters, Fig. 1, which is 118 ft. wide, 191 ft. long and 18 ft. deep. The wooden baffles forming the channels are supported by concrete columns. Each of the 24 channels or "turns" is 8 ft. wide. The total distance traveled by the water is 0.56 mile and the time required for passage is 31.8 min. at the nominal 128-m.g.d. rate. The head necessary to force the water through the basin is 3.3 ft. As the bottom of the basin is level and the channels are of uniform width, the depth of water is decreased and the velocity increased from 1.3 ft. per second at the entrance to 1.6 ft. per second at the outlet.

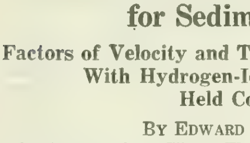


FIG. 1—MONTEBELLO MIXING BASIN
Showing the arrangement of the sampling points

Manholes in the roof served as sampling stations. Station 1 is at the first "turn" or beginning of the mix while Station 10 is at the point of entrance to the settling basins. The other samples came from intermediate points.

No precise method of measuring the time required for sedimentation has been recorded but, for the purpose of this study, the time required for each sample standing quietly to settle until its turbidity equalled that of a comparative sample from the effluent of the settling basin was adopted as the method of procedure. The settling basin sample was taken at the same time as the test sample and the clarification determined simply by the eye.

This study covers turbidities from 5 to 500 p.p.m. and a temperature variation of from 33 to 78 deg. F. As the turbidity increased the pH value decreased but pH^6 was maintained as a minimum in the basin by the addition of lime when necessary. The results presented give averages of 56 tests made at reasonable variations in turbidity for a period of 10 months dating from July, 1921.

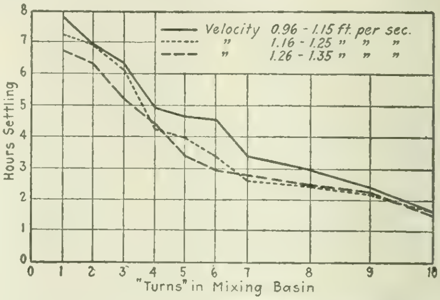


FIG. 2—RATE OF SETTLING OF SAMPLES
Samples from Station 10 always settled in shortest time, at all velocities.

One-liter samples were collected in beakers placed on a carriage at the end of a pole and submerged 2 or 3 in. below the surface. A single sample was collected at each station, beginning in every instance at "turn" 1 and proceeding rapidly to 10. The pH value by the colorometric method was determined and the samples allowed to stand quietly until their turbidity equaled the comparative standard. It is advisable to collect the samples in the same beakers in which they are allowed to stand, because pouring from one vessel to another breaks the floc and produces erroneous results.

The hydrogen-ion concentration did not vary (pH ± 0.1) through the basin. This test was used to establish the uniform application of chemicals in preference to the alkalinity or carbon dioxide determinations because of its rapid manipulation and absolute reliability. A water giving a definite pH value at "turn" 1 mantained the same value at every point in the basin. This condition indicates immediate establishment of the equilibrium of the chemical reaction.

Samples from station 10 having been collected after passage through the basin always settled in the shortest time. The others settled in a proportionately increased time, the length of time depending upon their coagulation.

Realizing that samples with the low turbidities, 5 to

25 p.p.m., are composed of finer particles than those of greater turbidities, 100 to 500 p.p.m., it was thought that comparative rates of sedimentation would be obtained by plotting the time of settling for each station in groups corresponding to the turbidities of the samples. No relative curve could be obtained.

As there is apparently no relation between the time of sedimentation and samples of equal turbidity, the factor of velocity was next considered. Various linear velocities were plotted against the time of sedimentation. Curves in Fig. 2 were plotted showing velocities of from 0.96 to 1.15, 1.16 to 1.25 and 1.26 to 1.35 ft. per second. A study of these curves shows that regardless of turbidity or variation of the velocity, within the limits of this study and with the pH value constant, after a definite time of mix and after traveling about one-half of the basin, the lines converge toward a common center and steadily draw closer together until the last "turn" is reached. Therefore after the thorough mixing of the coagulant, alum, and the water, with the chemical reaction established, further mixing will produce a more readily settleable floc.

Conclusions—It is clearly seen that the first few "turns" produce a fairly good mix but since it requires less time for sedimentation at each subsequent "turn," it is obvious that each "turn" has a value toward decreasing the time of sedimentation. This theory is strengthened by a study of Fig. 3. Portions of the baffling at "turns" 6, 7, 8 and 9 were broken, allowing a short circuit of the water without proper mixing. It is easily seen that there is no correlation between the two curves with the exception of the line represented by the velocities 1.26 to 1.35, which falls steadily. The theory may be advanced that the rapid flow produced the required mixing and caused the formation of a uniform floc.

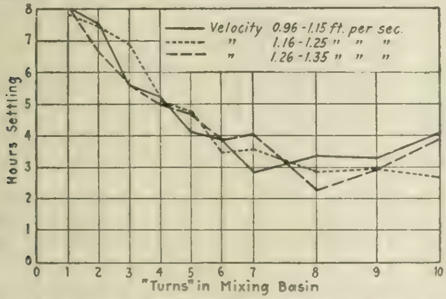


FIG. 3—RATE OF SETTLING WITH BAFFLES REMOVED
Baffles 6, 7, 8 and 9 were partially removed to permit short circuiting.

These studies show very clearly that good coagulation was obtained under all conditions and that two factors contributed to the result. The higher velocities produced a floc that settled out more readily in the first six or seven "turns" and, although the velocity increased gradually throughout the basin and subsequent "turns" have a decided value in forming a floc that will settle quickly, these higher velocities are of less value as the water approaches the last "turn."

Since the subsiding value at the last "turn" is practically the same for all velocities the time element is also of considerable value in securing a proper floc. It was not possible to learn the relationship between these two factors at this point as there is no way of eliminating the unknown variable.

Increased Application of Venturi Flume

VENTURI flumes measuring water to farmers are installed on the Milk River Project of the U. S. Reclamation Service, in four sizes. Their use is augmented by the insertion of a plug to measure small flows. H. Kenneth Smith, assistant engineer of the project, in the November *Reclamation Record* tells of them as follows:

Gage heights are measured with a hook gage from nails driven in the sides of the gage walls. The hook gages are made from strap iron ⅛ x 1 in., graduated by hundredths to 2 ft. Each ditch rider carries one of these hook gages as a part of his regular equipment and uses it as a 2-ft. rule for various purposes.

The discharge is determined from a semi-logarithmic chart, with upper gage heights and draw, or difference in gage heights, as co-ordinates, the discharge in second-feet being read on curves. The sheets are drawn of a size to fit the standard time-book cover of the Reclamation Service.

Operating conditions on an irrigation project often require that a small quantity of water be delivered through a ditch of considerably greater capacity, and at the same time it is required that the water be backed up until the ditch is practically bank full.

Generally it is not practical to instruct a ditch rider to read gage heights to a refinement greater than one-hundredth of a foot, and an error of one-hundredth is quite common. The problem, then, is to construct or modify the Venturi flume so that an error of one-hundredth in gage reading would not be material when delivering water to the farmers.

This difficulty is overcome by installing a plug in the throat of the flume, thereby reducing the water area. This plug consists of two weir boards bolted together, the sharp edges of both boards being toward the throat. A bolt with a thumb nut holds them in place.

These plugs can be placed in the flume or withdrawn while the ditch is in operation. Care must be used that the plug is snug against the bottom of the flume and so tight that it will not float or otherwise become dislodged.

By means of this plug a flow that in the standard design will cause a draw of one or two hundredths will now cause a draw of ten to twelve hundredths and is therefore a measurable quantity. An error of one-hundredth in reading at ten or twelve hundredths is of much less moment than the same error at one or two hundredths.

Four sizes of the Venturi flumes are in use on the Milk River project, having throat widths of 12, 18, 24 and 30 in. For the 12- and 18-in. sizes the height of the plug used is 9 in. and for the two larger sizes the height is 15 in.

These plugs have proved quite satisfactory and have greatly increased the accuracy of the measurement of water on this project.

Piezo-Electric Measurement of High Pressures

A new method of measuring high pressures or rapidly varying forces is discussed in a paper of the Bureau of Standards by J. C. Karcher. If several circular quartz plates are cut from a crystal and placed with an electrical axis perpendicular to them or assembled with metal plates between to form a condenser, any pressure applied to the stack of plates will liberate a charge proportional to the pressure applied, and this charge will appear as a current at the condenser terminals. When the current is measured by a galvanometer and the galvanometer deflection is photographed on a moving film, the pressure may be determined as the slope of the deflection-time curve multiplied by a suitable constant. Experiment has shown that the quantity of electricity liberated by the quartz plates is proportional to the pressure applied, up to pressures of 50,000 lb. per sq.in. Pressure measurements in guns have furnished a check on the action of this new form of gage.

The Present Status of Sewage Treatment in England—I

Impressions Based on Visits to Various Works and on Interviews with British Specialists in January, 1923, Presented with a View to Current American Problems

By George W. Fuller
Consulting Engineer, New York City

This is the first of three articles written for "Engineering News-Record" by Mr. Fuller directly after an inspection of a number of British sewage-works. After the general introduction, the Impressions are grouped under three heads: I. Administration and Policy Questions. II. Status of Older Types of Treatment. III. Outlook for the Activated-Sludge Method. In the present article Mr. Fuller treats of war and post-war handicaps and the present improved outlook. The current British practice of adopting works and methods that will give results commensurate with their cost is held up as worthy of world-wide adoption. The success of a modified decentralized control of stream pollution in England by river conservancy boards for drainage districts instead of the customary political subdivisions, is commended to American consideration.—Editor.

A VISIT of a couple of weeks in England is sufficient to show that sewage treatment practice there has entered a new and interesting period. During the war there was but little construction; in fact, during the last year or two preceding the armistice almost no plant extensions were sanctioned by the military establishment, which required for its own needs practically all available funds, personnel, materials and supplies. Consequently, the operation of sewage-works fell to a low ebb. In some cases there was no pretense of operating pumping stations or treatment works which were turned over to a minimum number of caretakers. In other instances the works were operated with perhaps one-fourth of the normal personnel and with the older, particularly the technical, members of the staff doing the work of machinists and of foremen. Women and German prisoners were availed of at some of the larger works. At some cities trade wastes, associated with military needs, increased while the output of other plants decreased. Constancy in the composition of the flow of outfall sewers became lessened to a degree which varied in different places and at different times and which is probably a factor worthy of note in some instances at present.

War Handicaps—Generally speaking, the English sewage-works got along during the war as best they could, considering the various handicaps under which their managers had to operate them. Ordinarily tanks at industrial works were operated on a plain sedimentation basis by persons not useful in military service. Rivers Boards and Conservancy Boards did but little in the exercise of their jurisdictions and a large proportion of their inspecting staffs joined the colors. In consequence of these factors many of the English rivers became more polluted than they had been for some time previous to the war, and neglected upkeep of the sewage-works caused many of them to reach a deteriorated condition not fully contemplated in earlier years.

Since the armistice real progress has been made in getting old plants back into working condition; in extending and bettering old works; in going forward with the construction of new works that were interfered with by the war; and in projecting new undertakings to supersede old ones. All of this has been done in the face of many unusual conditions. Construction costs are now from 80 to 100 per cent above pre-war prices and at times costs have been 200 per cent above pre-war figures. Tax rates are high and unemployment quite widespread.

The new Ministry of Health has taken over the functions of the old Local Government Board and all bond issues for the construction of sewage-works are predicated upon the sanction of this Ministry which has the power to disapprove the plans offered by local authorities. Approval of plans by this ministry is necessary except in cases where the projects are to be paid for by funds obtained in other ways than by loans (such as from local "rates" or taxes); or where the larger communities are proceeding in accordance with the terms of a Special Act of Parliament. This ministry has taken over the engineering organization of the Local Government Board and has added to its staff, as chief chemical inspector, Dr. H. T. Calvert, who formerly held a similar position with the West Riding Rivers Board in Yorkshire and who is best known in America as the translator of Dunbar's book on Sewage Treatment.

Hearings by Ministry of Health—Rules of Practice for the guidance of the advisors of local authorities have been issued by the Ministry of Health, which conducts formal hearings at each locality in a manner similar to that of its predecessor. Loans for building sewage-works are sanctioned when the plans provide for plant loadings in conformity with the requirements of the former Local Government Board, and these in turn are based on the findings set forth in the well known reports of the late Royal Commission on Sewage Disposal. The single exception deals with the newly developed method of activated-sludge treatment. The Ministry has sanctioned a number of loans for works of this type, usually to supplement overloaded plants of other types. Like everyone who is keenly interested in sewage treatment it is collecting and collating data to throw light on the essential elements for the successful application of this process. The information is coming from local authorities and river boards, however, as the Ministry has no laboratory or testing station of its own.

Sufficient has been said to explain the general situation. The progress in re-conditioning old works, in making decisions for installing new works, and in formulating programs for present and future developments, has been adequate for making some generalizations of interest to American sanitarians. These comments may be conveniently arranged under three headings: I. Administration and Policy Questions. II. Status of Older Types of Treatment. III. Outlook for the Activated Sludge-Method.

Administration and Policy Questions

As a first step towards getting sewage-works back on a fairly satisfactory basis of performance, local administrations have dealt with means for overcoming the abnormal amount of deferred maintenance incident to war-time interruptions. Naturally this has varied much in kind and degree at different places. Mechanical equipment was unprocurable during the latter part of the war and has been a factor of reconditioning in some measure. However, the principal undertaking has been to wash and restore clogged filter beds. This has involved contact beds, apparently of all kinds and sizes of materials, and also sprinkler or percolating beds of comparatively fine material. Just where to draw the line as to size of material in sprinkler beds which have been in service for fifteen to twenty years without clogging and those which have become seriously clogged is not a simple matter. But I should judge that little or no clogging of a permanent nature, due to sewage solids, has occurred in beds where the material was freed from particles passing a ¾-in. screen.

A second feature of local policy has been to make use of existing works so far as advantageously practicable. This natural step is shown by the general practice of installing activated-sludge plants in existing tanks or beds; by the conversion of contact beds to sprinkler beds; and by the substitution in the latter of coarse as compared with fine material, and the addition of humus tanks which are needed to follow beds of the former but not the latter type.

Associated with work of maintenance and betterments at existing sewage-works has been the task of furnishing, at some places, employment for unskilled workers. Perhaps this obligation has caused some managers to carry forward their work of rehabilitation to an extent greater than they might otherwise have recommended, although in some instances such work will lead most quickly to the securing of a fairly satisfactory effluent.

Results Commensurate with Cost—In all countries and at all times engineers have sought and should seek the adoption of works and methods that will give results commensurate with their cost. In England today, with its heavy tax burdens, it seems to me that more than ordinary attention is being given to this question of policy. Presumably it explains why some managers are making haste slowly in revamping existing works so that they may investigate new developments, such as the activated-sludge method; and thus allow themselves to come to a satisfactory conclusion as to whether a given performance of sewage treatment, in point of quantity and quality, can be more economically secured by reconditioning existing works or by installing new ones. Certainly this "performance-commensurate-with-cost" policy explains why the time-honored method of chemical precipitation has given place completely and, I believe, permanently to plain sedimentation.

At London this change was adopted some ten years ago on the advice of Fitzmaurice and Humphries and since the war has been adhered to by the latter, notwithstanding that during the very unusually dry summer of 1921 the dissolved oxygen is understood to have disappeared at intervals from the lower stretches of the Thames. Presumably there were some local smells but they evidently were regarded as of insufficient significance to justify the cost of chemicals or to interfere with the policy adopted before the war of carrying out an extensive program of building relief sewers to eliminate cellar-flooding in various low areas located some distance from the Thames and in which local sewers have become overloaded by storm water. The cost of this London County Council program for relief sewers was estimated at about £3,000,000, pre-war basis. It has been about one-third completed, although of course the cost of work done greatly exceeds one-third of the original estimated cost. As this work progresses tests are being made with the activated-sludge method at Crossness, the southerly London treatment plant, to secure data indicating what it would cost the County Council to adopt the latest type of treatment. In this way sound conclusions may be reached as to how reasonably available funds may be expended to do the most good.

Indicating and Recording Appliances—A visit to ten or a dozen sewage-works leads to the view that they are well equipped with good mechanical appliances for indicating and recording needed quantity data, as well as with good laboratory facilities such as have characterized English sewage-works for many years. It is quite possible that this view may be predicated on contact with works which are better managed than the average English sewage-works. However, it is a pleasure to record my appreciation of the carefully planned auxiliary equipment and devices installed by Hart at the new works at Leeds, and of the unique plant built by Garfield at Bradford for recovering grease from the local sludge. At the present time it is particularly important for the managers of English sewage-works to secure sound and adequate records showing the performance and condition of the various plant units, in order to know how best to proceed with improvements. In America there are some sewage plants where daily records are excellently kept but generally speaking I doubt if these records compare favorably with those secured by the managers of corresponding English sewage-works. Perhaps this offhand comment is unduly influenced by my observation that after sewage-works in America have been in service for a few years there is frequently a lessening of interest and support at the city hall, with the result that the management and records fall to a level below that of corresponding water and electric plants.

Rivers Boards or Conservancy Boards control in several districts the pollution of all streams in one or more major watersheds. They have the authority to jack up the performance at both private and public sources of pollution and they do not recognize city, borough or county boundary lines. Until they came into existence some twenty-five to thirty years ago comparatively little was accomplished towards lessening the pollution of English rivers, following the passage in 1876 of the Rivers Pollution Prevention Act, specifying certain maximum chemical limits for the impurities flowing into the streams. It was found that town authorities and directors of industrial works were very loath to spend substantial sums of money to correct pollution, in the absence of court decisions establishing the existence of nuisances caused by them. Neither was adequate incentive to initiate needed betterments forthcoming from the central authority, the Local Government Board at London, constituted to regulate the issue of loans with which to pay for the installation of works reasonably in conformity with local needs and the current state of the art. Into this breach came the district boards, supposed to represent each class of party in interest, and which slowly but surely brought about a decided improvement in the condition of English rivers and their tributaries, especially in the manufacturing sections.

These river boards were comparatively passive during the war but now their activities are again coming to the front, with indications that additional boards may be established to operate in watershed areas not at present receiving the benefit of co-ordinated direction of means for generally controlling pollution. It appears that a new agency is examining into the condition of English streams, the Ministry of Agriculture and Fisheries. I understand that in April hearings are to be held in respect to the formation of a Rivers Board for the Valley of the Trent, the headwaters of which are in the heart of the pottery district, where coal measures have been developed because the river is at times prejudicially affected by coal washings, and in an acid condition for a distance of two to four miles below Stoke. Lower down the valley are the activities of the important Drainage Board of Birmingham.

Limited Decentralization Deserves Study in United States—What the outcome may be in this particular instance I do not know. But generally speaking it is my judgment that these district boards constitute one of the sanest and most efficient factors of the English system for the control of river pollution. They provide decentralization to the extent of putting administrative authority into the hands of a local resident agency, constituted of representatives from city, borough, county and private business interests. And yet the board comes in no way in conflict with the central authority, with whom it can co-operate to mutual advantage. It can act as an effective whip on the town authorities. In particular does it effect co-operation with, rather than opposition from, the owners of mills and other private business establishments. While such district boards cannot hope to bring about the elimination of all objectionable pollution in a large valley in the course of a very few years, for financial if for no other reasons, yet they constitute in my opinion the most rational basis of procedure yet devised for steadily bringing about the progressive installation of important works, involving the expenditure of substantial sums of money by a multiplicity of public and private interests. In America there are some localities where such district boards could overcome the limitations resulting from interstate complications and could facilitate needed support from the business interests related to the problem by giving them the representation to which they are entitled on the administrative board. Where real action is sought for controlling the pollution of streams, not readily responsive to the jurisdiction of a state department of health, it will be well to study carefully the history of rivers boards in England.

Post Office Bill Would Encourage Aviation

In an effort to encourage commercial aviation, the Senate committee on postoffices and post roads has recommended the passage of legislation fixing the rate of postage on air mail of not less than eight cents for each ounce or fraction thereof, and authorizing the Postmaster General to contract for the transportation of mail by aircraft at a rate not exceeding two mills per pound per mile. At present no additional charge is made for the mail which is carried by airplane.

Special Structural Features of San Francisco Theater

Auditorium Unusually Wide, Thin Balcony and Gallery Reduce Height—Combined Footing and Retaining Wall Saves Expense

By Zara Witkin
Civil Engineer, San Francisco

FOUNDATION and gallery structure design of particular interest are embodied in the recently completed Curran-Shubert theater in San Francisco. To save in height, already reduced by the general arrangement of the ground plan, extremely slender balcony and gallery sections were designed, and these made it necessary to provide special girders with several bends in their flanges, in order to fit into the shallow floor sections without column support. In the substructure a considerable saving was realized by a combined wall and column footing, so worked out as to constitute a retaining wall at the same time.

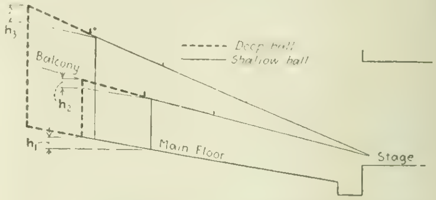


FIG. 1—THEATER HEIGHT RELATED TO DEPTH

A total of 14 ft. of height was saved—about one story height of an ordinary building. Most of this was due to planning the theater with a wide, shallow auditorium. The plan was worked out with a view to having each seat as close as possible to the stage, and to do this the hall was made unusually wide with respect to the length. For a total seating capacity of 1,800 the auditorium has a width of 90 ft. and a length along the center line of only 63 ft., giving a ratio of length to width of 0.7, which is considerably smaller than that of most theaters.

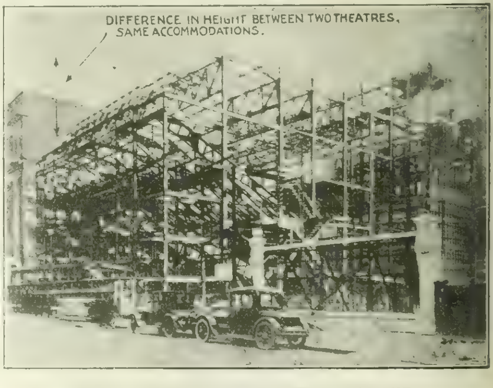

DIFFERENCE IN HEIGHT BETWEEN TWO THEATRES, SAME ACCOMMODATIONS.

FIG. 2—ONE STORY OF HEIGHT SAVED

Curran Theater, in foreground, has balcony and gallery like the older Columbia Theater alongside, in the background, but is a full story lower, because of its wide auditorium and thin floor sections.

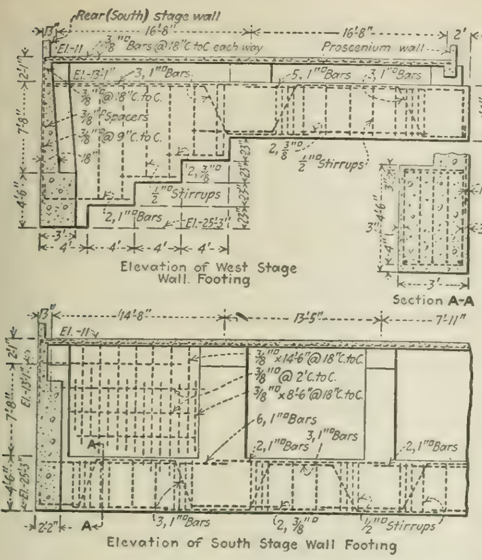


FIG. 3—CONCRETE GIRDER FOUNDATIONS AT STAGE
South or rear wall also retains 14 ft. depth of earth inside stage space.

The effect of this arrangement on the height is indicated in the sketch, Fig. 1, which represents a comparison of a deep hall with a shallow hall. It will be seen at a glance that the deep hall has the greater height by three items: h_1, the added height on the inclined main floor, extended; h_2, extra balcony rise over that of the main floor; and h_3, extra gallery rise over that of the balcony. The sum of these items, increased by what was saved through the use of thin balcony and gallery sections, made the total saving stated.

Special structural treatment is generally necessary for a theater owing to its individuality of arrangement and to architectural details. The fundamental condition of unobstructed vision from all parts of the auditorium requires the elimination of interior columns as far as possible, and the designing of girders and trusses for transferring the interior loads to the area limits of the building. These members are affected by difficult requirements of clearance, headroom, provision for transverse corridors and similar other factors. The effect of carrying interior loads to the outer limits of the structure is to produce large column concentrations, creating in some cases special foundation problems. The design of a typical, practically standardized office building rarely involves similar special considerations.

Special Foundation—The rear stage wall of the building extends down to a level of 25 ft. 3 in. below the natural ground surface. This wall is 105 ft. 10 in. long, the full width of the building. Under the stage the final ground surface is 11 ft. below natural surface, making the net retained height 14 ft. 3 in. There are eight rear wall columns, with loads varying from a minimum of 155,000 lb. to a maximum of 235,000 lb., spaced 13 ft. 5 in. to 15 ft. 10 in. apart. The piers for these columns run down from the bases to the footing and act as counterforts for the combined bearing and retaining wall. The wall between these column piers is a reinforced cantilever slab increasing from 8 in. in thickness at the top to 18 in. at the junction with the footing, and is restrained at the sides by the counterfort piers. The counterfort column piers and the retaining wall are integral with the combined footing (Fig. 3), which is designed as a reinforced-concrete inverted continuous beam for a uniform soil pressure of 4 tons per square foot, the imposed column reactions and a wall load of the first story.

The continuous footing beam of 7 spans has a total length of 105 ft. 10 in., a width of 3 ft. and a depth of 4 ft. 6 in. Over the end spans, the main bending reinforcement is nine 1-in. square bars. Shear reinforcement is provided by ½-in. square bar double stirrups spaced 6 in., from third-points to ends of spans.

This design for the retaining wall, with the column piers acting as buttresses and the combined continuous beam footing, was adopted as the most economical and practical means of avoiding large eccentric spread footings under the columns (the adjacent property prevented symmetrical footings) and a heavy gravity retaining-wall section between the column piers and footing. In consequence, trenching and excavation were greatly reduced, form work was cut down and simplified, and the placing of reinforcement and concrete pouring was made continuous and systematic.

The side walls of the stage also rest on continuous-girder footings. The west stage wall footing, 35 ft. long, is brought up in four steps from the level of the rear wall footing at 25 ft. 3 in. to 17 ft. 7 in. being 3 ft. thick throughout its length. The east stage wall footing is only 2 ft. 2 in. thick and is stepped up in three stages to a bottom level of 19 ft. The steps necessitated breaking the bending reinforcement, which was placed in several levels corresponding to the steps. All other footings in the structure are simple concentric spread footings.

Auditorium Floor—Sloping a little over 4 ft. in 53 measured along the center line of the auditorium, the floor slab transmits its load of 145 lb. per square foot to beams framing into two rows of girders and two walls concentric with respect to the seat tiers, Fig. 4. The beams are radial with respect to the seat tiers. The girders take a peculiar type of loading consisting of one beam reaction at the mid-point one side of the girder and two beam reactions at approximately the third-points on the other side. This special arrangement is caused by the seating area narrowing toward the

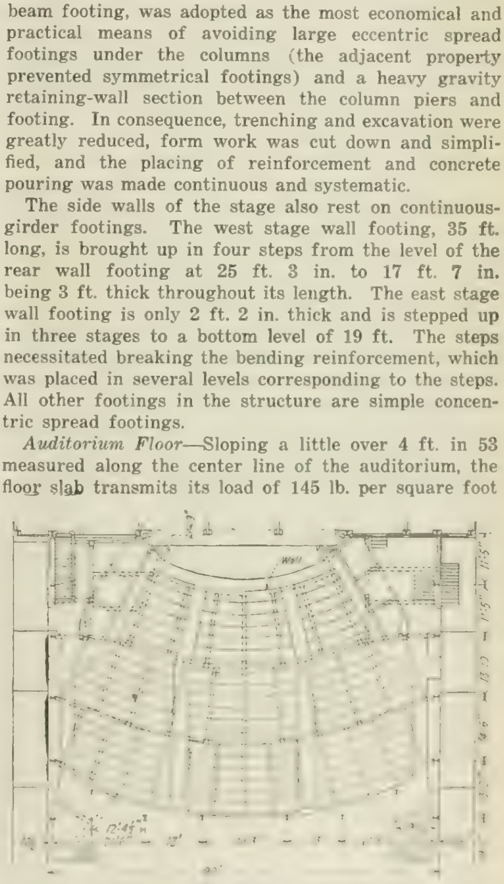


FIG. 4—IRREGULAR FRAMING OF AUDITORIUM FLOOR

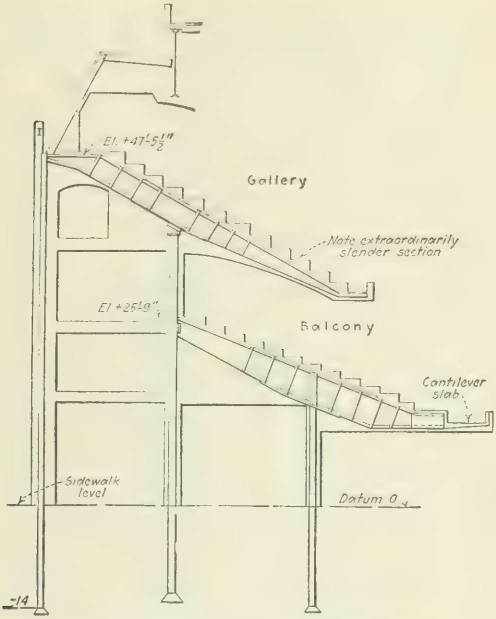


FIG. 5—FRAMING IN VERTICAL SECTION

stage, the panels becoming less wide and one beam being eliminated in each panel between successive arcs of concentric girders. The beams are 10 x 20 in., the girders 14 x 28 in.

There are two other general types of design for floor support, both of which possess inherent disadvantages for the auditorium floor construction. A plain rectangular beam and girder layout was impracticable owing to the slope and the dished floor, because of the necessity of placing the beams and girders in a number of different levels and sloping them irregularly to match the floor slab. This design was therefore not considered and a flat slab construction was not practical because of lack of uniformity and heavy coning of floor.

Balcony and Gallery Cantilevers—The theater was designed to meet the restrictive height requirements of the architectural plans, the total height of the theater being considerably less than other structures of the same kind, as illustrated by comparison with the Columbia Theater, directly alongside (Fig. 2). The 13-ft. difference in height of the two buildings is strikingly noticeable and besides enhancing the appearance of the theater it reduced its cost considerably. Owing to the thin balcony section there was not much choice in the design of the supporting members, while the gallery section was so slender as to require unusual cantilever girders to transfer the loads to columns in the rear of the balcony without supporting columns in the seating area to obstruct vision (Fig. 5).

The gallery which is 90 ft. wide and 45 ft. deep along the center line, was designed for a total load of 170 lb. per square foot (95 lb. dead load and 75 lb. live load). Seventeen longitudinal cantilever plate girders spaced 4 ft. 4 in. carry this load to transverse plate girders supported by eight columns in the outside wall of the lobby. These girders have long arms of from 38 ft. to 26 ft. and short arms of approximately 18 ft., making total lengths of 56 ft. to 44 ft. They are peculiarly shaped for complete concealment within the section of the gallery necessitating breaking the flanges at several points. The heaviest girder has ½-in. web with flanges of two 4 x 3 x ⅜-in. angles and three ⅜-in. plates and stiffeners of 4 x 3 x $\frac{5}{16}$-in. angles spaced 3½ ft. over the greater part of the length. The inclined bases which seat these special girders upon the transverse girders or the columns are built up of angles and plates, no castings being used. At the fulcrum the vertical depth of the girders is about 5 ft., which depth decreases to 5 in. at the ends of the long arm. Over the support special stiffening of two 4 x 4 x ½-in. angles is provided. The long arms of the girders are braced transversely by 4 x 4 x ⅜-in. angles.

A cantilever slab varying from 7 in. to 3½ in. in thickness, extending out 4 ft. 3 in., carries the transverse aisle at the rail; the reinforcement is ⅜-in. square bars spaced 4 in. on centers.

The gallery girders averaged about 5 tons in weight and were built up in the shop and set in place complete.

Meeting the same requirements the balcony girders had the advantage of a floor depth considerably more than the depth of the gallery section, which simplified the design of the cantilevers. There are six girders, seated either upon transverse girders or directly upon a row of columns in the front wall of the lobby into which the transverse girders are framed. The balcony members averaged 2 tons more in weight per girder than the gallery members, or about 7 tons apiece. In one case, where the balcony section is deeper than usual owing to architectural arrangements, a truss is used instead of a plate girder.

Balancing the loads on the long arms, the short arms are anchored by attaching them to columns supporting the gallery girders. In this way these columns are relieved from some of their load by the uplift effect. Fig. 5 shows how the gallery and balcony cantilever girder and support systems are inter-related and the loading is transferred to the three parallel rows of columns, the balcony load relieving the columns supporting the gallery, the gallery load in turn relieving the exterior columns in the front wall.

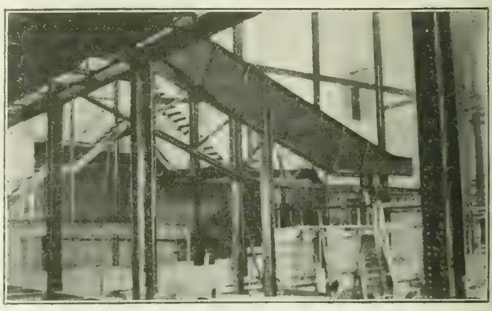


FIG. 6—TWO OF THE SPECIAL BALCONY GIRDERS

Estimated to have cost $1,000,000, the theater required a little over a year to construct. The architect was Alfred Henry Jacobs; the consulting engineer, W. W. Breite; and the contractor, Ira Coburn, all of San Francisco. The writer was associated with Mr. Breite in the design of the structure.

A Review of the Grand Trunk Railway Arbitration

The Post-War Difficulties of the Canadian Railways, and the Methods Used in the Valuation of the Grand Trunk System for Purchase by the Government

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RAILROAD valuation in Canada, as hitherto conducted, presents a different phase from similar work in the United States. There has been no valuation for rate-making, but the stocks of two of the principal companies have been taken over by the government, the price being fixed by arbitration. The Canadian Northern had a book value of $500,000,000, and the Grand Trunk, including the Grand Trunk Pacific, of over $600,000,000, so that property nominally worth more than a billion dollars has been submitted to arbitration in these two cases. The awards were comparatively small, but in their determination it was necessary to take account of the value of the entire property in which the stock represented an equity. Before taking up the engineering features of this work, there should be an understanding of the situation in general.

Canadian Railroad Development—A controlling factor in the railroad development of Canada has been the division of the country by political and topographical barriers into four distinct parts. Ontario and Quebec, with more than half the population and wealth, occupy the central position. The state of Maine thrusts itself far to the north between them and the maritime provinces. On the west a barren wilderness five hundred miles in extent must be crossed to reach the prairie provinces, while two hundred miles of rugged mountain ranges lie between these and British Columbia.

Were it not for the artificial obstacle of a national boundary, each of these sections would find its markets and sources of supply, to a large extent, in the territory to the south of it. In order that Canada might become a united nation it was necessary to overcome this tendency and to link these separated parts by lines of communication wholly within the national boundaries. Such a development was not possible except by government aid and this aid has been freely extended. Subsidies, on a mileage basis, have been generously paid. Land grants were given to Western roads. Interest on bonds was guaranteed by both national and provincial governments, and in emergencies loans or gifts of cash were made.

As a consequence of this liberal policy the railroads of the country have grown faster than the population they serve. Three great systems, the Canadian Pacific, the Canadian Northern, and the Grand Trunk, stretch from ocean to ocean. There has been much unnecessary duplication. For 150 miles two lines cross and re-cross each other in the canyon of the Fraser. From Edmonton to the headwaters of the Fraser two lines were built across the Rocky Mountains, nowhere more than ten miles apart. Three lines cross the vast wilderness north of Lake Superior, where there is practically no local traffic, nor prospect of any. The total mileage, in proportion to population, is twice that of the United States.

The Canadian Northern—Under the stress of war the weakness of the railroad structure soon became apparent. The Canadian Northern was the first of the large systems to give way. The strain of its recent expansion into a transcontinental line was too much for its financial strength, in spite of the profitable operation of its lines in the prairie provinces. Notwithstanding aid was freely given by the Dominion government during the early years of the war, 1917 found it unable to carry on. Parliament, fearing the effect of the bankruptcy of so great a corporation on the morale of a nation engaged in a desperate struggle, authorized the taking over by the Crown of the remainder of the stock of the company, a part having already been taken as security for loans. The price was fixed by arbitration at $10,800,000, or 18 per cent of par, but the proceedings were necessarily hurried, and little was brought out that would be of interest to engineers.

The Grand Trunk—The Grand Trunk was the first of the Canadian railroads. Chartered in 1851 and occupying the richest part of Canada, it maintained its supremacy by absorbing all competitors, but in so doing acquired much unproductive mileage and many duplicate lines. The stock was nearly all held in England and was always highly speculative. The shareholders insisted on all receipts in excess of expenses being at once paid out in dividends and permitted no reserves or surplus to be accumulated. The results of this hand-to-mouth policy and long-distance control are plainly apparent in Grand Trunk history. Probably it was because of the benumbing effect of such conditions that the Grand Trunk made no effort to secure the control of any part of the vast traffic which the Canadian Pacific and the Canadian Northern were building up in the prairie provinces between 1890 and 1900. They also pushed into Grand Trunk territory, reaching the more important cities and usually managing to obtain better access to industries and business than the earlier line. It was the Grand Trunk theory that business should come to the railroad. If a town was difficult of access they laid their line at a distance and served it with a spur track. The other companies believed that the railroad should seek the business, so they built into the towns which the older system had neglected.

In 1903 the Grand Trunk board, after some previous investigations, decided that it would be necessary for the Grand Trunk Ry. to construct its own lines into the Northwest in order to maintain its position, and, as a result, obtained a charter for the construction of a line from Winnipeg to the Pacific Coast under the name of the Grand Trunk Pacific Ry. and entered into an agreement with the government for the operation of a line to be constructed by the government from Winnipeg via Quebec to Moncton. This latter line was built by the government, but the original estimates of cost were so greatly exceeded that the Grand Trunk Pacific Ry. Co. refused to carry out its agreement with the government to operate the road. The government did not take any legal steps to compel the company to fulfill its obligations, but has since operated this road itself under the name of the National Transcontinental.

The Grand Trunk Pacific proved much more costly than was expected. It was built to standards of grade and alignment suitable for the New York Central or the Pennsylvania. It reached scarcely a foot of territory not already served in Manitoba and but little in Saskatchewan and Alberta. Even before it was officially declared open for operation, the Grand Trunk Co. which held the entire stock and which had guaranteed its bonds to the extent of about $100,000,000, declared it "impossible for them to meet the extra liabilities arising from the Grand Trunk Pacific Co." This was in December, 1915. The management proposed that in return for the stock the government should relieve them of all responsibility as guarantors and repay them for all money advanced to the Grand Trunk Pacific Co.

This the government did not agree to but made several advances to the railway company for the purpose of tiding it over the period of stress. Finally in 1919, a receiver was appointed, and the obligations of the Grand Trunk with respect to the Grand Trunk Pacific were met by the government, the Grand Trunk Ry. being to that extent in debt to the government.

The Post-War Problem—With this assistance the Grand Trunk managed to survive the war, but the enormous increase in operating expenses and the falling off in traffic following the armistice were more than their finances would endure. The government found itself confronted with a perplexing problem. Securities of the Grand Trunk, Grand Trunk Pacific and allied companies which it had purchased or payment of which it had guaranteed amounted to over $100,000,000, while provincial governments were similarly involved to the extent of about $13,000,000.

The bankruptcy of the Grand Trunk Co. meant the loss of practically the entire amount, and would have resulted in the disintegration of the system into numerous small companies which was not considered desirable if it could be avoided.

On the other hand, the taking over of the property meant the assumption of an immense load of debt and the expenditure of vast sums in order to put the lines into proper shape. All this must be added to the already staggering burden of the Canadian National Ry. System, composed of the Intercolonial, the Transcontinental and the Canadian Northern, whose operating deficit in 1919 was $40,000,000, with an interest charge of $30,000,000. As against this, the Grand Trunk lines would furnish the national system with much needed connections with southern Ontario and its many manufacturing cities, and especially with the Niagara frontier, across which moves the greater part of Canada's coal supply.

The Government Authorized to Purchase—Moved by these considerations and influenced no doubt by the desire of a considerable faction for government ownership of all railways, Parliament decided to authorize the government to enter into an agreement with the Grand Trunk Ry. Co. for the control of the stock of that company, which carried with it ownership of all the western lines. An act was accordingly passed in November, 1919, authorizing the government to enter into an agreement with the shareholders for the acquisition of the stock, the price to be determined by arbitration. The agreement, as subsequently made, provided for the purchase of £12,500,000 of guaranteed stock at par, by the payment thereon, in perpetuity, of 4 per cent dividends, and for arbitration as to the value of the preference and common stocks, of £37,000,000 par value. The award was limited to $64,000,000 and it was provided that payment should be in the form of a 4 per cent annual dividend. The holders of £32,000,000 of debenture stock were guaranteed the interest thereon, "as and when payable, in accordance with the terms thereof."

Compliance with the necessary legal formalities delayed the final acceptance of the agreement by the shareholders and approval by Parliament until May, 1920, but as agreement on some terms was assured, both parties went ahead with their preparations. The shareholders employed J. B. Berry, of Chicago, formerly chief engineer of the Union Pacific, who began the preparation, in the fall of 1919, of an estimate of the cost of reproduction at current prices. H. H. Vaughan of Toronto was engaged as mechanical engineer.

The government selected W. N. Tilley of Toronto as chief counsel. Associated with him were Pierce Butler, of St. Paul, H. A. Lovett and J. C. H. Dussault of Montreal, Hector McInnes of Halifax, N. S., and E. F. Newcombe of Ottawa. R. A. C. Henry, of Ottawa, was appointed engineer-in-charge; J. G. Sullivan of Winnipeg, C. S. Gzowski, assistant to the president of the Canadian National Ry., and the writer, were employed as consulting engineers.

The act authorizing the purchase designated Sir Walter Cassels, Judge of the Exchequer Court, as chairman of the arbitration. The government selected Sir Thomas White, Minister of Finance during the war, and the shareholders chose the Hon. William H. Taft, now Chief Justice of the United States. The selection of the arbitrators was not completed until July, 1920.

Theory of the Case—The first problem confronting the government staff was the relation of cost of reproduction to value. It was the unanimous opinion of the engineers that in this particular case neither original cost nor cost of reproduction should be considered, but only earning power. Government counsel approved this view, but advised that inasmuch as it was expected that the company would rely largely on the cost-of-reproduction theory, preparation should be made for defence along that line. Field engineers were accordingly instructed to take their notes with sufficient completeness to enable the office force to make a fairly close check on reproduction cost, if it should prove necessary.

Inspection—Apart from the records of past earnings and expense, it was believed that the most pertinent evidence as to future earning power was to be found in the condition of the property, the amount of deferred maintenance, and the necessary expenditures in the near future for betterments. It was therefore determined to make a thorough inspection of the property. The work was divided into sections as follows: bridges, buildings, docks and wharves, elevators, roadway, grading, land, equipment, floating equipment, signals, electrical equipment. The inspection of grading and land was confined to selected portions of the property for the purpose of checking estimates which might be presented by the company. All other sections covered the entire property.

The inspecting engineers were instructed as follows:

> The inspection of all the properties of the Grand Trunk Ry. System is to be such that with the additional information which will be obtained from the records it will be possible to calculate:
>
> (a) the depreciation, or loss in service-life, of each class of items,

(b) the amount of money which it would be necessary to spend this year on repairs if the property were to be brought into good condition,

(c) the amount of money which ought to be spent this year and each of the next five years for renewals,

(d) the amount of betterments which should be added immediately, and in the next five years, dividing these items into two classes as follows:

(1) those which will increase net earnings, either by reducing operating expenses or by increasing business,

(2) those which will not materially increase net earnings but are made necessary by public demand or competition.

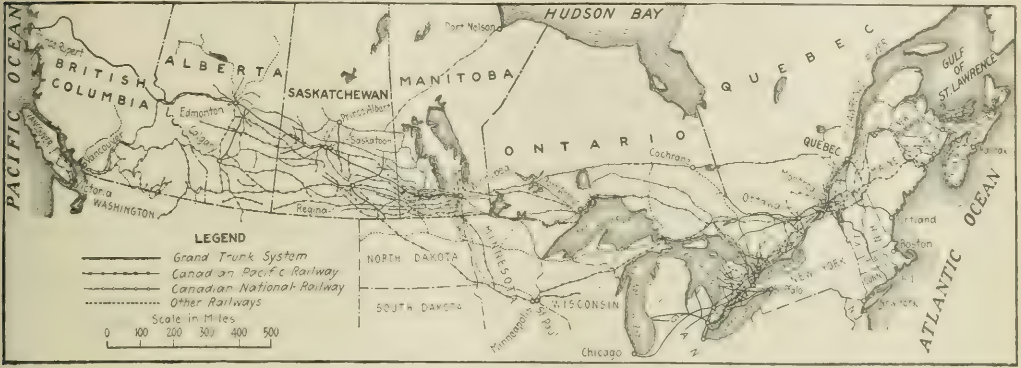
The inspecting engineer must take care that the report on each item of property covers the above four points, presenting either a completed estimate, or such information that the record can be completed and the estimate made in the office.

Besides ascertaining the condition of the property, it is the intention to obtain sufficient information to be able to criticize, if necessary, any physical valuation that may be made by the Grand Trunk Ry. Co.

The field engineers were advised that they were not to be unduly critical, but were expected to make such reports and recommendations as would be desired by a management wishing to put the property in thoroughly good working condition. The information collected was intended for use in future operation as well as for the arbitration.

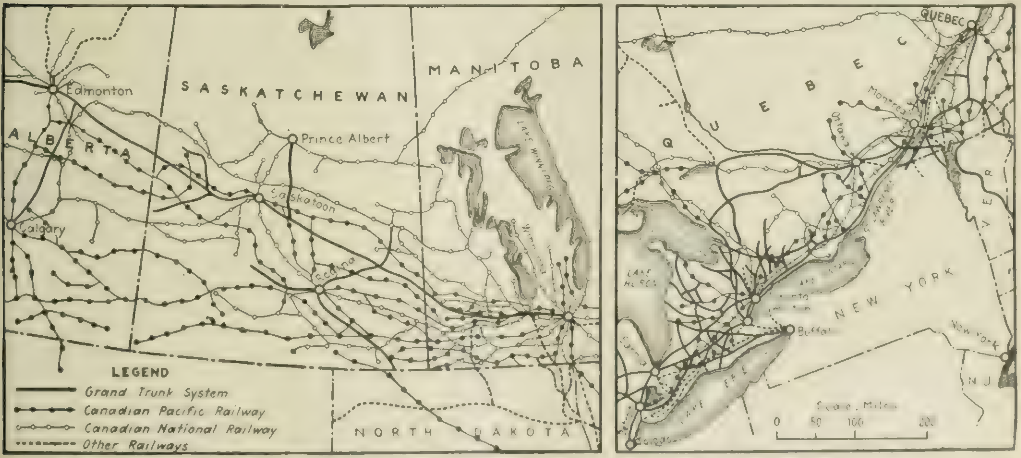
In addition to estimating current repairs and the renewals required within five years, estimates were made of the loss of service-life or depreciated condition per cent, of all plants not yet ready for retirement. This was done in the usual manner, except in the case of rail, the treatment of which has been made the subject of a separate article. (*Engineering News-Record*, Aug. 24, 1922, p. 310.)

The bridge inspection was directed by Col. C. N. Monsarrat, formerly chief engineer of the Quebec Bridge, assisted by P. L. Pratley. The field engineers were instructed to make complete records as to character and general dimensions of structures unless fully shown by plans, to note damage or settlement in substructures, corrosion or injury to paint, condition of



THE RAILWAY SYSTEMS OF CANADA

On this general map will be seen the duplication of railway lines between Alberta and British Columbia, the unnecessary lines through the wilderness north of Lake Superior and the large mileage of Canadian railways, now government-owned, in the United States. The total mileage in proportion to population is twice that of the United States.



ENLARGED MAP OF THE RAILWAY SYSTEMS OF WESTERN CANADA AND LOWER ONTARIO

This enlarged detail shows the network of lines in Manitoba and Saskatchewan, nearly all of which were built before the Grand Trunk Pacific entered the field.

Although the Grand Trunk had fully occupied this field of Lower Ontario it was [illegible] competing lines would have taken away [illegible] painting and any repairs necessary. In case of temporary bridges they were required to obtain all information necessary for estimating approximate cost of permanent construction. The various parts of the system were classified in accordance with traffic, in three classes. Bridges on first-class lines were investigated for two Mikado engines with a following load of 4,500 lb. per lineal foot of track. Those on second-class lines for Cooper's E45, and on third class for Cooper's E35. If in good physical condition, bridges were considered satisfactory when the unit stresses with allowance for impact under the above test did not exceed 75 per cent of the elastic limit of the material used in the construction. Otherwise, estimates were made for their replacements.

Roadway inspection on the Grand Trunk was put in charge of F. W. Cooper, for the territory east of Toronto, and M. A. Fullington, for lines west. Each had from three to five parties in the field for about five months. Each party was composed of an engineer, a recorder (usually a McGill University student), a conductor, who was responsible for the motor car used for the transportation, and a car runner. They were required to inspect for slides, settlement, scour, insufficient clearance, loose rocks, or other defects of the roadbed, and general conditions of culverts, wooden bridges, fences and all minor structures. Tie-counts were made at intervals of about a mile and notes taken of condition of rail and ballast. The roadway parties inspected also water and fuel stations and small buildings. They were expected to obtain the necessary local information for estimating cost of filling wooden trestles, replacing culverts or renewing ballast. Blank forms were furnished for convenience in recording information. Parties averaged from seven to ten miles per day, exclusive of important yards. The division engineers were much of the time in the field, instructing their men so as to secure uniformity of treatment and also collecting information as to cost of work. From the data thus obtained estimates were made at quarters of the cost of present and future requirements.

The Grand Trunk Pacific being a comparatively new road with light traffic, less detailed inspection was required, and it was covered by three parties, reporting to Mr. Sullivan, at Winnipeg.

The work of examining equipment was entrusted to A. N. Wheatley, president of the Armstrong-Whitworth Co. of Canada, assisted by A. D. Porter. All locomotives and passenger cars and 10 per cent of the freight cars were inspected. Shops were examined not only for condition but also for efficiency of arrangement and location.

Several engineers were employed on large buildings, elevators, docks and wharves, signals and electrical equipment and a naval architect on floating equipment. Their instructions were similar to those already quoted. Special studies were made of impending grade separations in Chicago, South Bend, Detroit, London, Hamilton, Toronto and Montreal; and of the need of additional yard facilities and rearrangement of divisions.

Traffic—Investigations of conditions affecting traffic were conducted by Geo. O. Somers, formerly general freight agent of the Great Northern. The Grand Trunk territory originally produced a large amount of lumber. After the timber was cleared off, agricultural products furnished a bulky traffic. This has now been superseded to a very great extent by dairy products, which bring comparatively little revenue to the carriers. At the same time manufacturing has increased enormously, with corresponding effect on traffic originating in the cities.

Water competition has always exerted a powerful influence on Grand Trunk earnings. From Quebec to Toronto the road parallels the St. Lawrence River and Lake Ontario. The lower Ontario peninsula is reached on all sides by lake transportation. The completion of the new Welland ship canal and the possible construction of the St. Lawrence ship canal will further intensify this competition.

Other factors studied were: The facilities of the Grand Trunk for serving industries, as compared with its competitors; the extent to which it originates its traffic; the effects of competition by automobiles and electric railways; the empty car movement; the railroad development per square mile in Grand Trunk territory as compared to a similar area immediately adjacent in the United States; the effect of the national boundary line, crossed at seven places, in restricting traffic; the degree to which Canadian rates are controlled by American; the effect of water-power development on the demand for coal; abnormal conditions caused by the war and the extent to which they are likely to be permanent.

An interesting disclosure was that while Grand Trunk freight business had increased at a moderate rate, passenger traffic had fallen off for several years. Study of the cost of service showed that the latter was much the more profitable.

The policy of the company in seeking traffic from Chicago and adjacent territory destined to New York and New England points, which must be carried over a route considerably longer than competing lines, had been the subject of dispute for sixty years. The company has made special efforts to build up this business in recent years. A careful study was therefore made, and it was found that a portion, at least, of this traffic was carried at less than cost.

Accounting—The arbitration dealt not only with the Grand Trunk Ry. but also with seventy-five subsidiary corporations, controlled by ownership of all or part of the stock, or by lease. These included elevators, car-ferries, coal mines, warehouses, express, docks, steamship lines, electric lines, refrigerator service, townsites, telegraph and terminal companies. Some of these represented actual purchases, others were acquired as bankrupts, many had been taken over on assumption of debts or by exchange of stock. Real cost was impossible of ascertainment.

Some had been unprofitable from the beginning; most of them had dropped "into the red" in recent years. Various devices had been employed in order to keep up a favorable financial showing. New lines were kept "under construction" as long as possible so that interest might be charged to construction instead of income. Loans were made to subsidiaries and immediately returned in the form of payments of interest, which were credited to earnings. The process of unraveling all these transactions and presenting them in a form that would fairly represent the earning power of the property was exceedingly complicated. Guaranteed, preference and common stocks and government and provincial guarantees, with varying degrees of precedence, added to the difficulty.

The accounting work was directed by D. E. Brown, formerly assistant director of accounts of the United States Railroad Administration.

The Hearing—It had been originally expected that the hearing would begin in September and be completed by the end of the year, but various delays occurred and it was not until Feb. 1, 1921, that the hearing was begun. After some preliminary testimony, the shareholders' attorneys offered their evidence on the cost of reproduction, but it was at once objected that such evidence was not admissible in a case of this nature. After prolonged argument and consideration, the arbitration board sustained the objection, but with Mr. Taft dissenting.

The importance of this decision as a precedent in valuation justifies an attempt to abstract the opinions, which are too long for presentation in full. Briefly, Judge Cassels and Sir Thomas White held that earning-power was the sole factor in determining value for purchase; that there was nothing before them to show that the board of railway commissioners, in fixing rates, was obliged to consider the reproduction value of railway property nor that the board had ever laid down the principle that such value has any bearing on the question of Canadian railway rates; that even if such principle were adopted, evidence of the reproduction value of one railway would not be useful without similar information as to all competitors; that the same reasoning would apply in the case of the American lines to the cost of one road without that of all others in the same group, as provided by the Transportation Act. They therefore considered the effect of cost of reproduction upon future rates as too remote and indefinite to be taken into account in this case.

Mr. Taft, while agreeing that earning capacity, present and potential, is the basis of value, dissented strongly from the conclusions of his colleagues. His position is indicated by the following excerpts:

> Even if we assume that the company may charge what it pleases and is only affected by competition we may properly assume that in the long run the rates which it charges will have a tendency to produce a net reasonable return on the investment necessary to reproduce at the time of enquiry, a railroad which would do the work to be done for the public with efficiency and economy. . . . Experience has led to the appointment of public utility commissions to regulate and to fix such rates. There is such a board in Canada, and we can properly assume that in fixing these rates in the future the Canadian commission will grant rates that will secure a fair return on the amount of capital needed to reproduce the railway doing the work efficiently and economically. . . . The rule of fair return on necessary value invested is the rule of the government of the United States. . . . Congress, therefore, passed a law which adopted specially the principle that the public service rendered by railways should be compensated for by rates which shall secure a fair return upon the railway property used in the service of transportation under honest, efficient and economical management. . . . This is to fix the rates according to the average physical value of the existing railways engaged in service, which is only an alternative method of determining the amount of capital to reproduce a railway which could render the service efficiently and economically, assuming that the average value of all railways engaged in the service would be the cost of such a new railway. . . .
>
> It would seem to be fair to admit into evidence that reproduction cost of the railway upon the basis of which the future return to the purchaser may fairly be determined, and in all probability will be determined. . . .
>
> The government can meet the evidence, if disputable, by showing lack of economy and efficiency in the present railway, or the one proposed to be reproduced, by showing original bad planning, or any other defect affecting its usefulness as a net revenue producing instrument and by proof of the great amount of additional expenditure on changes needed to render it effective and economical.

The majority necessarily prevailed, and evidence of cost of reproduction was rejected. Although professing themselves greatly disconcerted by this unexpected ruling, the company's attorneys proceeded with the case and introduced a mass of testimony as to the condition of the property and of opinions as to future prospects.

The appointed time for the completion of the arbitration expired on April 9, and the government refused to extend the time unless the company would grant immediate possession. The proceedings were suspended but the shareholders finally yielded the point and the hearing was resumed on June 1. The company completed the presentation of testimony on June 7. During this time the government staff had collected a vast amount of evidence. It then became the duty of counsel to select what was best suited for their purpose and to secure its presentation in the most forceful manner. The approach of hot weather made it desirable to shorten the proceedings as much as possible.

On account of the rejection of evidence as to cost of reproduction, all showing of depreciation was eliminated from the case. The government engineers had found the rolling stock and mechanical equipment in fair to good condition, and no testimony was therefore introduced along this line, the company's statements being allowed to pass unchallenged. Statements of past earnings, expenses and income, testimony as to the condition of the property, estimates of extraordinary expenses and of additional investment required now and in the near future, and opinions as to the future traffic and cost of operation formed the substance of the case for the Crown. Twelve days were required for its presentation. The argument covered eight days, and the case ended on July 8, seventy-one days having been spent in the actual hearing.

The decision of the arbitrators was rendered on Sept. 8, 1921. Sir Walter Cassels and Sir Thomas White held that the preference and common shares had no value. Mr. Taft dissented from this opinion and appraised these shares at $48,000,000. The verdict not being unanimous, the shareholders were permitted to appeal to the Privy Council, but the council, on July 28 of 1922, dismissed the appeal and upheld the decision of the arbitrators.

200-Century-Old Stumps Dug Up in Washington

Steam shovels excavating for foundations for the Walker Hotel on Connecticut Ave., Washington, D. C., have unearthed stumps and logs of trees neither decayed nor fossilized which scientific investigators assert to be at least 20,000 years old, says a recent bulletin issued by the National Lumber Manufacturers Association. The fiber of the wood is well preserved and easily recognizable as cypress. Both sapwood and heartwood are preserved and in some cases even the bark. Dr. G. W. Stephenson, chief of the Section of Coastal Plains Investigation of the U. S. Geological Survey, and C. K. Wentworth, of the same bureau, made examinations of the fossils and gave it as their opinion that they were at least 20,000 years old, and probably belonged to the Pleistocene age.

Some New Ideas on Concrete Design and Construction

Abstracts of Four of the Papers Presented at the Nineteenth Annual Convention of the American Concrete Institute, Cincinnati, Jan. 22-25

Inundation Methods of Measuring Sand in Making Concrete

By G. A. Smith and W. A. Slater
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It is with the purpose of developing the principles of a proposed method of accurate field measurement of sand and of water for concrete that the investigation reported in this paper was undertaken. The method proposed is based upon the belief that one of the important causes of variability in the strength of concrete is the variation in the quantities of sand and water introduced into successive batches of concrete, even when care is exercised in the measurements. Sand when measured by volume in either a loose or a compacted condition may show great variation in volume for a given weight of sand, depending upon the quantity of moisture in the sand. In one case the volume of the sand when moist was found to be 49.7 per cent greater than the volume of the same quantity of the same sand when dry. A concrete using that sand and designed to be mixed in the proportions of 1, 2 and 4 of dry materials would in reality be mixed in the proportions, 1, 1⅓ and 4 if the sand were measured in a moist condition such as that reported in the paper referred to. Although the figures given indicate a richer mix when the sand is used in a moist condition no advantage in strength is derived therefrom unless the quantity of water used in the batch is reduced for the richer mix. On the contrary, the probability is that if the same quantity of water per batch is added for the moist sand as for the dry sand the increase in the ratio of the water to the cement (due to the moisture content of the sand) will result in a decrease in the strength of approximately 15 per cent. At the same time the cost of the cement for a cu.yd. of concrete will be increased by about 15 per cent, perhaps 65 cents per cu.yd. of concrete with cement at $3 per barrel.

Summary—In considering the applicability of inundation methods of measuring sand, to the making of concrete it should be remembered that such accidental variations in the gradation of the sand as may occur in the field were eliminated in these tests. Other features of the laboratory tests also may not be duplicated in the field. It does not seem likely that such accidental variations need be important but only field application of the method can determine as to its practicability. The following paragraphs summarize the results of the investigation made in the study of the inundation methods.

(1) The results of the tests indicate that when sand is measured in water the quantity of sand per unit of volume is almost constant regardless of the original water content of the sand and that the water filling the voids in the sand is also nearly constant for any given method of placing the sand.

(2) The shoveling of the sand into the water gave more nearly constant quantities of sand and of water per unit of volume than any of the other methods used.

(3) The screening method gave slightly larger quantities of sand and slightly smaller quantities of water per unit volume than did the shoveling method and the results of the tests indicate a lower percentage of air voids for this method of placing the sand than for either the shoveling or the rodding methods.

(4) The rodding of the sand in water gave a larger quantity of sand per unit of volume than any of the other methods used.

(5) Placing the dry sand and the wet sand according to the A. S. T. M. standard C29-21 gave quantities of sand per unit of volume slightly less than when the sand was rodded after shoveling it into the water. The quantity of sand obtained when moist sand was rodded in air was much less than when it was rodded in water.

(6) The inundation method of measurement when used with a predetermined apparent specific gravity may afford a convenient means of determining the proportion of sand to other concrete materials even for jobs on which the materials are being measured by other than the inundation method.

(7) The variation in surface water per cubic foot of coarse aggregate was approximately proportional to the variation in the fineness modulus of the coarse aggregate. The quantity of surface water was considerably greater for the crushed trap rock than for the quartz pebbles. The quantity of surface water averaged about 9 per cent of the total water used in the concretes of these tests or about 8 per cent by volume of the cement. The quantity of absorbed water per cubic foot was greater for the quartz pebbles than for the crushed trap and was independent of the fineness modulus.

(8) For concretes made with quartz sand measured in water the strengths were nearly the same regardless of the condition of the sand, the method of placing it, and the proportion of fine aggregate to coarse aggregate.

The indication is that the measurement of sand by inundation methods should be of assistance in reducing variability of strength of concrete caused by variations in quantities of sand and water in a batch.

The use of a constant water cement ratio for the concrete together with a constant fineness modulus for the mixed aggregate resulted in nearly a constant strength regardless of the proportion of fine to coarse aggregate in the mix.

(9) The use of a constant fineness modulus of the mixed aggregate did not result in a constant slump or flow for the concrete. The variation in each was approximately proportional to the variation in the fineness modulus of the fine aggregate in the mix.

(10) The weight of the concrete per cubic foot and the volume yield of concrete per barrel of cement were practically constant.

How to Minimize Some Defects in Concrete Buildings

By H. D. Loring
Ferro Concrete Construction Co., Cincinnati, Ohio

Structural defects in reinforced concrete usually show as cracks; occasionally as disintegration without definite cracks, and less commonly as spalling or buckling. Such defects may be the result of accidents that cannot reasonably be foreseen but many of them can be prevented by proper design and precautions in construction. We are concerned here more particularly with those that can be corrected in the drafting room.

Many structures are injured or rendered unsightly by cracks due to the applied loads for which they are supposedly designed. Walls to retain earth or water are frequently designed as vertical cantilevers, and such walls seldom give trouble, when they are straight. When, however, two such walls are built at right angles to each other as a continuous structure, a wide crack is very apt to appear near the corner, because each wall bends, under the earth or water pressure, enough to cause rupture, even when considerable amounts of steel are bent around the corners. The rigidity of continuous floor construction is so well fixed in the minds of most building designers that they may not at first thought consider how comparatively limber a cantilever is, but recalling that a cantilever of uniform cross-section, under uniform load, deflects forty-eight times as much as a similar fixed beam with the same span and load, will give one a measure of the deflection that may be expected in cantilever walls. The simplest and often the best preventive of such cracks is to design the walls as separate structures with a joint near the corners. Where liquids are to be retained this is not practicable and the two walls may be connected by a curved or broken section of considerable radius with liberal horizontal reinforcements extending into each wall far enough to take care of stresses caused by restraint. For low walls a generous fillet in the corner with liberal horizontal reinforcement, may suffice.

Cinder Fills—A frequent trouble in buildings having the roof insulated with a fill of cinders is the buckling of the cement topping placed over this fill to receive the roofing. The topping usually is a thin slab of rather lean mortar and unable to withstand the compressive stresses due to expansion at summer temperature, which will frequently raise large blisters. The resulting ridge and cracks are very destructive to roof coverings and are a frequent source of troublesome leaks. Expansion joints are easily made in the topping with some of the prepared strips of bituminous material sold for the purpose or by leaving wood strips which are removed and the space filled with mastic. Such joints should provide for expansion in all directions at the rate of at least ½ in. for every 50 ft.

Cinder fills often become saturated from rains before topping is laid and the water slowly finds the only way out—through the ceiling, resulting in dampness for many weeks or even months. The cost of fill and topping with the cost of carrying their weight to the foundations may amount to 15c. or 20c. per square foot and at best they do not form as good a foundation for roofing as a solid slab. This leads to the inquiry as to whether they must not be eliminated altogether in many cases. Inasmuch as composition roofing contractors will usually guarantee a dead level roof as readily as a sloping one, filling is not a necessity for forming slopes when it is not desired to pitch the structural slab for this purpose. The best reason for the use of cinder fill is as an insulator to prevent undue condensation on a cold ceiling in winter and excessive heat in the top story in summer. While cinder fills accomplish this result successfully and are desirable in buildings, with thin roof slabs in beam and slab construction, the greater thickness of structural concrete in flat slab construction is in many cases sufficient insulation in itself.

Expansion Joints—The question of expansion joints has been a much discussed one and probably the present tendency is to use them in fewer buildings. We believe they are seldom needed in buildings up to 300 ft. in length. Where they are used careful designing is necessary to prevent their giving trouble, especially from leaking floors, in buildings where wet operations are carried on.

Perhaps the best form of expansion joint is one in which the adjoining parts are independent cantilevers. In one building, 560 ft. long, it was considered advisable to use an expansion joint which was secured by resting the ends of the beams carrying one side on brackets formed on the girders and columns of the other; to form a sliding joint. In this case, however, the frictional resistance developed by the dead load of the construction was sufficient to spall or pull off some of the brackets, rather than permit sliding. In designing such brackets either for expansion joints or to carry future extensions, care should be taken that sliding on the joint will take place before any destructive force may be transmitted to the brackets.

In beams, cracks of the well known shear variety may be caused by forces other than loading; for example, a slight settlement of supports, or of the formwork before the concrete has fully set. These cracks are likely to occur as in shear failures, since the accumulated stresses are greatest at these points. Cracks of this kind can usually be avoided by placing stirrups throughout the beam, not further apart than three-quarter the effective depth, and repairs can be made by cutting out a section of the beam and floor, placing sufficient stirrups and re-concreting.

In many buildings having structural members exposed on the exterior, time and the elements have worked considerable damage by spalling and flaking of concrete and exposing steel to corrosion. Frequently the spalling is occasioned by the swelling of steel which has carroded when reached by moisture, due to insufficient covering; perhaps occasionally aided by electrolytic action. The great preventive of such unfortunate results is sufficient concrete protection for the steel. No such members should be designed with less than 2 in. minimum cover and 3 or 4 in. would often be desirable. Where bars are accidentally exposed during construction, the trouble should be remedied at the time.

The dense surface finishes produced by rubbing in cement grout are a protection to the building as well as an addition to its appearance, while the bush-hammered effects and other finishes which expose aggregate should only be used when ample cover is given to the steel. Repairs to buildings so damaged are difficult and costly, but should not be neglected. The steel should have all loose scale wire-brushed or otherwise removed before pointing is done and every precaution taken to secure a bond for the pointing mortar. Metal lath may sometimes be used to advantage by tying to the reinforcing with galvanized wire. Painting the steel with a bituminous coating before pointing with mortar may prevent further corrosion.

Some building codes encourage the placing of steel too near the surface by specifying that in vertically rodded columns only the concrete inside the ties may be counted to carry load. This appears to be based on an incorrect idea of the use of ties in vertically rodded columns; their function is, of course, only to stay the vertical bars and they cannot add anything to the strength of the concrete in the way that closely spaced spiral hooping does. Such test data as the writer has examined do not show any effect of changing the location of vertical steel in a column, as long as it is symmetrically disposed. In designing columns for bending moment, the position of steel must of course be taken into account.

A Concrete Tank Reinforced With Outer Tightened Bands

By W. S. Hewett
Consulting Engineeer, Minneapolis, Minn.

SHRINKAGE of concrete is a much more important factor in a structure subject to hydraulic pressure than it is in the ordinary structure. This great factor has received but little consideration in existing tanks. In cases where these tanks have been wet until filled and then have been filled, or partially filled, no serious results have followed from shrinkage. But if we examine the history of tanks that have stood for some time before being filled or have been repeatedly emptied and filled the result of shrinkage is apparent.

From my experience and observation and from my study of the experience and observation of others I have formed the opinion that a logical reinforced concrete tank should be designed in accordance with the following principles:

(1) Shrinkage stresses should be kept at a minimum, not over ¾ of 1 per cent of steel should be placed in the concrete.

(2) Concrete should not be in tension.

(3) Concrete should not be subjected to heavy shear on horizontal planes.

I can best outline my methods of construction by taking an example. At Barnum, Minn., we built in 1922 a tank 20 ft. in internal diameter, 32 ft. high and approximately 75,000 gal. capacity. We first made excavations to a depth of about 5 ft. and put in a footing for the side walls. We next built the bottom of the tank which was a slab 15 in. thick, with a diameter of 20 ft. This slab was reinforced with light radial and circular rods top and bottom and rested upon the ground with its outer part resting upon the footings already placed for the side walls. Side walls were then constructed 7½ in. thick, with vertical recesses at intervals 15 in. wide and 1½ in. deep. These recesses were for the accommodation of the turnbuckles for adjusting the steel bands. Each band had three turnbuckles.

The side walls were built in a sectional form 6 ft. 6 in. high, allowing a vertical run of about 6 ft. each day. The construction joints between the day's work were cleaned and washed before the next day's run was started. Forty-eight

⅝-in. round vertical rods, spaced about 16-in. apart, were placed in the wall. There were also three horizontal bands ½-in. round rods placed in each day's run about 24-in. apart, used as a precautionary measure in construction.

The forms for the side walls were adjustable to permit them to be loosened before raising to the new position. The side walls were run in six days. This work was done in late October and during November. Temperature ranged from a few degrees below freezing to about fifty degrees. The water used in mixing concrete was heated but no other precaution taken and no heat was applied to the finished work. As soon as the side walls were complete, the work of assembling the adjustable bands began. These bands were simply placed in position and tightened sufficiently to keep them in place. These bands were each in three pieces, the turnbuckles being spaced 20 ft. 4½ in., 20 ft. 4½ in. and 26 ft. 4½ in. The turnbuckles were not staggered. The rods were of mild steel, with an elastic limit of about 36,000 lb. and a modulus of elasticity of about 24,000,000. They were not upset but were provided with rolled threads. Our computations indicated that an initial stress of about 14,500 lb. per square inch was desired in the rods near the bottom, changing to about 15,000 lb. per square inch higher up.

The rods were assembled in such a manner that the lever used in tightening the rods worked down. Three men were selected, each weighing about 175 lb., and placed at the turnbuckles. Strain gage measurements were made at points on one of the rods and the length of the wrench changed until satisfactory readings resulted. It was found that when tightening a rod 1 1/16-in. in diameter, a 15-in. wrench in the hands of a man weighing 175 lb. would give the desired result. This rod was then loosened and the work of adjusting the rods was started at the bottom of the tank. No more readings were taken until all rods were adjusted. Readings taken on the rod referred to above gave an average stress of 14,000 lb. per square inch. This rod was No. 18 from the bottom of the tank. Readings taken on rod No. 53 from the bottom showed an average of 14,560 lb. per square inch. In adjusting, the rod was tapped with a light hammer at points between the turnbuckles. This tapping relieved the brake action and adjusted the rods to the concrete surface with uniform stress. Our measurements indicated but slight difference between the stress near the center of the rod and that near the turnbuckle.

After the rods were adjusted a wire netting covering the entire tank was attached to the rods. The circumference of the outer forms used in molding the side walls was enlarged to permit the placing of 3 in. of concrete outside of the rods and embedding the wire netting. This outer concrete gives a protection to the rods and increases the bearing. Where a gunite plant is available, a coating of gunite 1¼ in. thick would be preferable to the 3-in. placed as above.

After the adjusting of the bands on the lower part of the tank, 9 ft. of water was put in the tank to observe its action on the porous concrete in the lower 6 ft. This concrete, when the forms were removed, showed the rock in many places. When water was put in the tank, the lower 6 ft. section sweated to such an extent that the wall was wet on the outside. Above this, where the richer mix was used, only very slight damp spots were observed on possibly 20 per cent of the surface. None of the construction joints leaked. After allowing the concrete to be thoroughly soaked the water was drawn off and the inside of the tank wall given a brush coat of "Ionite," and followed by a brush coat of 80 per cent cement and 20 per cent "Ionite." Both coats were put on with paint brushes and but very little left on the surface.

The tank was entirely filled before the outer coating of concrete was placed to permit of measuring the ultimate tension in the rods. This ultimate stress measured 16,500 lb. per square inch.

Five per cent of hydrated lime, by bulk was used in all concrete.

The next day after the tank was completed it was filled to its capacity and left three days for the examination of the engineers. Not the least dampness ever appeared on the outer surface.

Trend of Concrete Road Design

By H. Eltinge Breed
Consulting Engineer, New York City

As far as I can ascertain the influence upon design of considering the relation between the road-bed and the paving slab is likely to develop in two opposite directions. Either we shall pay much more attention to the road-bed, or we shall pay none at all.

Design Road For Subsurface—In the first case, before designing a road at all, the engineers will make a much more thorough study of drainage and subsoil conditions and bearing power of the subgrade. Then we will design, not in terms of miles or even hundreds of feet as we do now, but in terms of slab units, proportioning the strength of each slab to the support it receives from the foundation. Thus, across a stretch of swampy ground the slabs might be designed 9 in. thick with steel reinforcement equal to that of a building floor founded on supports while 200 ft. further on, up the sharp ascent of a hill, the slabs may be only 6 in. thick with slight reinforcement. The high cost of the slabs on unstable soil would be leveled down by the low cost on the firm soil until the average cost of the road would not exceed that of the so-called average road today.

The second tendency is to leave the road-bed out of consideration, and with regard for economy devote our energy to getting a pavement structure that per se will sustain the demands of traffic upon it. This is the line along which Professor Elmer Hooper, of New York University, has been working and he has permitted me to present to you here some of his results. I now quote from him:

A Proposed Precast Road—"The usual percentage of steel is so small that it is readily acknowledged by most engineers to be of little value in load distribution. Its specified purpose is therefore limited to temperature resistance, bond between adjacent units to prevent vertical and horizontal separation, and strengthening of relatively weak local areas such as corners and unsupported edges. Of these only the temperature stresses seem to determinate and at first thought it might appear possible to make calculations to fix the amount of steel to keep intact a predetermined length of slab. It is unfortunate, however, that when stresses develop from temperature change there are very likely to exist at the same time severe stresses from passing loads which, though not causing any increase in the resultant axial stress do cause such a distribution of it as to overburden and rupture those fibers farthest removed from the neutral axis. When the crack starts it has to continue because of the reduced area to resist. Calculations on this basis are therefore of doubtful value. To develop a pavement of positively known qualities it is necessary to make determinate the nature and condition of supports. If and when that condition is established there is no logical reason why a design may not be developed, along the same lines as a bridge or building. It would not be necessary to use such low unit stresses for calculation of a pavement unit since it would not involve serious danger to life and property in the event of failure of a unit.

"Along this line the writer has evolved a plan of design and construction, which has for its purpose to satisfy the conditions just discussed. The point of most importance is that the pavement is made up of units, each supported at three points. The supports are solid and carried below frost. Each support carries the ends of one or more adjacent units. Adjacent edges are designed to interlock to make adjoining slabs mutually supporting. It may be readily seen that with this method of support a slight settlement of one end will cause no appreciable change in designed stresses.

"In the plan proposed the subgrade will carry no load though under excessive deflection there may be contact. There will, therefore, always be a sag between supports, due to dead weight as well as to live-load. The top surface will be always in compression and therefore not subject to cracking, while the bottom will always be in tension. Since the supports may be considered as permanent, the moments and shears for given loads may be calculated.

Foundation and Scour Protection of Large Power Station on Mississippi River

Alluvial Subsoil and Flood Scour Possibilities at Site of Cahokia Station Near East St. Louis Lead to Use of Mat Foundation on Concrete Piles Protected by Concrete Sheet-Pile Cut Off

DIFFICULT foundation conditions, heavy building loading and direct exposure to the attack of the Mississippi River constituted one of the critical problems in the design of the Cahokia Station, a large-capacity steam turbo-generating station on the east bank of the river for the Union Electric Light & Power Co. of St. Louis. McClellan & Junkersfeld, Inc., engineers and constructors of the station, found the solution of the problem in the use of a foundation of reinforced-concrete piles, adopted on the score of strength and permanence. A unique feature is a deep cutoff at the river front, constructed of interlocking concrete sheet-piles of unprecedented size. The station, which is now being built, is represented in its most important features by the cross-section Fig. 1 herewith.

Soil Conditions—The site selected for the station is on a broad plain on the Illinois side of the Mississippi River, about a mile below the center of the city. The station receives its name of Cahokia from this plain and from the first settlement in Illinois, nearby. The soil is a river deposit, as indicated by the topography, and is a fine-grained sand of no value as a foundation material. Rock is at a depth of about 100 ft. or more.

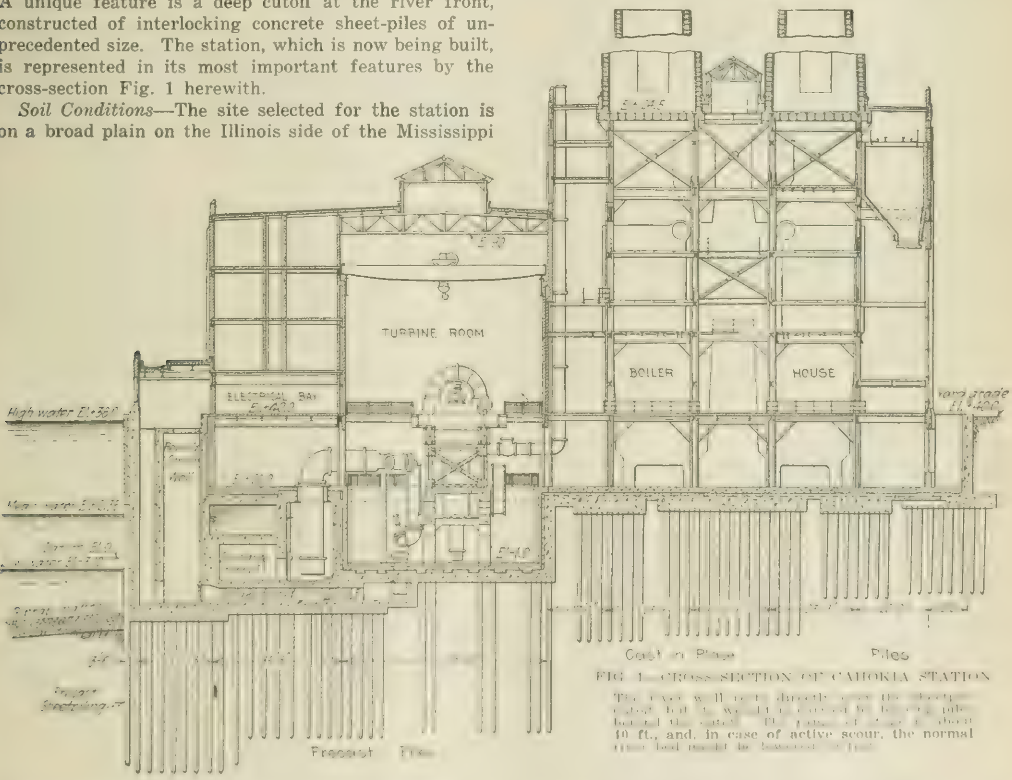


FIG. 1—CROSS-SECTION OF CAHOKIA STATION

The river wall rests directly upon the heavily [illegible] but it would [illegible] pile [illegible] the [illegible] about 40 ft., and, in case of active scour, the normal river bed might be lowered [illegible] feet.

Borings made at the site showed that the fine sand extends about 25 ft. below low water, and that at this depth it merges rather quickly into a stratum of coarse firm gravel, not of recent origin. From this fact, and a careful and thorough investigation of the river records and history, it was concluded that the possible river scour is limited to 30 or 40 ft. and that a sufficient penetration below this level would be proof against scour. The reinforced-concrete bearing piles used for the foundation are jetted and driven to a firm bearing in the gravel stratum and the interlocking concrete sheet-pile wall along the river front extends down to and enters the gravel stratum to give additional protection to the bearing piles should the river bed be lowered by scour.

Station Plan—An ultimate capacity of 240,000 kw. is to be provided for in the Cahokia station. The present installation will be one-fourth of the ultimate, comprising two 30,000-kw. turbo-generators. This first section of the station extends approximately 230 ft. along the river by 235 ft. in depth, and the intake and discharge tunnels and condenser pit for the first two units are all within the building and are located about at the center of the first section. The subsequent sections will be substantially duplicates of this one.

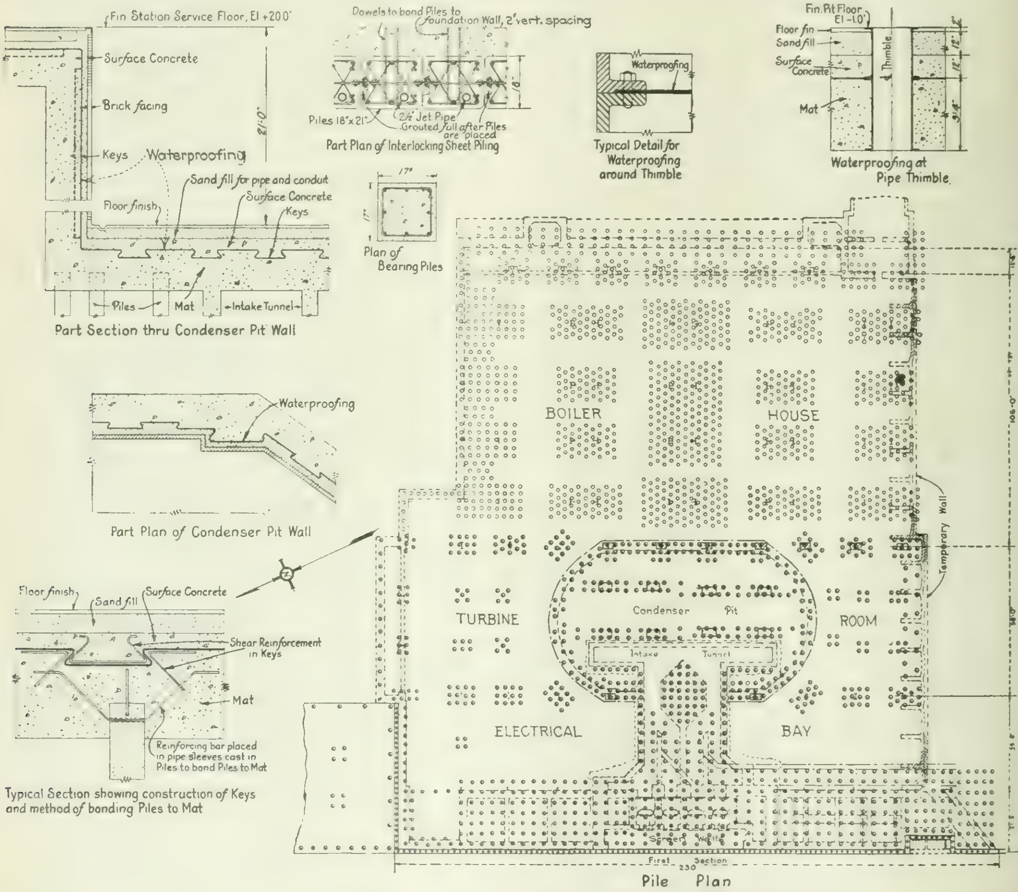
Bearing Piles—A foundation plan of the first section is shown in Fig. 2. As will be seen from the drawing, the piles are grouped and spaced according to the amount and distribution of the loads imposed by the structure and equipment.

The piles in the part of the station nearer the river are precast reinforced-concrete piles 17 in. square at the butt and 40 to 75 ft. long, depending on the driving depth and the cut-off level. The piles are jetted down and finally driven to bearing well into the coarse gravel. In the rear half of the station regular Raymond cast-in-place piles are used, being cheaper and their use being practicable as this part of the site was above water.

River Cut-off Wall—For the river cut-off wall, interlocking concrete sheet piles were adopted. These are 18 x 21 in. in section, rectangular, with integral steel interlocks, and are 75 ft. long; they weigh 15 tons each. They extend from El. +15 to —60, the latter depth being 25 to 35 ft. below the top of the gravel stratum. Above and back of this sheet-pile cut-off is the river wall of the station. The face of the river wall is continuous with the front of the sheet piles but its principal mass is back of the cut-off and rests on the reinforced-concrete mat and bearing piles. The lowest part of this mat is at El. —16, under the intake tunnels, and as the river wall extends up to the level of the turbine floor, El. +40, its maximum height is 56 ft. The wall is bonded to the sheet piles of the cut-off by reinforcing bar dowels. Thus a substantial barrier against river action between the levels of high river stage and deepest scour, a height of about 70 ft., is provided.

Waterproofing of Mats and Walls—The reinforced-concrete mat over the piles is in general 48 in. thick. It is tied to each pile by steel bars engaging the bars in the piles so that the pile weight and its frictional resistance assist in overcoming hydrostatic uplift. To provide against the possibility of water entering the building through the mat and walls a waterproofing membrane of asphalt and fabric is used. Due to the piles entering and being doweled to the mat it was necessary to place this membrane on top of the mat.

Under ordinary methods of construction the concrete surfacing over the waterproofing would have been made of sufficient weight to resist the hydrostatic pressure penetrating through the mat and acting on the bottom of the waterproofing. Under a condition such as obtains in the condenser pit, where at high water there may be a head of 40 ft. acting on the membrane, so great



Part Section thru Condenser Pit Wall

Part Plan of Interlocking Sheet Piling

Typical Detail for Waterproofing around Thimble

Waterproofing at Pipe Thimble

Plan of Bearing Piles

Part Plan of Condenser Pit Wall

Typical Section showing construction of Keys and method of bonding Piles to Mat

Pile Plan

FIG. 2—PILE PLAN, SHEET-PILE CUT-OFF, AND DOVETAILED WATERPROOFING

The surfacing concrete is held to the foundation mat by the dovetails, over which the waterproofing is laid. This avoids the use of a surface course heavy enough to resist the hydrostatic uplift.

a thickness of concrete would have been required that the ingenious expedient of bonding the surfacing concrete and the mat together was devised, thus reducing the thickness of the surfacing concrete by using the weight and strength of the mat plus the piles to resist the upward pressure. The bond is obtained by keying the surfacing concrete to the mat by a dovetail construction, as sketched in a detail in Fig. 2. The dovetails are formed in the mat, the waterproofing is then applied to follow the contours of the dovetails, and finally the surfacing concrete is poured directly on the waterproofing, thereby completing the keying. The dovetails are substantially reinforced with shear bars and the surfacing concrete between dovetails is designed and reinforced as a slab. A similar construction is used for the walls wherever there is water pressure.

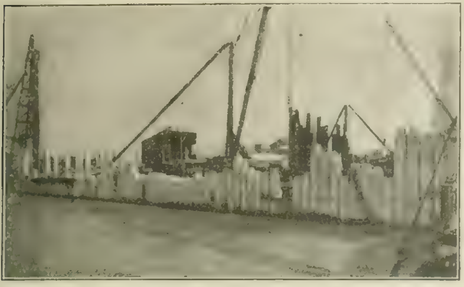


FIG. 3—SHEET-PILE CUT-OFF UNDER CONSTRUCTION

Construction—A pile casting yard was established at the site and the piles were allowed to season not less than 30 days. They were handled from the forms to the seasoning yard and thence to scows by locomotive cranes. A trestle was built projecting into the river to give the crane access to the scows at varying river stages. All of the precast bearing and sheet piles were placed by floating drivers. The piles were lifted from the scows to the leads by special tackle designed for this purpose. In sinking each bearing pile, two jets were used, supplying a large volume of water under high pressure. For the sheet piles the jets were supplemented with a 2-in. pipe cast in each pile. All of this work was done by the Raymond Concrete Pile Co.

In order to provide the necessary draft for the driving barges and to lower the river bottom to the elevation of cut-off of the piles under the lower portions of the mat, it was necessary to do a large amount of dredging. It was also necessary to deposit about 200,000 cu. yd. of hydraulic fill in the form of levees to raise the site to established yard grade. A 20-in. hydraulic dredge was used for this work.

The condenser pit, intake and discharge tunnels and water basins in the river bay, the mats of which are below normal water level, were constructed within cofferdams consisting of timber cribs enclosed with interlocking steel sheet piling. The length of the steel sheet piling was in general about 50 ft. and the piling was driven to bring the tops to El. +15. After the cofferdams were excavated to the proper levels and before they could be unwatered, concrete sealing mats, the tops of which are at the underside of the station mat, were deposited by tremie because the saturated, granular soil could not withstand the unbalanced pressure despite the penetration of the sheet piling. These mats were of a thickness determined to be from 20 to 25 per cent of the head that might be expected during the period of use of the cofferdam. After sufficient time had elapsed for the sealing mats to set (depending on the temperature of the water), the cofferdams were unwatered and the construction of the reinforced-concrete mats and walls was carried on in the dry.

The river and weather conditions have been favorable and no unusual difficulties or setbacks have been encountered thus far. The concrete work, exclusive of the piles, is being done by Fruin-Colnon Co. of St. Louis.

California State Aid Colonization Projects Achieve Success

IRRIGATED lands in California at Durham and Delhi, which were developed and supervised with the aid of state funds, are making a very favorable showing, according to the recently issued report of the Land Settlement Division, California Department of Public Works (Sacramento). During a period of the hardest times ever known to farmers, the report states, settlers on these projects have been able to meet their payments on farms, continue their improvements, and help build up wholesome and successful rural communities.

Both settlements are solvent enterprises. The land in the first settlement at Durham was sold for more than enough to pay for the land and to meet all development expenses. After the state has been paid the principal and interest of its advance, there will remain a surplus profit of $140,000.

The Delhi settlement is still being developed but if the farms continue to sell at prices now fixed there will be a considerable surplus over all state expenses. The increase in population and taxable wealth which is coming to the state from these two ventures has therefore placed no burden on state taxpayers. A total of 356 farmers have established homes in the two settlements, of whom more than one hundred are ex-service men.

Co-operation in buying and selling has been a notable feature of these settlements. Ten per cent has been saved, the report states, on the cost of homes and even more in the purchase of equipment, while the formation of co-operative enterprises for marketing products has enabled producers to command the best prices. Although the irrigation system for Delhi is not completed, settlement has kept pace with this progress. Last year a new house was completed every two days.

The first part of the report contains a statement of the relation of state aided land settlements to the prompt and successful development of irrigation districts and shows the same need for financing settlers that there has been for providing the millions of dollars with which reservoirs and main canals have been constructed.

The fact that there are a million acres of land in existing irrigation districts awaiting settlement is cited as showing this to be one of the most important social and economic problems of the state.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

What a Sales Engineer Does

Sir—Mr. Bedell's letter and your editorial in the Dec. 28 issue of *Engineering News-Record*, objecting to the term "sales manager" and taking the position that there is not and cannot be any such profession due to the inevitable conflict of the ethics of the engineering and selling professions, are open to three main objections: First, the sales engineer is an indispensable factor in industry, has been for years, and the field for his further development is practically unlimited; second, the Pharisaical objection to the term by other engineers is based on a complete misconception—and ignorance—of the principles governing good salesmanship; and third, sales work offers the most comprehensive and profitable solution of the problem facing the engineering profession today—the surplus of trained engineers and the consequent inadequate remuneration and lack of employment. Anything which tends to turn engineers from an outlet offering ideal employment for men of their general type and training, is obstructing the progress of the profession as well as that of the individual members.

The question "what is a sales engineer?" can perhaps be answered best by concrete cases. The two largest manufacturers of electrical apparatus have for years used engineers exclusively on their sales forces. Graduates in electrical or mechanical engineering, these men usually spend two years in the factory and two or more years in the engineering department, specializing on some particular line of apparatus, before they go out on the sales force.

As sales engineers, in touch with the latest developments in engineering and production, keeping up with what their competitors are doing, they can and do give the customer necessary and valuable technical advice; recommending to his engineers the purchase of such apparatus as will best fit his conditions, the scrapping and replacement of obsolete or uneconomical machinery, etc. This may be objected to as the legitimate field of the consulting engineer, but even if it were not a more economical arrangement all around, the progress of the electrical industry has been so rapid that no consulting engineer, not connected with a manufacturing company, could keep up to date. The customers' engineers depend on the sales engineering representatives of the different manufacturers to keep them abreast of the times in engineering development.

In the field, in a position to study the apparatus in operation, the sales engineer appreciates the customers' requirements as well as the manufacturers' and is less an "advocate" and more a "judge" than the design engineer sitting at a desk in the factory; devoted to his own ideas, and influenced, more or less unconsciously, by the manufacturers' point of view. To the writer's personal knowledge, it is common practice for these "unethical" salesmen to demand of the manufacturer, changes the better to meet the customer's requirements, even at a possible expense of manufacturing expediency and profits.

Again, in case of trouble, he is the manufacturer's engineer on the job, the first man called in to help get the machinery in regular operation again. Is there any defensible reason why these men should not retain their right to be designated as engineers? Can any better method of distribution be devised—from the standpoint of manufacturer, salesman or customer?

They are also salesmen in that they actually "book orders" which brings us to the matter of ethics. What is the ethical difference between an engineer who sells his services to a manufacturing company to design and develop products in accordance with the price, quality and trade standards of his employer and the engineer who sells these same products? If the products are such that the salesman can't honestly sell them, how about the ethics governing the engineer who designed them? In practise does the design engineer refuse to design inferior or faulty products as often as the sales engineer refuses to sell them?

Mr. Bedell states that if a salesman should apply "professional ethics"—by which I assume he means plain ordinary honesty—to sales work, he would soon be out of a job. He is most likely to be out of a job if he doesn't. When he has lost the confidence of the customer—which he certainly will, if he gives incorrect or prejudiced technical advice and persuades him into buying something he does not want—he has lost the customer's future business and is of no further value to his employer. That is obvious cold-blooded logic, and neither customer nor employer will take into consideration any imaginary "double standard" of ethics governing engineers and salesmen.

If you happen to know of an engineer who in his complete ignorance of the essentials of selling, is attempting to sell an inferior product by crooked methods, don't blame his fall to his entrance into sales work. "Sharp practise," misrepresentation, hypnotic stunts, have no more place in the sales profession than patent medicine methods have in the medical profession. If a product is so inferior as to require such methods, the engineer should leave it to the so-called "super," "high caliber," "six-cylinder" salesmen. The sooner such products are forced off of the market, the better for everybody, including their manufacturers.

Establishing his position in the sale of machinery to industry, the engineer has only scratched the surface of his opportunities in sales work. All the materials and supplies purchased by industry offer an attractive field for the application of sales engineering methods. Once rid of the fallacy that his engineering training fits him only for a particular branch of the engineering profession in which he has specialized, and awake to the fact that a trained mind can be applied to any work, the whole selling field offers interesting possibilities to the engineer.

To be sure the average engineer will need to cultivate tact, the ability to present his subject clearly and convincingly, to think and act quickly in an emergency, and he must know human nature. But these things are of equal, if less recognized importance, in strictly engineering work. Success as an engineer depends directly on sales ability, the engineer's ability to sell his services to an employer, to put over his engineering projects with capitalist, executive, or the public.

I am afraid I am exceeding my space allowance, but intimate contact, especially since the armistice, with first class engineers, out of work or obliged to maintain their families on inadequate salaries, and the tendency to discourage the younger generation from taking up engineering work in college have emphasized the importance of a realization of the opportunities offered by sales work to the trained mind of the engineer. On the other hand manufacturer and consumer need the engineer in sales work. He can be of invaluable assistance in standardizing and perfecting the product, simplifying and improving the methods of distribution.

These are not opinions but facts as I have found them in sixteen years of engineering, manufacturing and sales work. My associates and myself, a sales organization composed of mechanical, mining and electrical engineers, see no reason for removing "Sales Engineers" from our letterheads. We sell only products which stand strict engineering investigation. We recommend them to our customers when they will meet their requirements, or tell them frankly when they will not. There is nothing altruistic or unusual about our methods—we simply practice good salesmanship.

Speaking for the sales engineers of the country, I make the unreserved statement that the ethics of our profession will stand comparison with the ethics of any other branch of the engineering profession

New York, Jan. 15. HARRY CARLTON.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The 1923 convention of the National Highway Traffic Association which was to have been held in Cleveland, Ohio, Feb. 19 and 20 has been postponed.

The Finance Committee of the Senate and the Ways and Means Committee of the New York Assembly have announced that a hearing on the Webb-Hackett bill, authorizing a state highway bridge across the Hudson River at Poughkeepsie, will be conducted Feb. 20.

The 1923 paving program for Akron, Ohio, according to information supplied *Engineering News-Record* by E. A. Kemmler, highways engineer, includes 18.3 miles of paving, 0.70 of repaving, 2.5 of resurfacing, and 12.18 miles of grading and walks. The total estimated cost is $2,950,000, of which $676,000 will fall on the city.

In order to obtain an accurate knowledge of the water power of the Winnipeg and English Rivers 24 government engineers are now engaged in making a geodetic survey. The levels are being taken from Sioux Lookout to Fort Alexander. The engineers will submit their report to the Dominion government in March.

The Rolling Stone bridge over the Susquehanna River at Clearfield, Pa., which was damaged two years ago in an ice jam and was being rebuilt, was further damaged in another jam last week. All work of the last two months was torn out. Damage is estimated at $7,000.

The caisson for the New York river shaft of the Hudson River vehicle tunnel between New York and Jersey City was towed from the yard of the Staten Island Shipbuilding Co., where it was built, to its position at the foot of Canal St. on Jan. 30. The caisson is about 93 x 37 ft. and forms the lower section of one of the shafts by which the tunnel will be ventilated.

Governor Silzer of New Jersey has recommended George Paddock of Newark; Harry D. Werthing, of Orange; and Joseph McDonough of Newark, as the three-man highway commission to replace the eight-man body he recently dissolved. Names of these men will be sent to senate leaders for tentative approval, according to their request.

Four men were killed by the collapse of a two-story brick dwelling house in Pittsburgh on Jan. 22. The house was over 50 years old. A commercial building was being constructed alongside, and foundation work was in progress. It is reported that the footing excavations undermined the side wall of the house and caused the wall to buckle half way up. The men killed were at work on the new footings.

B. F. Cresson, Jr., Port Authority Chief Engineer, Is Dead

Benjamin F. Cresson, Jr., chief engineer for the Port of New York Authority, died Jan. 26 following an operation for appendicitis. He was taken ill in the corridor of the building housing the Port Authority offices two days prior to his death. Mr. Cresson was forty-nine years of age.

Mr. Cresson, who was born in Philadelphia, received his education at Lehigh University and the University of Pennsylvania. After leaving college he served on the engineering forces of the Lehigh Valley R.R. from 1894 to 1897, at which time he was appointed transitman on the construction of the Reading subway in Philadelphia. In 1900 he was made assistant engineer in the office of Jacobs & Davies, consulting engineers, New York City, on preparation of plans, specifications and estimates for the proposed tunnels for the Long Island R.R. under the East River, New York City. In 1901 he was assistant engineer in resurvey plans for the completion of the Hudson tunnels under the North River (McAdoo tunnels). During the next nine years he was assistant engineer, alignment engineer and resident engineer in charge of precise triangulation on the North River, resident engineer in charge of a section of the subaqueous tunnels under the North River, and resident engineer on the Pennsylvania Terminal in New York.

Mr. Cresson was appointed first deputy commissioner of docks of New York City in 1910, during which time he visited Europe to study important harbors. He held that position until early in 1913, when he resigned and was appointed engineer of the New Jersey Harbor Commission. Two years later he was appointed chief engineer of the Board of Commerce and Navigation of the State of New Jersey. He held that position two years, after which he resigned to enter consulting practice in New York City.

In his consulting practice Mr. Cresson served the Board of Harbor Commissioners of Wilmington, Del., Pacific Port Terminals, San Francisco, City of San Diego, Cal., Port of Tampa, Fla., and the Board of Harbor Commissioners of Camden, N. J.

He became associated with the investigation of the engineering features of New York harbor at the time of the formation of the interstate body which preceded the organization of the Port Authority and was responsible for the major part of the engineering plan made by that body and incorporated in the interstate treaty. He became chief engineer of the Port of New York Authority at its formation.

Concrete Institute Meets in Cincinnati

Program Covers Construction and Design Problems and Study of Concrete Products

Engineering News-Record Staff Report

A growing interest in the concrete products industry was the distinguishing feature of the nineteenth annual convention of the American Concrete Institute, which was held at Cincinnati, Ohio, Jan. 22-25. In the early days of the Institute, then the National Association of Cement Users, the so-called cement block was very much in evidence, but as that product declined in quality and quantity interest in the society likewise declined. Now, however, when a different sort of individual is in the concrete products business and he is producing a quite different sort of product, the Institute has recognized the growing necessity to provide a forum for debate and a medium of standardization for the various precast concrete activities. Two or three of the sessions, therefore, were devoted to committee reports discussing concrete blocks, brick, and tile, and to the business of concrete products manufacture. While the major part of the proceedings was devoted as usual to the structural field, the recrudescence of the products field is significant.

TWENTY-FIVE PAPERS PRESENTED

Some twenty-five papers and twenty-two committee reports were presented in the ten sessions in the four days. Of the reports, twelve were merely of progress, eight presented tentative standards, and two final standards adopted to be sent to letter ballot. The adopted standards were a set of definitions by Committee G-4, on Nomenclature and the revised edition of the well-known specification on stucco by Committee C-3, on Treatment of Concrete Surfaces. The specifications and recommended practice accepted by the convention as tentative were as follows:

Tentative Standard or
Recommended Practice
Concrete building block and tile
Concrete brick
Concrete floors
Monolithic concrete sewers and design rules
Rec. prac. for concrete fuel oil tanks
Rec. prac. for treatment of exterior surfaces
Concrete stucco
Concrete road

Of the committees which presented progress reports the most important was that by Committee E-6, on Destructive Agents and Protective Treatment, which submitted the results of an extended inquiry into the effect of sea water on concrete. The inquiry consisted of a review of the literature of the subject and a questionnaire sent out to about seventy-five men who have had experience in sea-water work. "Of the fifty-one replies received to the questionnaire," says the report, "all but one gave approval to the use of concrete in fresh or in sea water and they were universal in stating that their general experience led them to believe that the failures of concrete in sea-water service were attributable to either improper material or poor workmanship." The report is an excellent review of the present stage of knowledge of sea-water construction situation, but does not contribute anything new. It contains, also, some review matter on the effect of alkalies, oils, high temperatures, and acids. Committee E-7, on Waterproofing, reported that it had organized for an intensive investigation of the much debated waterproofing subject. Committee P-5, on Fire Resistance of Concrete Buildings, gave a preliminary report of the tests on concrete block walls made at the instance of the Institute at the Underwriters' Laboratories last year, and these tests have not yet been fully reported so that definite conclusions are not yet available. Committee P-1, on Contractors Plant, concluded its investigation of the relative merits of different types of concreting plant for buildings, an investigation started last year.

SOME PAPERS ABSTRACTED

The more important of the papers presented are abstracted on another page of this issue. These include the main conclusions of the papers by W. A. Slater and G. A. Smith on the inundation method for measuring sand in making concrete with the explanations of some practical applications therefrom by R. L. Bertin of the White Construction Co., of New York, who devised the method. This inundation method was explained briefly in *Engineering News-Record*, June 22, 1922, p. 1047, when it was first proposed by Mr. Bertin. It has since been tested at the Bureau of Standards as reported by Messrs. Smith and Slater.

The basis of the method is the assumption that the varying moisture in the sand, which results in a varying strength in a uniformly proportioned concrete, can be overcome by dropping the sand into a receptacle of water, the resulting saturated sand having the same quantity of water content regardless of its original moisture. This assumption was confirmed in large degree by the Bureau of Standards tests.

One session was devoted to a discussion of concrete stadiums, the principal paper by Prof. C. T. Morris, of Ohio State University, describing in considerable detail the new stadium at that institution (see *Engineering News-Record*, Oct. 19, 1922, p. 640). Prof. Morris gave the unit costs in some detail, but he stated that they were subject to revision. The cost per seat was about $22, but this includes rather elaborate ornamentation and extensive use of under-stand space. H. T. Campion, of New York, in describing the new Franklin Field stand for the University of Pennsylvania, said the seat costs there were $15.64 for the permanent stand, including also architectural effects and interior finish. At Ohio the costs, barring decorations, etc., would have fallen to about $19, and at Philadelphia to about $11. R. L. Bertin described briefly the framing of the Yankee stadium at New York City.

Prof. D. A. Abrams, of Lewis Institute, reported some rather surprising tests on the effect of impure waters used in mixing concrete. The tests were in two series, extending over strength test periods of two years and involved the use of a number of different impure mixing waters, ranging from sea water, both artificial and real, to that from the infamous Bubbly Creek in Chicago. Contrary to the general opinion held on this subject, the tests showed that, with the exception of the heavy salt solution (more than 10 per cent) and the waste water from oil and tannery plants, there is little decrease in strength due to polluted water. Even the Bubbly Creek water, heavy with organic refuse, showed little decrease in strength from a pure water. For some reason, however, all tests with pure as well as with impure water showed a falling off in strength at two and one-third years. Another set of tests reported by G. W. Hutchinson, of the North Carolina State Highway Department, gave the correction coefficients which had been found by tests should be applied to cylinders of different dimensions than the standard 6x 12-in. Prof. Abrams reported similar tests that had been made in his laboratory.

DECORATIVE CONCRETE SESSION

In an evening devoted to decorative concrete J. C. Pearson, of the United States Bureau of Standards, talked interestingly on the subject of concrete house construction, which he has been investigating for some time. Mr. Pearson feels that the development in this line must be along either an all-concrete house or a concrete wall house with steel or steel and concrete interior, and that the concrete exterior with frame interior if of little greater permanence or fire resistance than an ordinary frame house. He said that in the development of the concrete house further propaganda must insist on the saving in amortized cost. The same evening Lorado Taft, a Chicago sculptor, gave a delightful talk on "The Fountain of Time," that remarkable concrete group which has just been finished at the entrance of the old Midway in Chicago. Mr. Taft explained how the idea of this monumental group had been growing in his mind for many years but seems impossible of accomplishment on account of the difficulty of material until he had learned of the work done by J. J. Earley in exposed aggregate concrete casting. Mr. Earley later described the rather intricate structural requirements of the casting of the statue.

A brief paper by John J. Ahlers, of New York, described the preliminary tests made to determine whether a premixed aggregate such as was used in a building in New York City reached the concrete mixer in the same gradation as it left the aggregate mixing plant. Mr. Ahlers' tests are not yet complete, but as presented they were rather severely criticised from the floor.

Last year an innovation was introduced by Prof. Abrams and Stanton Walker, of Lewis Institute, in the way of an actual demonstration of the method of proportioning concrete devised by the laboratory there. This year this method was used for three papers, one by Mr. Walker to illustrate the products manufacturers, how they may best proportion their aggregate; one by R. F. Havlik, of Mooseheart, Ill., to illustrate how they make molded concrete products at his institution, and the last by Prof. Slater and Mr. Bertin to demonstrate the inundated sand principle of proportioning. The bringing before the audience of the actual material and methods proved well worthwhile. A question box was another novelty that took up one afternoon's session. Many questions had been asked by members and were answered by other members to whom they had been assigned. This feature resulted in a discussion of current problems in concrete difficult to report on in detail, but appreciated by those present.

The Wason Medal for the most meritorious paper presented to the Institute last year was awarded to Prof. George E. Beggs, of Princeton University, for his paper "An Accurate Mechanical Solution of the Stresses in Indeterminate Structures by Use of Paper Models and Special Gages." Prof. Beggs presented at this year's convention some supplementary notes on the applicability of these methods to actual structures.

W. P. Anderson, of Cincinnati, was re-elected president, and Harvey Whipple, 1807 East Grand Boulevard, Detroit, Mich., secretary.

New Mississippi Flood Bill

Washington Correspondence

A determined effort will be made to pass a new Mississippi River flood control bill at this session of Congress. The flood control committee of the House has agreed on a bill which now is on the calendar. The bill authorizes the appropriation of $10,000,000 annually for an indefinite number of years; money to be used for channel improvement and for federal aid in levee construction. It simply extends the provisions of the existing flood control act whereby two-thirds of levee construction is paid by the federal government and the remaining one-third by the local interests, but the local interests are required to furnish the right-of-way and maintain the levee, which makes the actual cash outlay practically equal for each of the contributors.

The committee before reporting out the bill considered a plan whereby the local interests would be allowed to deposit levee board bonds with the Secretary of the Treasury in lieu of a cash payment. Due to the heavy expense incurred during the high water of 1922, many of the levee boards are in financial straits. The scheme was rejected as being impracticable, however.

The committee also rejected a plan to limit the appropriation to $100,000,000. The existing flood control act was limited to $45,000,000. The last of that amount will have been expended during the next fiscal year and there still are long stretches of levee which have not been brought to the grade and cross section prescribed by the Mississippi River Commission. Now that the jurisdiction of the Commission has been extended to tributaries, the total cost of levee and revetment work becomes more problematical than ever. For that reason the committee decided to resort to the continuing type of authorization.

Technical Societies Hold Annual Meetings

State Organizations of Illinois, Indiana, Colorado, Iowa, and Engineering Institute of Canada, Discuss Pertinent Topics

Illinois

PROVISION for including engineering expenses in cost estimates for special assessment ordinances was one of the most actively discussed subjects at the annual meeting of the Illinois Society of Engineers held at Peoria, Ill., Jan. 23-25. Support of a movement for suitably amending this law was voted.

With successive sessions assigned to particular branches of engineering a wide field was covered by a well balanced program. In sanitary engineering, a review of sewage disposal in Illinois showed that 62 of 127 plants have only single-story tanks, the others having either one- or two-story tanks with supplementary filters of various types. A discouraging feature, however, is the almost universal lack of attention to the operating conditions of these plants. This review was by H. F. Ferguson, state sanitary engineer, and Paul Hansen, consulting engineer. The activated sludge process was discussed by Dr. A. M. Buswell, Chief of State Water Survey, along the lines of his article in *Engineering News-Record* of Jan. 18, p. 119.

Predicting Well Boring Results

Predicting the results of deep well borings by study of geological conditions was the subject of a paper by W. T. McClenahan, Chicago, and water supplies from gravel in the Illinois valley were discussed by G. C. Habermeyer, engineer, and M. M. Leighton, geologist, of the State Water Survey. Of particular local interest were two papers relative to the Illinois River, since Peoria claims that the Chicago drainage canal pollutes the water and causes floods. An address by F. W. Mohlmann, chemist of the Chicago Sanitary District, showed the fallacy of the first complaint, while M. G. Barnes, chief engineer of the State Waterway Division, showed records indicating that increased flood heights of recent years are largely the result of channel restriction by levees for land protection and of the straightening of tributary streams, thus hastening their runoff.

Open or closed specifications for asphalt pavement were discussed at some length, but mainly in favor of the "open" system on account of greatly reduced cost for work of equal quality. Experiments with sprinkling calcium chloride on concrete roads to hasten the curing have given excellent results according to H. F. Clemmer, of the State Highway Division. If the material remains on the surface for six hours it gives its full effect and need not be renewed if then washed off by rain. Two papers relating to highway traffic were on automobiles and motor truck operation, by Prof. Hewitt of the Bradley Polytechnic Institute (Peoria) and on the effective lighting of roads to facilitate night traffic, by Prof. A. R. Knight, University of Illinois.

A successful malaria-mosquito campaign at Carbondale, Ill., was outlined by H. F. Ferguson, chief sanitary engineer, State Board of Health, and A. F. Dappert, assistant sanitary engineer. By swamp drainage, clearing ditches and water courses, oiling and covering rain-water barrels and putting fish in wells and cisterns, the number of malarial cases was reduced in one season from 267 to 19, or 4.26 to 0.3 per cent of the population. An item of this work was the excavation of a drainage ditch by explosives. Both the engineering and commercial aspects of land drainage were illustrated in a paper by J. W. Dappert, Taylorville, Ill., describing the reclamation, cultivation and settlement of a tract of some 90,000 acres near Albert Lea, Minn., as described in *Engineering News-Record* of Oct. 6, 1921, p. 552. This was one of the papers accompanied by moving pictures, which were a feature of the meeting.

H. E. Babbitt, assistant professor of sanitary engineering, University of Illinois, was elected president. E. E. R. Tratman, Wheaton, Ill., (associate editor of *Engineering News-Record*) is vice president and secretary.

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Indiana

A DESCRIPTION of the power, development work in progress on the Tippecanoe River at Monticello, Ind., was a feature of the annual meeting of the Indiana Engineering Society, held at Indianapolis, Jan. 18 and 19. The plant will have a present capacity of 10,000 hp. but is designed for an ultimate capacity of 30,000 hp. The paper on this plant was read by Roger M. Freeman, consulting engineer, New York. A power generating and distribution project of the Central Indiana Power Co., which provides for interconnection of several plants in order to secure economic operating results, was described by L. B. Andrus, chief engineer of Kelsey, Brewer & Co., Grand Rapids, Mich. Officers for 1923 were elected as follows: President, John L. Elliott, city engineer of Indianapolis; vice-president, Prof. D. D. Ewing, Purdue University; secretary, Charles Brossman, Indianapolis, Ind.

* *

Colorado

ONE hundred thirty members of the Colorado Society of Engineers attended the seventh annual meeting held in Denver, Jan. 20. R. M. Hosea, retiring president, read a review of the year's activities of the society and urged the engineers to go into the study of economic problems, as an aid to their professional work.

Officers elected are: W. M. McMechen, president; Fred C. Steinhauer, vice-president; C. M. Lightburn, secretary-treasurer; R. J. Randall, R. G. Hosea, J. J. Vandemoer, I. C. Crawford, R. J. O'Rourke, W. R. Hellyer and A. K. Vickery, directors.

Mayor Bailey, of Denver, and Frank N. Briggs, former president of the International Trust Co., addressed the engineers on the progress and the needs of the city and state.

Engineers addressing the meeting were: Frank Shepard, Thomas B. Stearns and Ralph Carpenter.

Engineering Institute of Canada

PAST-PRESIDENTS of the Engineering Institute of Canada are to establish a fund to provide medals and prizes for the best papers on engineering subjects submitted to the institute throughout any year. This announcement was made by J. M. R. Fairbairn, a past-president, at the annual convention of the institute held at Montreal, Jan. 23. Gold medals will be given members and cash prizes to students. Already a fund of $2,350 has been subscribed.

Arthur St. Laurent was elected president of the Institute as noted in these columns last week. George A. Walkem, president of the Vancouver Machinery Depot, and Walter J. Francis, consulting engineer of Montreal, were elected vice-presidents.

J. G. Sullivan, chief engineer of the Canadian Pacific and retiring president of the Institute, indicted union labor as it exists in Canada, asserting that union organizations had not lived up to their avowed purpose—improving the condition of the worker. He said that much work was hampered by the operation of restrictive union rules, and that a great amount of the inefficiency of union organizations could be laid to the professional labor leader. He recommended the industrial shop plan of co-operation as a means of improving the relation between capital and labor.

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Iowa

AS the Iowa Engineering Society is playing a prominent part in furnishing to legislators on bills pertaining to engineering, one session of the annual meeting of the society held Jan. 23-26 at Des Moines, was attended by the code revision committee of the house and senate. Although it was the camp fire meeting usual yarn-swapping and ballyhoo entertainment features were obscured when, by request of the legislators, papers on highway development, traffic regulation and taxation, given at an earlier technical section meeting, were repeated. Members of the committee entered into the discussion, asking questions and noting pertinent information.

For several years the engineers have discussed proposed bills or changes in bills on highways, drainage, and sanitation but repeatedly have been put off awaiting general code revision. The engineers' legislative committee of the society of which C. H. Young is chairman, acts as a clearing house in getting information to the legislators. Statewide publicity and effective work on specifications for drainage and pavements were further notable activities reported at the meeting, which was attended by about 300 engineers and guests. Younger men were decidedly in evidence.

The publicity committee, under the chairmanship of W. J. Schlick, has been effective in attracting the attention of the legislators. Publicity is sought on the principle that when legitimate for the engineer's work, it is necessary; and that before the engineer can change his status greatly he must think and act as a citizen as well as an engineer. With these points in view letters were sent each member of the society urging him to submit articles of his year's

(*Continued on page 227*)

Speedy Trial of War-Fraud Suits Urged by A.G.C.

Consideration of Federal Indictments Against Members Features First Day at Los Angeles Meeting

Engineering News-Record Staff Report

Consideration of the federal government's suits against war-camp contractors and of the indictments of seven individuals connected with the letting of war-construction contracts was the principal feature of the first day of the fourth annual convention of the Associated General Contractors which was held in Los Angeles this week. At the close of the first day, Tuesday, there was a registration of 350, including about 100 ladies. At the afternoon session the finances of the organizations were considered and the reports of the committees on legislation and publications approved.

In the annual address the retiring president, Arthur S. Bent, of Los Angeles, characterized as the chief recent accomplishments of the construction industry the development of "pride of calling" with a consequent erection of ideals and standards and the impressing on the public the importance of the construction industry. As factors in these accomplishments he reviewed the work of the association during the past year stressing the beginning of standardization conferences with equipment manufacturers, co-operation with technical societies on standard contract forms, the securing of release of open-top freight cars and the co-operation on contract provisions with the American Association of State Highway Officials.

Turning to the war-contract indictments and suits he repainted vividly the picture of war stress under which the contractors were called in to do their almost impossible tasks. Now, nearly five years later, they are branded as conspirators against the government and as profiteers. He maintained that the industry should meet the challenge and demand an immediate trial for the charges reflect on the whole industry. If the men were guilty the industry would be first to repudiate them.

Immediately following Mr. Bent's address D. A. Garber, as chairman, presented the report of the committee appointed to investigate these same federal indictments and suits. The report pointed out that the fees paid camp contractors had averaged 2.7 per cent on $100,000,000 of work and that after careful study two committees of experts had approved the form of contract as the only one feasible under the conditions. The report recommended that these and other facts constituting a review of the situation be referred to the Resolutions Committee as a basis for resolutions expressing the sentiment of the association. This recommendation was approved.

Announcement was made that at a meeting of the joint committee of the association and equipment manufacturers standard specifications for wheelbarrows had been agreed upon and had been referred to the manufacturers for approval. It is hoped to draw up standards for various features of the important classes of equipment and to urge the advocacy of these A.G.C. standards upon all contractors.

Under the head of finance there was a lengthy discussion of dues, some advocating the present plan of a percentage on the contractor's gross business and others a flat basis with higher dues for a sustaining-member class. The advocates of the latter plan contended that the percentage method was keeping out the small contractor. No decision was reached, the completion of the discussion being laid over until the budget was considered.

The publications of the Association were discussed, bringing out strong an approval of the present publication policies.

Colorado Assigns Highway Funds

The Colorado State Highway Commission has apportioned $6,777,596 for construction of highways in 1923. The report of the highway advisory board has been approved by the governor of the state. Of the total to be spent, $3,161,691 represents entirely new construction, the remaining sum being left over from the previous three years. Federal-aid projects total $5,272,700 and state projects, $1,494,896.

According to a statement issued by Maj. L. D. Blauvelt, state highway engineer, most of the construction during the coming season will be on main north and south, and east and west highways.

May Fix Professional Salaries by Executive Order

Washington Correspondence

An executive order may have to be issued to provide an adequate scale of salaries for professional positions in the government service. Congress has wrestled with this question for more than two years, and now as the session is about to close, the reclassification legislation seems to be jammed hopelessly. It is just possible that Congress, on learning that the President is prepared to meet this situation by an executive order, may compromise its differences and provide the long-needed legislation.

If an executive order is issued, it is believed the scale would be about as follows: chief professional, $7,500 and up; full professional, $5,700 to $7,500; associate professional, $4,500 to $5,700; assistant professional, $2,460 to $4,500; junior professional, $1,860 to $2,460. The Brown report on reorganization now is promised for Feb. 1.

Sacramento Filter Intake to Be Completed Below Estimate

The intake conduit leading from the Sacramento River to the filtration plant being built for the City of Sacramento, Calif., is now about 75 per cent. complete and it is definitely stated that as all hazardous portions of the work are done the total cost can be placed about $98,000. This figure is $33,000 under the city engineer's estimates and about $60,000 less than the lowest bid received at the opening on Sept. 19 when bids were rejected and it was decided to do the work by day labor under the direction of the city engineer.

A résumé of the rearrangement in design and plan of construction was published in *Engineering News-Record* Oct. 26, 1922, p. 719.

John W. Cowper Is Elected President of A.G.C.

John W. Cowper, new president of the Associated General Contractors, whose election took place at the Los Angeles convention early this week, since 1915 has been president of a Buffalo contracting concern which bears his name. Previous to that time he had been in the vice-president's office of the Lackawanna Bridge Co. and before that engineer for James Stewart & Co. engaged in erecting buildings for the plant of the British Westinghouse Electric & Manufacturing Co. of Manchester, England.

Mr. Cowper has had extensive engineering experience, having been first employed in an engineering capacity by the department of sewers in the city engineer's office at Chattanooga, Tenn. in 1888. For the next five years he was in the engineering department of the Cincinnati Southern and the Alabama Great Southern Rys. on construction and maintenance-of-way work. From 1896 to 1899 he was engineer, maintenance-of-way, Cairo division, in charge of track, bridges and buildings on 270 miles of the C. C. & St. L. Ry. He became engineer, maintenance-of-way, of the St. Louis division of the same railroad in 1901 and placed in charge of maintenance of track, construction and bridges, buildings and incidental work on 265 miles of track.

Mr. Cowper has taken an active part in the A. G. C. activities for several years past. He is vice-chairman of the Joint Committee on Uniform Contracts, composed of members of the A. G. C. and from other societies. He has also been chairman of the Associations Committee on Contracts.

Half Million in Damage Suits for Knickerbocker Collapse

Suits for damages for the death of persons killed in the collapse of the Knickerbocker Theater roof in Washington on Jan. 28, 1922, were filed during the past week to an aggregate amount of nearly half a million dollars. Seven damage suits filed previously bring the total well over half a million. Some of the suits are directed at the Knickerbocker Theater Co., owners of the theater, and others also against its president, the architect of the theater, the steel contractor (and designer), and the District of Columbia.

The theater company has demurred to certain of the suits, on the ground that the declarations failed to show any act of negligence on the part of the company. Representatives of the plaintiffs argued in reply that the happening of the accident proved negligence, and referred to the legal doctrine that the owner of a place of entertainment warrants the premises to be reasonably safe for the purpose. The District Supreme Court, in which the suits are brought, has not yet made a decision on the demurrer.

Hoover Urges Engineering Unity at Loweth Luncheon

Profession Has Failed to Account for Fact Government is Applied Science of Economics

Washington Correspondence

With more than his usual earnestness, Commerce Secretary Hoover made a plea for unity among engineers in the course of remarks at a luncheon tendered Charles F. Loweth, the new president of the American Society of Civil Engineers, at Washington, on Jan. 23. Secretary Hoover declared that the civil engineers should not raise secondary questions when that course interferes with engineers as a whole doing their full duty to the country.

As a result of the inadequacy of transportation, the public is being driven into a clamor for public ownership of the railroads he pointed out. It even may be an issue in the next campaign, he predicted. Mr. Hoover declared that he is against this proposition and said the country is not within 200 years of the time when such an undertaking could be handled successfully.

The Federated American Engineering Societies is not in a position to throw the weight of its influence into the study of the transportation problem because of the failure of the civil engineers to co-operate, he said. As a result the country is confronted with a situation of utmost gravity and the engineers are not united to urge its solution along sane lines. The only ones in contact with the situation in Washington are those who are interested on either one side or the other, he continued.

Government, Secretary Hoover said, is the applied science of economics. Engineers have not taken that fact into sufficient account, he said, as the dominating thing in engineering today is the interpretation of economic forces, yet the profession is not a unit in Washington, the point from which their efforts in the national welfare must issue.

Mr. Loweth did not reply to Secretary Hoover. His remarks had preceded those of the Secretary of Commerce. At that time he called attention to the fact that if the American Society of Civil Engineers should not arrange to co-operate through American Engineering Council, the organization itself would make arrangements for close co-operation with the government. It evidently was this reference to the alternative which led Secretary Hoover to speak as he did.

The luncheon was organized by John C. Hoyt, retiring director of the Am. Soc. C. E. for the Washington district.

City of Bergen, Norway, Invites Bridge Plans

An international competition has been announced by the municipality of Bergen, Norway, for the submission of plans and drawings for new bridge over Nygaardstrommen in Bergen. Further particulars regarding the competition may be secured upon application to the Bergen Road Board, Bergen, Norway, by a deposit of 50 kronen. The latest date for submitting plans is June 30, 1923. The outline of the program is printed in Norwegian, German and English.

Iowa Engineers Discuss Technical Problems

(Continued from p. 225)

work to the local newspaper. One engineer in each county was asked to prepare a tax analysis for local distribution. Twenty articles were published and 35 tax analyses made.

Work in the drainage section on standard specifications for levees, open ditches and tile drains has been under way for several years. With minor changes those submitted last year were adopted.

Prof. T. R. Agg presented a set of suggested specifications on concrete, brick, asphalt, coarse aggregate bituminous concrete and bitulithic pavements for municipal and primary road paving projects containing essentials that the state highway commission would require.

Technical papers and discussions (more than 20) were confined largely to drainage, highways, mechanical-electrical, municipal, railroad and structural-architectural. Claude C. Coykendall's suggested solution for the Iowa highway transportation problem elicited spirited discussion and interest. C. W. Eby's discussion on the regulation and taxation of motor buses and trucks presented the citizen's more or less disgruntled viewpoint, emphasizing the complaints of the inequality of taxation, undue destruction by the small percentage (0.54) of 5-ton trucks, arguments for the proposed 2-cent gasoline tax and objections to the state highway commission because it advocates a large construction program but no remedy for the equalization of taxes.

Municipal technical papers related to sick sewer systems, infiltration of ground water, town planning, refuse disposal and water supply status in the state and reasons for failures in asphalt paving. The structural-architectural section heard papers on Prof. A. H. Fuller's impact studies on the Skunk River bridge near Ames, Prof. Byron J. Lambert's new design of an all-steel grandstand at Iowa City, and a discussion on the design of reinforced-concrete circular tanks by William Hewett.

The newly elected officers are: President, Lloyd A. Canfield; vice-president, C. C. Coykendall; and new director, J. D. Wardle. Mr. Canfield's place as secretary has not yet been filled by the board of directors.

Engineers Discuss World Congress

A conference on plan and scope for an international engineering congress, to be held at the time of the sesquicentennial celebration in Philadelphia, was held in New York Tuesday, Jan. 9. The meeting was held in accordance with plans previously initiated by the Engineers' Club of Philadelphia, which organization requested the four founder societies and the Am. Soc. T. M. to meet in conference to discuss a world engineering congress in 1926.

Some twenty-five or thirty prominent engineers in the four founder societies and the Federated American Engineering Societies attended the conference. It was the general opinion that a real opportunity for knitting together technical bodies of various countries was present in the proposed world congress.

The meeting was called to order by Richard L. Humphrey who is also the chairman of the committee on plan and scope. Nothing definite was attempted, various committeemen merely discussing what can be done in the matter of cementing international engineering ties through the medium of the world congress.

Various technical associations are represented in the world congress movement by the following men:

Am. Soc. C. E., George S. Webster and Richard L. Humphrey.

A. I. M. E., J. Vipond Davies and Charles F. Rand.

A. S. M. E., James Hartness and D. Robert Yarnall.

A. I. E. E., Arthur E. Kennelly and Charles E. Skinner.

F. A. E. S., J. Parke Channing and L. P. Alford.

The Engineers' Club of Philadelphia, W. C. L. Eglin and Charles E. Billin.

Engineering Societies

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 13-15.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

The Pacific Northwest Chapter of the A. G. C. will hold its convention in Seattle, Feb. 9-10. Besides eastern delegates, on the Coast attending the general convention of the association, members from Idaho, Oregon, British Columbia and Washington will participate. W. L. Clist is chairman of the convention committee.

Personal Notes

BRIG.-GEN. WILLIAM BARCLAY PARSONS, deputy chief engineer, G. H. Q. Organized Reserve, and during the World War commander of the 11th Engineers, has been awarded the Distinguished Service Medal which will be conferred upon him at 2nd Corps Area Headquarters, Governors Island, N. Y. on Feb. 1.

LIEUT. WILLIAM J. HORRIGAN, Chemical Warfare Service, U. S. Army, has resigned and has opened an engineering office at Louisville, Ky. He will specialize in sanitary, hydraulic and structural engineering.

M. T. CANTELL, of Winnipeg, Can., architect and engineer for the Northeastern Contruction Co., has been elected a fellow of the Royal Society of Arts, England, in recognition of his work in the advancement of architecture and engineering.

Hon. Peter J. Venist, minister of public works, has been appointed prime minister of the Province of New Brunswick, Can.

Fred McElmon, Bellingham, has been elected county engineer of Whatcom County, Wash., succeeding J. C. Hills.

Robert Lile has been appointed street superintendent of Livingston, Calif.

Francis R. Molther, recently engaged on railway location from the port of Tumaco to Pasto and from Pasto to Popayán, Colombia, S. A., has accepted a position with F. P. Platt & Bro., architects, New York City.

D. G. Scott, of Henderson Harhor, N. Y., has been appointed by the board of supervisors of Jefferson County, N. Y., as county superintendent of highways, to succeed Capt. Henry D. Ball, who died recently.

O. S. Finnie, director of the Northwest Territories and Yukon Branch of the Department of the Interior, has been elected chairman, for the coming year, of the Engineering Institute of Canada, Ottawa Branch.

Frank R. Goodman, state engineer of Arizona, announces the selection of his staff as follows: Assistant engineer, W. W. Lane; district engineers, northern, B. M. Atwood, eastern, W. R. Hutchins, central, Clyde L. Jenkin, southern, Edward Ten Eyck; superintendent of equipment, P. J. Harrison.

E. J. Foster has been appointed county engineer of Webb County at Laredo, Tex.

George Carleton Brown has recently been promoted from the position of resident engineer with the Michigan State Highway Department to that of district engineer in charge of maintenance, with headquarters at Ann Arbor. The latter position was made vacant by the resignation of W. W. Shanor, who has become associated with the Rockford Construction Co., Rockford, Ohio.

N. D. Cole has been appointed office engineer to R. V. Glenn, consulting engineer of the Tarrant County, Texas, Highway Department. D. A. Davis, until recently the office engineer of the Tarrant County Highway Department, has been appointed county engineer.

Alvin L. White has been appointed county engineer of Brewster Co., Texas, with headquarters at Alpine.

W. J. Kelly, of Trinity, Texas, has been appointed county engineer of Montgomery Co. He is stationed at Conroe, Texas.

G. M. O'Rourke, roadmaster of the Indiana division, Illinois Central R. R., has been appointed to a similar position on the St. Louis division, with headquarters at Carbondale, Ill., to succeed J. W. Kern, Jr. promoted to district engineer at New Orleans.

C. W. Lentz, chief building inspector, Illinois Central R.R., has been appointed roadmaster of the Indiana division, with headquarters at Mattoon, Illinois.

Andrew Hamilton, of Hamilton & Shreve, consulting engineers, Fayetteville, Ark., has been made district manager and consulting engineer with the National Lime Association, with headquarters at Dallas, Tex. Walter Shreve will continue consulting engineering work at Fayetteville, as the firm has the contract for the construction of the Fort Smith-Greenwood road.

L. W. Weed, recently concrete engineer with Helmle & Corbett, architects, of New York, and before that associated with the Turner Construction Co., has joined the staff of Day & Zimmermann, Inc., of Philadelphia, as concrete engineer.

H. C. Bottorff, city comptroller of Sacramento, Calif., since Jan. 1, 1921, and assistant city manager since the city manager form of government was instituted, has been appointed city manager of Sacramento, succeeding Clyde L. Seavey.

Harry H. Hume, Butte County (Calif.) road engineer, has been reappointed for a four-year term by the board of supervisors. He was appointed two years ago to fill the vacancy caused by the resignation of Martin C. Polk.

W. H. Gordon, formerly engineer at the Napa, Calif., state hospital, has been appointed engineer of the municipal water-works in that city.

George Fessenden has been appointed county engineer and surveyor, and Robert Fleming has been appointed county highway engineer of Flathead County, Mont., with headquarters at Kalispell.

George Le Boutillier has been elected vice-president and a director of the Long Island R.R. to fill the vacancy caused by the death of Thomas Dewitt Cuyler. Mr. Boutillier has served the Pennsylvania railroad system for 27 years. Until recently he was located at Harrisburg, as general superintendent of the Eastern Pennsylvania division. He has been consecutively assistant engineer, division engineer, engineer of maintenance-of-way, division superintendent and general superintendent.

Col. L. H. Rand, former executive officer of the California Debris Commission and who has been in charge of river and harbor work on the Sacramento and San Joaquin Rivers, is now actively participating in the consulting engineering work carried on by the Cope Rand Means Company, San Francisco. Col. Rand resigned from the U. S. Army in July, 1922.

W. G. Brown has been appointed engineer, maintenance-of-way, Florida East Coast Ry., and Calvin Oberdorf, engineer of construction, of the same road. Both report to the office of the general manager in St. Augustine, Fla.

Major Julian L. Schley, Corps of Engineers, U. S. Army, has been awarded a distinguished service medal for meritorious service as commander of the 307th Engineers, and for service with the 5th Army Corps during the St. Mihiel and Meuse-Argonne offensives. The presentation was made by Col. J. A. Woodruff, commandant of the Engineer School at Fort Humphreys, Va.

Obituary

Hon. Richard C. Parsons, internationally known as a water works and drainage expert, died in London, Jan. 26, aged 71 years. He superintended the design and construction of the water and drainage works for the City of Buenos Aires and prepared complete designs for a drainage system for the City of Petrograd in 1908. He was a member of the Institution of Civil Engineers of Great Britain and the Society of Civil Engineers of France, of the Institution of Mechanical Engineers and other technical and educational organizations. He had contributed many articles to scientific societies.

Frank W. Hodgdon, prominent along the Atlantic Coast for work in harbor improvement, died Jan. 26 in Boston. At the time of his death he was chief engineer, Division of Waterways, Massachusetts Department of Public Works, and had been associated with harbor work in Boston since his graduation from the Massachusetts Institute of Technology in 1876, at first with the Harbor Commission in connection with the improvement of the South Boston piers and then as engineer for the Land Commission. In that capacity he designed and superintended construction of pile platforms at two piers opened by the New Haven road. From 1879 to 1893 he was assistant engineer of the Harbor and Land Commission, becoming its chief engineer and serving until 1912 in that capacity. In 1897 Mr. Hodgdon was appointed a member of the Commission on Topographical Survey of Massachusetts and in 1898 was a member of the Massachusetts - New Hampshire Boundary Line Commission. From 1908 until 1912 he was consulting engineer for the Florida Coast Line Canal and Transportation Co., and in 1911 was a member of the Commission of Engineers in the Costa Rica-Panama boundary arbitration, representing the Republic of Panama in the boundary negotiations.

C. H. Hollingsworth, widely-known contractor and for several years associated with The A. Bentley & Sons Co., of Toledo, Ohio, died in Boston, Jan. 4. Mr. Hollongsworth was a graduate civil engineer, having studied at Halifax University, Nova Scotia. He came to the United States early in his professional career, his first employment being in the engineer's office of the city of Newton, Mass. During his lifetime he had charge of many large construction enterprises throughout the United States, Canada and Mexico, some of the most noteworthy of which were water-power development at Sault St. Marie, Mich.; water-power development for the city of Quebec; day superintendent on the Manhattan end of the Pennsylvania R.R. East River tunnels, New York City general superintendent on twenty-two dams of concrete and earth construction in Mexico; general superintendent on the contract for one section of the New York-Catskill aqueduct; and general superintendent for the construction of Camp Sherman at Chillicothe, Ohio, and Camp Joseph E. Johnson at Jacksonville, Fla.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Concrete Pipe Association Hears Engineers

Progress of the year's tests on culvert pipe at Iowa State College, together with tentative conclusions, were given the American Concrete Pipe Association at the technical session of the convention Jan. 19, 20 and 21 in Chicago by Dean Anson Marston. Some of his deductions were as follows:

(1) A real demand exists for increased strength of pipe. (2) Enough definite data have not yet been obtained to write a final specification. (3) While engineers are inclined to design so no cracks will appear, 36-in. cracked pipe 3 in. out of round have stood for at least three years. (4) A factor of safety of 1½ over laboratory breaking stress leaves only a slight margin. (5) Additional culvert pipe research costing $30,000 is needed.

Two men are to be put in the field this season to collect data on existing culverts. Embankments are to be built over 24-in. pipe finally to determine the ratios of possible increase in strength by more than ordinary careful bedding and by concrete cradles. Laboratory tests are to be continued on impact due to trucks. Improvements in the type of reinforcing will be sought.

Langdon Pearse, sanitary engineer, Sanitary District of Chicago, spoke of the work of the district and in discussion indicated that the only difficulty with concrete disintegration was in a sewer carrying slow-moving septic sewage without outlet for the hydrogen sulphide. Ventilating manholes were placed to remedy the situation.

W. G. Chace, chief engineer, Lock Joint Pipe Co., during his talk on the work of the company, explained the details of the high-pressure joints.

Alfred N. Shearman was elected president for the fifth time. M. W. Loving continues as secretary and G. E. Warren as treasurer.

Motor Industry Made Record Railway Shipments in 1922

"Shipping of assembled automobiles from main factories and assembling plants during the past year reached the record figure of approximately 400,000 carloads, transporting 1,700,000 machines," as reported by William E. Metzger, chairman, traffic committee, National Automobile Chamber of Commerce to the directors' meeting of that association recently. In addition, more than 750,000 machines were driven away by dealers from factories and assembling plants.

Manufactured parts, the report states, amounted to about 100,000 carloads and it is not unlikely that this heavy shipping will place automobiles and parts third in the number of carloads of manufactured articles shipped on the railroads. In 1921 it ranked fourth, being exceeded only by refined petroleum, iron and steel products, and cement. Much of the refined petroleum and a considerable part of cement and iron and steel shipping, however, is the direct result of motor car manufacture and use.

New box cars with extra wide door openings, known as automobile cars, to the number of 18,000, have been included in railway equipment orders during the past year, which will bring the total of such cars in service up to 111,000.

Concrete Mixers Shipped Abroad

During November, 1922, figures from the U. S. Department of Commerce show that 22 concrete mixers valued at $15,531 were shipped for export trade. England was the biggest consumer, with 5 mixers costing $2,949.

During the same month 56 conveyors costing $43,767 were shipped abroad. Construction equipment not specifically classified totaled, during November, 314,278 lb., valued at $59,368.

Associated Equipment Distributors Hold Annual Meeting

In addition to a representative attendance of member companies, 82 manufacturers of construction equipment and materials, in addition to a number of well-known contractors, attended the annual meeting of the Associated Equipment Distributors held in Milwaukee, Jan. 12-13. The program for the first day covered a discussion of the relations between contractors and equipment distributors. Among the speakers were F. J. Herlichy, White Construction Co., Chicago; C. G. Milburn, Siebert-Milburn Co., Columbus; H. E. Smith, president, T. L. Smith Co., Milwaukee; George J. Kirkgasser, Chicago. A discussion of service and replacement of defective parts was opened by E. D. Townsend, president of the association.

The meeting on the second day was closed to members of the association and covered discussion of rental contracts, restriction of sales contracts, and salesmen's salaries. Among the speakers were A. C. Aslesen, Minneapolis Equipment Co., Minneapolis; Morton R. Hunter, Hunter Machinery Co., Milwaukee; and George B. Curd, George B. Curd Equipment Co., Cincinnati.

William F. Tubesing, president of the Builders & Traders Exchange of Milwaukee and also head of the contracting company bearing his name, urged manufacturers not to deluge contractors with circular mail matter regarding their equipment, but rather to present the merits of their machinery through the medium of trained representatives. He urged uniformity in catalog sizes, standardization of repair parts and the publication of accurate repair parts booklets from which a contractor may order correctly. Mr. Tubesing made the point that standard parts should be listed as such, with the result that nuts, bolts, piston rings and similar items could be purchased locally with a considerable saving in time.

More Suggestions

For Better Equipment and Repair Parts Service

In the Dec. 14 issue was begun a discussion of "Better Equipment Maintenance and Repair Parts Service." Its object is to show how some of the misunderstandings between maker and user of construction machinery can be avoided. This week's contribution is a recital of experiences by manufacturers of hoists and of crushers.

From the Lidgerwood Manufacturing Co., New York

We believe regular plant inspection on the job would be of considerable benefit to the user. In addition, we find that several of our contracting friends are following a plan which saves them much trouble. Upon the completion of a job the engine is sent to their yard or storehouse, is thoroughly inspected and cleaned up, defective parts replaced or repaired, and the engine put in condition so that it will be ready to go out on another job.

To the matter of supplying repair parts this company has given considerable study. Each hoist, as built, is given a shop number. We do not experience any difficulty in connection with repair parts provided the customer gives with his order the following information: (1) Shop number of the hoist; (2) name of the part; (3) whether the part is for right or left-hand side of hoist, or for the front or rear. If this information is omitted from the order we, of course, cannot be certain that the order will be correctly filled. We publish a duplicate part list which explains this matter fully to the customer.

From a Maker of Rock Crushers and Gravel Handling Plants

Two points about the maintenance of rock crushers may be of value:

(1.) Most contractors, including quarry and gravel-pit operators, do not provide an adequate stock of repairs for their rock-crushing equipment. In the mining field the average crusher operator is very careful to stock a duplicate of every part in the crusher which is likely to require replacement on short notice. In the contracting field, however, the opposite policy prevails. Even the less expensive, but sometimes very important, parts are not ordered until urgently needed; and occasionally a plant may be shut down for several days, waiting for a small part that should have been ordered months before.

For instance, last summer a road contractor in North Carolina neglected to [illegible] during the railroad strike. Duplicates [illegible] shipped promptly by the factory. The [illegible] time and the goods took a long time in transit. [illegible] 10 days.

(2.) Ninety per cent of all crusher trouble is caused by attempting to force the machine to make too great a ratio of reduction. In his excellent work on "Ore Dressing," Prof. Richards recommends a maximum ratio of reduction of 5 to 1. That is, if the crusher has a receiving opening of 10 in. Prof. Richards recommends that the discharge opening should not be less than 2 inches.

We have frequently found it possible to operate successfully on soft rock, like limestone, with a reduction ratio of 6 to 1. That seems to be the limit of safe reduction. Nevertheless, we continually find cases where contractors are forcing a crusher to do double service, making a reduction of 8 or 9 to 1. This practice increases the pressure on the bearings and augments the load on every part of the machine to such an extent that wreckage is almost certain if the practice is continued for any length of time. The results are the same no matter what type of machine is used. In many cases the user has been warned against attempting too great a reduction ratio, but simply ignores these warnings.

To Be Continued

Review of Construction Equipment and Materials During 1922—Part IV

DEVELOPMENTS in construction equipment and materials during 1922, as noted in "Engineering News-Record's" review beginning in the Jan. 4 issue, took the form of improvements in details rather than in new types of machines. Previous installments of the review included power shovels, concrete chuting equipment, industrial locomotives, elevating loaders, rock crushers, road graders, mixers, and concrete road building plant, buckets, cranes, hoists, gasoline engines, air compressors and pneumatic tools. With this week's installment the review is concluded:

Material Haulage Equipment

IMPROVEMENTS in equipment for transporting material consist mainly of details—nothing new has been added to the standard types of dump-car, batch-box car, dump-wagon, trailer, tractor, and truck. Greater ease of operation is being secured through a more general use of roller bearings and industrial tracks of less sharp curvature than were formerly common. More batch boxes are being made of steel. Tractors witnessed a wider use in the construction field during the year, particularly in road grading. On motor trucks the introduction of a two-range transmission makes possible the utilization of maximum power only when needed. Trucks with short wheel bases and special bodies were developed for road-building work and in the trailer field devices were introduced to facilitate haulage in trains.

C. L. Best *Tractor Co.* ON ITS 60-hp. unit the Best company has changed the final drive from an internal gear to a heat-treated cut nickel steel spur gear, thoroughly inclosed and running in a bath of oil. Steering controls have been improved for easier operation. On the 30-hp. unit an improved form of sprocket tooth has been adopted which is less liable to clog in operating in snow or soft loose soil.

General *Motors Truck Co.* THE OUTSTANDING feature added to G M C trucks, especially for contractors' use, during 1922 was the two-range transmission. The first range is for rapid movement on good roads, and the second for increased pulling power, at lower speeds, on poor roads or with heavy loads. With this transmission power is conserved by applying the maximum effort of the engine only when needed.

Lakewood *Engineering Co.* SEPARATE cement compartments are being provided in Lakewood batch boxes and an increasing use of steel for this type of equipment is noted. To assist in discharging cement diagonal chains in cement compartments have been introduced. On batch-box cars roller bearings are employed to reduce wear and improve traction. On industrial track the advantages of pressed steel ties riveted to the rail are emphasized and easier curves—60-ft. radius, instead of 30 ft.—are being employed to minimize derailments.

Stroud & Co. WHILE THE design of the "Little Red" dump wagon has remained unchanged, the company has brought out three new models of larger wagons, the capacities being from 2 to 10 cu.yd.

Republic *Truck Sales Corp.* A SHORT wheel-base, 110 in., is a feature of the Republic road-building truck, which may be equipped with 1- and 2-cu.yd. batch bodies. The weight is evenly distributed, approximately 40 per cent of it being carried on the front axles. The truck can turn in a radius of 15½ ft. Pneumatic tires are employed. Three types of body design are furnished.

Watson *Products Corp.* TO ADAPT its bottom-dump wagons for operation in trains the Watson corporation has developed a train hitch so constructed that all the pull comes on a heavy chain passing under the line of wagons. There is claimed to be no more strain on each wagon operating in a train than when they are hauled singly by a team of horses. With the train-hitch wagons are coupled simply by slipping a link over a hook. The units may readily be changed from train wagons to horse-drawn wagons.

Western *Wheeled Scraper Co.* FOR RAILWAY maintenance of way the Western air-dump car is fitted with an apron designed to throw material beyond the ends of the ties in a railway track when discharging.

This extension floor or apron can be attached to any Western dump car. When the car is dumped, the apron, which ordinarily hangs in an upright position, moves out automatically extending the floor 28 in.

On the company's batch-box car changes in design provide for increased strength and size of axles and bearings and the use of a center sill.

Cableway Excavators and Loaders

EXCEPT for improvements in details designed to increase speed and capacity, cableway excavators and loaders underwent no important changes during the year. For small scale operations a new type of portable drag scraper outfit was introduced.

Link-Belt Co. FOR STORING coal and handling sand, gravel and crushed stone a "power hoe" or drag scraper was announced.

Sauerman Bros. A PORTABLE drag scraper outfit was introduced for small-scale operations in utilizing local sand and gravel deposits. The power equipment is a double-drum hoist furnished with gasoline engine direct-connected or arranged for belt drive from a tractor.

On its larger dragline cableway excavators Sauerman Bros. have increased the size of the power units to handle larger yardages of material than formerly.

T. L. Smith Co. ON ITS excavator and loader the Smith company this year installed a four-cylinder Wisconsin gasoline engine, providing about 40 per cent additional power over previous equipment. These excavator and loader units are designed for general dragline work, digging basements and loading directly into wagons or trucks on the surface.

Wood Block

IMPROVEMENTS in creosoted wood paving block included a countersunk lug feature and built-up sections of wood block for installation at points of intersection between railroads, car lines and streets.

Jennison-Wright Co. THE Jennison-Wright Co. added to its line of Kreolite lug wood block by introducing a countersunk lug with grooves on either side. The countersunk feature enables the lugs to remain of standard dimensions for any separation desired, while the grooves and open joints between the blocks permit the penetration of a bituminous filler to the full depth. When compression occurs the grooves serve as reservoirs for collecting surplus filler.

A new type of wood block paving for railway crossings is made up in sectional mats; it can be quickly removed, without injuring the material, when the track needs repair. This type of paving is built up within a framework and floor made to fit the area between tracks at a crossing. Creosoted wood blocks are nailed to the floor of this framework.

Steel Reinforcement and Building Products

IN the field of concrete building construction several additions to previous types of steel reinforcement were made during the year. Among them was an I-beam in heights of from 4 to 8 in., with the top flange sheared to form rigidly connected diagonals extending into the concrete above, thus producing a unit of reinforced-concrete beam and slab. A development in the steel joist line was the introduction of the plate girder type of joist made from strip steel in a variety of sizes, gages, and sections. Several types of self-furring metal lath or fabric reinforcement were developed.

***National* Steel Fabric Co.** For stucco work a combined reinforcement and base consisting of galvanized steel fabric to which is fastened a backing of waterproof paper was one of the year's products. The paper backing is attached to the fabric by crimps, which also serve as a self-furring feature, holding the material at a uniform distance from the background. The paper backing, it is claimed, reduces waste from droppings and with it no forms are called for.

***Truscon* Steel Co.** For the reinforcement of concrete structural work the Truscon—I construction was introduced to combine the steel economy of reinforced concrete and the saving of form-work in structural steel. This reinforcement consists of a series of I-beams manufactured in a variety of sizes from 4 to 8 in. high, with top flange sheared to form rigidly connected diagonals extending into the concrete above. The Truscon—I's are thus integral with the concrete, making a unit of reinforced-concrete beam and slab. A system of removable steel forms, suspended from the I's, is provided. Steel Floretyles are ordinarily used with this type of construction.

New steel joist sections of the plate girder type were announced during the year in a variety of sizes and gages; prongs in the flanges for attaching Hy-Rib are furnished where required.

In the company's sectional steel buildings an alternative for standard panels is offered in the form of steel windows extending continuously and supported by curtain walls of any material. A steel basement window for houses and apartment buildings was introduced and an additional new product was a self-furring lath with dome-like projections formed every 4 feet.

Pipe

CAST-IRON pipe is now being manufactured in the United States by the centrifugal process, in which a rapidly revolving mold is used. Another development which has made progress during the year is the production of large diameter steel pipe—from 20 in. to 8 ft.—by the hammer-weld method, eliminating all rivets and projecting ribs.

***National* Tube Co.** The hammer-weld process was perfected for the production of pipe from 20 in. to 8 ft. in diameter. By this method steel plates are bent into tubular form and the overlapping edges are welded, after they have been heated, by hammer forging on an anvil block. The addition of the larger sizes of pipe made possible by this process enables the National Tube Co. to meet practically all wrought tubular requirements with a range from ⅛ to 96 in.

***U.S. Cast Iron* Pipe & Foundry Co.** Increased strength and lighter weight of pipe have been made possible through the introduction of the de Lavaud centrifugal process of casting undertaken by the U. S. Cast Iron Pipe & Foundry Co. In this process molten metal is poured into a horizontal cylindrical mold which is rapidly rotated by an impulse wheel. The mold is water cooled. Tests show that the tensile strength of the centrifugally cast metal is 37,000 lb. per square inch as against 16,000 lb. per square inch for sand-molded metal.

Business Notes

MACKINTOSH ENGINEERING CO., Cleveland, Ohio, has been appointed agent for the Brownhoist small cranes, buckets and storage bins. The territory will cover all of Ohio, with the exception of Hamilton County. The line of equipment will include steam, gas engine, and electric cranes mounted on creeper trucks, road wheels, or four or eight-wheel railroad trucks.

AMERICAN CONCRETE PIPE ASSOCIATION announces the appointment as assistant secretary of J. A. Dunn, formerly field engineer for the Portland Cement Association.

T. H. NEEDHAM has been appointed manager of the Houston, Tex., office of the Uvalde Rock Asphalt Co., 906 Goggan Building.

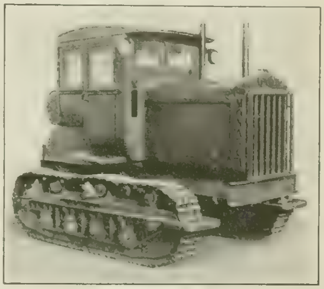
THE TEXAS AMIESITE CO. has opened office in Ft. Worth at 1909 F & M Building.

SOUTHERN PINE ASSOCIATION will hold its eighth annual meeting at the Hotel Grunewald in New Orleans, La., March 20 and 21. During the same week and in the same city the NATIONAL LUMBER MANUFACTURERS' ASSOCIATION will hold its annual meeting.

Equipment and Materials

New Model Crawler Tractor Has Six-Cylinder Engine

A six-cylinder, 60-hp. gasoline engine, instead of the four-cylinder unit previously used, is one of the features of the new model tractor just announced by Monarch Tractors Inc., Watertown, Wis. For all-year round work the tractor is equipped with an inclosed cab and mounted on three heavy silico-manganese springs which form a flexible three-point support. The general features of the design of the new unit are shown in the accompanying photograph.



Pistons, connecting rods, bearings, valves and springs on the new six-cylinder machine are interchangeable with those on the four-cylinder engine heretofore used. The tractor is equipped with three-speed transmission and an electric starter. A built-up frame of angle iron carries the crawlers, which are of manganese steel. The Monarch principle of mounting the drawbar on the crawlers only is continued in the new model. A coil spring is introduced to prevent excessive shock in starting.

Publications from the Construction Industry

Feed-Water Heaters—H. S. B. W.—COCHRANE CORP., Philadelphia, in a new 60-p. illustrated booklet, discusses feed-water heaters in their relation to steam plant efficiency. The text is not primarily descriptive of apparatus, but rather a presentation of the theory and practice of boiler feed water heating. Various forms of apparatus and their uses are presented, including vacuum deaërating heaters, back-pressure heaters, heaters in conjunction with make-up water evaporators, feed-water heating by stages, different methods of control for securing continuous heat balance, heaters in connection with exhaust steam heating systems, heaters in conjunction with hot water heating and service systems, including heaters operated at temperatures below 212 deg. F., combined heaters and softeners and combined heaters and feed water meters. The feed water temperature best for plant efficiency is not a sharply defined quantity, as it is found that the temperature can vary through quite a wide range without seriously affecting overall economy.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

January Contracts Higher by 16 per Cent

Industrial Works and Bridges Show Heaviest Increases—Big Gain in Water-Works

Contracts awarded during January on important engineering projects in the United States and Canada reached a total value of $142,599,000 as against $123,143,000 for December. This represents a gain in value of 16 per cent and in volume 6 per cent. The increase over a year ago is 75 per cent in value and 30 per cent in volume.

Minimum costs observed in Construction News on each class of construction are as follows: Water-works, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings, $150,000.

Industrial works gained about 32 per cent in January, while the value of bridge contracts was six times as great as the December lettings.

Two sections of the country did not show construction gains: the Southern and the New England States. In New England, figures were about the same as for the preceding month, while the South declined considerably. The heaviest lettings of the month were in the Middle West, valued at $42,329,000 as against $37,648,000 in the Middle Atlantic states, making the fifth time during the last thirteen months that this group has surpassed the usual high record of the Middle Atlantic states. An increase of 25 per cent is reported in Canadian lettings for the first month of the new year.

The actual number of contracts awarded last month in relation to money values is shown in the following comparison with December:

Water-Works—The gain in January was in the average value per contract: 26 jobs averaged $192,000, against 28 projects, averaging $71,000.

Bridges — This classification gained in both value and number of contracts: 31 jobs averaged $225,000, compared with 19 averaging $52,000 per contract.

Streets and Roads — Gains both in number and total value of contracts were realized during January: 131 jobs with an average value of $168,000, as against 98 averaging $183,000.

Industrial Works — Fewer contracts were awarded in January but with a higher average value: 98 averaging $255,000, as compared with 116 averaging $163,000.

Buildings — While the value of contracts fell off $3,000,000 in January, the total number of awards was greater: 162 buildings averaging $413,000 as against 144, with an average value of $486,000 in December.

Federal Government Work—January contracts increased in both number and value: 24 jobs averaged $250,000, compared with 22 averaging $104,000.

Engineering News-Record Construction Cost Index Number

February, 1923	**197.40**
January, 1923	**191.70**
February, 1922	**168.72**
Peak, June, 1920	**273.80**
1913	**100.00**

Engineering News-Record's Construction Cost Index Number advanced 5.7 points since last month, due to higher steel and lumber prices, and stiffening in labor rates. Steel rose to $2.10, from $2.00 per 100 lb., Pittsburgh mill. The average rate for common labor is now 48c. Thus, general construction cost is 17 per cent higher than one year ago and 28 per cent under the peak; it is 97.4 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
January, 1923 (*4 issues of E. N.-R.*)	**126**
December, 1922 (*4 issues of E. N.-R.*)	**111**
January, 1922 (*4 issues of E. N.-R.*)	**91**
1913	**100**
Yearly	
1922 (entire year)	**130**
1921 (entire year)	**88**
1920 (entire year)	**91**
1913	**100**

Engineering News-Record's Construction Volume Index Number is 126 for the month of January, and 130 for the whole of 1922, as against 100 for 1913. This means that the actual volume of construction in 1922 (not the mere money-value of the contracts let that year) is 30 per cent above the volume of construction for 1913. Our monthly volume number, 126 for January, 1923, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING JANUARY, 1923

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Canada	Total
Water-works		$1,094,000	313,000	$151,000	$3,068,000	$36,000	$58,000	$4,720,000
Sewers		60,000	96,000	1,717,000	501,000	571,000	377,000	3,322,000
Bridges	$95,000	1,023,000	1,090,000	597,000	2,545,000	150,000	1,400,000	6,900,000
Excavation, drainage and irrigation		200,000	......	25,000	45,000	278,000		548,000
Streets and roads		2,814,000	3,085,000	3,023,000	9,923,000	2,846,000	...	21,691,000
Industrial works	2,775,000	3,371,000	1,395,000	12,751,000	3,731,000	485,000	300,000	24,808,000
Buildings	7,867,000	26,498,000	2,501,000	20,226,000	4,419,000	5,294,000		66,805,000
Federal Government		2,028,000	1,305,000	982,000	....	1,195,000		5,510,000
Miscellaneous	60,000	560,000	361,000	2,857,000	1,159,000	512,000	2,786,000	8,295,000
	$10,797,000	$37,648,000	$10,146,000	$42,329,000	$25,391,000	$11,367,000	$4,921,000	$142,599,000

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 55 to 68, are the following:

An office building at Montreal, Que., for Montreal Insurance Exchange. $3,000,000.

An apartment at Philadelphia, Pa., for Lincoln Drive Apartment Co. $2,000,000.

A pier at Philadelphia, Pa., for Phila. & Reading R.R. $1,500,000.

A sewer project at Denver, Col., for the city. $2,000,000.

A hotel at Paterson, N. J., for Alexander Hamilton Hotel. $1,000,000.

A temple at Ft. Wayne, Ind., for Masonic Bldg. Co., $1,000,000.

A school for the Board of Education at Oakland, Calif. $100,000.

Bank Debits for the week ending Jan. 24 totaled $9,237,000,000, or more than a billion under the preceding month.

Construction in 1922 and Outlook for 1923

The construction of public works and of buildings established in 1922 a new record for volume. In large works and fireproof building construction, statistics show that the volume in 1922 was 47 per cent greater than in 1921. Building permits alone, in 166 cities, according to the Federal Reserve banks, showed an increase of 57 per cent for the first nine months of this year as against the first nine months of 1921. As to all building and construction work, the increase will easily amount to 33 per cent above 1921. The total expenditure involved is estimated at not less than four and a half billion dollars; of this figure three billions is accounted for by actual tabulated figures.

The largest part of the general increase in construction has been in the building line, as the figures quoted above indicate. Extensive road construction, greater activity in the building of industrial plants and a small increase in the amount of railroad work have all contributed to the making of the record.

The outlook for 1923 is distinctly encouraging. The volume of highway work will probably not be less, though in many quarters tax payers are looking askance at increasing tax rates. There will probably be somewhat more railroad work; while, with increasing prosperity, more activity can be looked for

Labor Rates and Conditions Throughout the Country

Well sustained business activities and an extensive general recovery in nearly all industries, have marked the first month of the new year. Despite a slight improvement in transportation facilities, particularly in the shipment of building materials, dealers are urged to prepare for a possible car shortage during the first half of 1923.

Factors pointing toward expanding industry are as follows: (1) Value of contracts let last month was 16 per cent greater than in December; (2) heavier sales of fabricated steel; (3) increasing coal output and prompter handling; and (4) record retail sales.

The adverse factors are the car shortage, scarcity of labor (particularly in the steel mills), and the disturbed foreign situation.

Conditions in the building industry, relative to wage schedules and an adequate labor supply, are visibly improving throughout the entire country.

The common labor rate for the nation, as applied to pick and shovel men in construction operations, is placed at 48c. per hr. as against 47c. for the preceding two months, according to *Engineering News-Record's* figures. Local industrial conditions are as follows:

Atlanta—Open winter favors building. Wages tending upward. Bricklayers demand $1.12½ per hr. from April 12.

Baltimore — Carpenters' strike on. Scarcity of hodcarriers. Normal supply in other trades. Hodcarriers receive 87½c. as against 60@75c. per hr. The minimum rate in the accompanying table is that paid non-union mechanics; the higher figure represents the union wage.

Boston—Labor plentiful with the exception of hoisting engineers. Weather conditions tieing up construction operations.

Cincinnati—All classes of building trades mechanics plentiful.

Dallas — Ample supply of common laborers. Small surplus of skilled men.

Denver—No unemployment. Some workmen paid slightly above the union scale.

Detroit—Very little unemployment. Conditions normal in all trades.

Kansas City — More carpenters needed; plenty in other skilled trades. Possibilities of hodcarrier shortage in spring. Demand for first class common laborers.

Montreal—Scarcity of plasterers. No shortage of other skilled trades.

New Orleans—Lumber mills no longer handicapped by car shortage. Labor plentiful.

New York—Agreements reached between employers and most of the skilled building trades for the coming season. The 1922 wage schedule will continue in effect, with the exception of marble workers, who demand an increase of $1 per day over last year's rate. Clauses removing all restrictions on production; prohibiting strikes and lockouts and providing for arbitration of all disputes between employers and unions, are contained in the agreements.

Philadelphia—Scarcity of bricklayers, hodcarriers and common laborers. High rates being paid these trades wherever men are obtainable. Fair supply of hoisting engineers, pile drivers and structural iron workers.

Pittsburgh — Secretary of Builders' Exchange urges co-operation in eliminating labor and materials shortages. Builders in the past, he says, harmed the industry by bidding against each other in an effort to get skilled workmen.

St. Louis—Bricklayers rate $1.25; but owing to shortage, as high as $1.37½ per hr. frequently paid. Carpenters will demand $1.25 on and after May 1, as against present rate of $1.10 per hr. Hoisting engineers plan to apply for the same rate as carpenters after May 1. Common laborers, non-union, receive 40@50c. per hr. as compared with 30@45c. last month.

San Francisco—Present wage schedule will remain in effect for one year beginning Jan. 1, 1923. Plenty of employment for all trades.

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90	$0.70	$0.70	$0.30	....	$0.65	$0.30@.35
Baltimore	1.25	+.80@.90	+.80@1.00	+.87½	—$0.65	.80@1.00	.30@.45
Birmingham	1.00	.75	.50@1.00	.15@.25	......	1.00	.20@.25
Boston	1.25	1.00	90@1.00	.75@.80	1.00	1.00	.50@.60
Cincinnati	1.25	.95	.95	.72½	....	.95	.35@.40
Chicago	1.10	1.00	1.10	....	1.10	1.05	.72½
Cleveland	1.25	1.10	1.10	.75	.91	1.10	.75
Dallas	1.37½	1.00	1.00	.40	.87½	1.00	.30@.50
Denver	[illegible]	1.00	1.00	.75@.81¼	1.00	1.03⅛	.35@.50
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	[illegible]	1.00@1.25	1.00@1.25	[illegible]	1.00	1.00	.30@.50
Los Angeles	[illegible]	1.00	1.00	1.12½	.87½	1.00	.56¼@.62½
Minneapolis	1.00	.80	.80	.65		.80	.35@.50
Montreal	[illegible]	.65	.50	[illegible]	.50	.60@.65	.25@.30
New Orleans	1.00	.85	.90	[illegible]	.80	1.00	.35@.40
New York	[illegible]	[illegible]	1.25	[illegible]	1.00	1.12½	.45@.60
Pittsburgh	[illegible]	[illegible]	1.00	.90	1.00	1.00	+.50@.60
St. Louis	[illegible]	[illegible]	1.12½	[illegible]	1.12	1.12½	+.40@.50
San Francisco	[illegible]	[illegible]	[illegible]	[illegible]	1.00	[illegible]	.50@.56¼
Seattle	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.50@.60½
Philadelphia	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	+.40@.65

in factory construction. In municipal public works, the volume is not likely to decline, because our cities have not yet caught up with their programs, delayed by the war. Moreover, the demand for their tax-exempt securities will probably still be active, so that the needed funds can readily be raised.

The one adverse factor is cost, which has been rising since last March and is now about 17 per cent higher than it was a year ago. On the other hand, the average cost of construction of all kinds in 1922 was 14 per cent under the average cost of 1921.

Skilled and common labor are still high, and, in the building field particularly, scarce. The average rate paid common labor as reported by twenty of the principal cities is 48 cents an hour and is rising. This contrasts with an unskilled rate of from 17 to 20 cents an hour before the war. Union wages, covering the skilled trades, are very high. The prospective demand for labor is such that a lowering of wages is not in sight.

Materials prices, too, will probably not decline, for the demand promises to keep pace with supply.

With increasing volume of construction in the early part of the year labor conditions are likely to tighten, increasing the difficulties of builders and contractors. This, in turn, may discourage the letting of contracts toward the end of the year, and thus decrease the volume of work performed in 1923.

All in all, the construction industry is justified in looking forward to a continuation in the immediate future of its present great activity.

Business Failures Gain Slightly in Week

All districts in the United States except the Pacific section show increases in the number of failures reported to R. G. Dun & Co., during the week of Jan. 27, whereas all except the Pacific section showed decreases for the preceding week. The total for the week ending Jan. 27 is 511, as against 482 for the week of Jan. 20, and 605 a year ago.

An approximately proportionate increase is evident in the number of defaults with liabilities of more than $5,000 in each instance; in the week of Jan. 27 they amount to 298, or 58.3 per cent. of the total, while in the previous period they numbered 280, or 58.0 per cent of the aggregate for that week. In the corresponding week of 1922, similar insolvencies were 368 in number, or 60.8 per cent of the total.

Failures reported from the Dominion of Canada are fewer than for the week of Jan. 20, 82 for the week of Jan. 27 comparing with 90 for the preceding period; a year ago the total was 104. Defaults involving more than $5,000 in each case number 41, as against 47 for the week previous and 53 a year ago.

Bill to Admit Alien Labor Before Senate

A bill to amend the joint resolution extending the operation of the Immigration Act of May 19, 1921, as amended by the resolution of May 11, 1922, was introduced in the United States Senate, Jan. 9, 1923, read twice and referred to the Committee on Immigration.

The proposed amendment contains the following provisions:

"That for the purpose of determining the annual quota of each nationality of otherwise admissible aliens due consideration shall be given to the emigration of aliens of such nationality during that year, and such calculation shall be made and announced at the end of each three months' period by the Secretary of Labor.

"The Secretary of Labor may, upon submission to him of satisfactory evidence that there is a continuing shortage of labor of a particular type or class which, after reasonable effort, has not been found unemployed in the United States, authorize contracts with and the admission of otherwise admissible alien labor to such extent as will in his judgment meet such established shortage, notwithstanding that such aliens so authorized to be admitted may exceed the quotas of their respective nationalities now admissible under this Act. The Secretary may prescribe reasonable rules and regulations for the presentation of evidence under this section."

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 55 to 68, are the following projects:

An office building at New York City, N. Y., for F. T. Ley & Co. $6,000,000.

An apartment hotel at St. Louis, Mo., for A. M. Cornwell. $2,200,000.

A hotel at Los Angeles, Calif., for Davenport Corporation. $2,000,000.

An office building at Houston, Tex., for Houston Cotton Exchange. $1,500,000.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Higher pig-iron prices due to scarcity of iron and steel scrap. Both basic and bessemer quoted at $29.27 per ton, Pittsburgh, including freight charge from valley, as against $24.25 for basic and $27.50 for bessemer, one month ago.

Railway Supplies—Light rails up $3 per ton at mill. Rerolled rails also $2 per 100 lb. higher at Pittsburgh. Spikes and section angle bars advanced 15c. per 100 lb. during month.

Pipe—Wrought steel pipe discounts dropped two points on Pittsburgh basing card, during month; wrought iron pipe also tending higher. Cast-iron pipe market strong and very active in view of advancing pig-iron prices. Rises of $4 per ton reported in San Francisco; 50c.@$1.50 in St. Louis and $2 in Chicago; stiff advances in New York. Sewer pipe down about 4c. per ft. in Dallas; higher in Cincinnati and Seattle.

Road and Paving Materials—Seasonal dullness in road oil market. St. Louis, however, advances 1c. per gal. on 50@60 per cent asphalt, following rise of 10c. per bbl. in crude oil, Jan. 13. Average drop of about $2 per ton in asphalt, f.o.b., Minneapolis, Dallas and St. Louis. Stronger market anticipated in latter part of February, with opening up of spring bidding activities. Paving stone and wood blocks up 10c. per sq.yd. in Boston; lower in Kansas City.

Sand, Gravel and Crushed Stone — Upward tendency in price due to freezing weather and consequent impeding of shipments. Gravel up 15c. per ton in Cincinnati. Both sand and gravel, however, down 5c. per cu.yd. in St. Louis. Crushed stone up in Boston and Dallas; down in Kansas City.

Lime—Common lump lime $3@$3.25 per bbl., 280-lb. net, f.o.b. New York, as against $2.75@$3.13½, one month ago. Hydrated lime, both finishing and common, up 20c. per ton in St. Louis; hydrated common, higher in Atlanta. Hydrated down 50c. per ton in Boston; lump finishing declined $1 and common lump, 25c. per ton in St. Louis, since January 4.

Cement—Market reflecting seasonal decline. Price down 4c. per bbl. in Atlanta; 10c. in Boston, Kansas City and Philadelphia and 25c. in Montreal, since last month.

Structural Steel—Demand for steel plates and structural shapes continues active; mills well booked for present quarter, with prices firmly placed at minimum of $2.10 per 100 lb., f.o.b. mill. Quotations nearing minimum of $2.10 on bars, with tendency to go higher. Shapes now $3.29 as against $3.14 per 100 lb. in New York warehouses. Bars, $3.19 as compared with $3.04, one week ago.

Triangle Mesh and Metal Lath—Expanded metal lath advanced about 2 per cent in St. Louis and triangle mesh, 20 per cent in New York, due to increased costs of raw materials.

Brick and Hollow Tile—Common brick up $1 per M in Cincinnati and St. Louis. Seattle, Minneapolis and Dallas report drop of $1 per M during month. Slight reductions in hollow tile in Boston and St. Louis; higher in Minneapolis.

Lumber—With shipments 5 per cent and demand about 25 per cent above normal, the lumber market is unusually firm for this season of the year. The output, however, is about 22 per cent below normal. Douglas fir timbers advanced $3@$5 per M ft. in San Francisco, and yellow pine, $2, in New York, during January. Higher lumber-prices are reported in Boston, Seattle, New Orleans, Denver, Minneapolis, Birmingham and Philadelphia; declines in Atlanta, Kansas City and Detroit.

Scrap—Prices higher in New York and St. Louis; tendency downward in Chicago.

Explosives—Slight advances in Boston, Kansas City and Dallas; no declines.

Linseed Oil — Flaxseed market steadier. Prices unchanged in New York and Chicago, during month. Up 3c. per gal. in Atlanta and Minneapolis.

White and Red Lead—Both dry and in oil up ¾c. per lb. in month; and advance of $1 per lb. since December.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Feb. 1	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$27.55	$22.50
Northern Basic	**29.27**	22.02
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	**29.77**	23.52
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	**33.44**	28.50
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	**24.00**	18.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	**29.76@30.14**	22.26
Virginia No. 2 (silicon 2.25 @ 2.75)	33.17	28.74
Basic	**28.00**	20.75
Gray Forge	28.14	22.50
CHICAGO		
No. 2 Foundry Local (silicon 1.75@ 2.25)	**29.00**	21.70
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	**30.01**	24.66
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	**28.00**	22.46
Basic	**29.27**	20.96
Bessemer	**29.27**	21.96

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Feb. 1	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$40.00	....	**$43.00**	43.00
Standard openhearth rails	43.00	40.00	**$43.00**	43.00	43.00
Light rails, 8 to 10 lb	**43.00**	1.55*	2.00*	43.00	43.00
Light rails, 12 to 14 lb	**43.00**	1.55*	2.00*	43.00	43.00
Light rails, 25 to 45 lb	**43.00**	30@36	2.00*	43.00	43.00
Rerolled Rails	**28@32**	1.45@1.50*	.....	......	......

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In by 8½ Ft.
Chicago, White Oak	**$1.50**	**$1.65**
Chicago, Hardwood and Red Oak	1.25	1.40
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco...... Green Douglas Fir	.84	1.17
San Francisco, Empty Cell Creosoted. Douglas Fir	1.60	2.25
St. Louis, White Oak	1.30	1.55
St. Louis (creosoted) (zinc treated)	1.70	2.05
St. Louis, Red Oak, plain	1.15	1.40
St. Louis, Sap pine-cypress	1.05	1.30

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Feb. 1	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, 9/16-in. and larger	$2.75@**2.90**	$2.30@2.35	**$3.00**	$3.60	$4.45	$3.29
Track bolts	3.75@4.50	3.00@3.25	**4.00**	4.70	5.45	4.29
Standard section angle bars	2.75@**2.90**	2.40	**2.75**	3.45	4.10	2.94

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card

BUTT WELD

Inches	Steel Black	Galv	Inches	Iron Black	Galv
1 to 3	66@64	54½@53½	¾ to 1½	34	19

LAP WELD

Inches	Steel Black	Galv	Inches	Iron Black	Galv
2	59@57	47½@45½	2	29	15
2½ to 6	63@61	51½@50½	2½ to 4	32	19
7 to 8	60@58	47½@46½	4½ to 6	32	19
9 to 12	59@57	46½@45½	7 to 12	30	17

BUTT WELD. EXTRA STRONG, PLAIN ENDS

Inches	Steel Black	Galv	Inches	Iron Black	Galv
1 to 1½	64@62	53½@52½	¾ to 1½	34	20
2 to 3	65@63	54½@53½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

Inches	Steel Black	Galv	Inches	Iron Black	Galv
2	57@55	46½@45½	2	30	17
2½ to 4	61@59	50½@45½	2½ to 4	33	21
4½ to 6	60@58	49½@48½	4½ to 6	32	20
7 to 8	56@54	43½@42½	7 to 8	25	13
9 to 12	50@48	37½@36½	9 to 12	20	8

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	57%	62½%	**57%**
2½ to 6 in. lap welded	54%	59½%	**54%**

	Galvanized New York	Galvanized Chicago	Galvanized St. Louis
1 to 3 in. butt welded	**44%**	48½%	**44%**
2½ to 6 in. lap welded	**41%**	45½%	**41%**

Malleable fittings, Classes B and C, banded, from New York stock sell at list less **1%**. Cast iron, standard sizes, 29% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York Feb. 1	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	**$47.50@48**	**$61.30**	$50.30	**$55.20@56.20**	**$53.60@54.60**	**$57.00**
6 in. and over	43.00	56.60	47.30@48.30	**53.20**	**49.60@50.60**	**56.00**

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Feb. 1	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$40.00	$40.00	**$62.50**	......	**$55.00**
4	95.00	50.00	40.00	**75.00**	$76.50	**65.00**
5	80.00	80.00	....	**100.00**	97.75	**84.00**
6	105.00	100.00	75.00	**175.00**	127.50	**110.00**
8	170.00	150.00	**170.00**	**187.50**	212.50	**181.00**

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0.14	$0.105	......	.....	**$0.15**	$0.12	......
4	.14	.105	$0.10	$0.0875	**.15**	.15	*$0.12*
5	.20	.1575	.125	.	**.23**	.18	*.16*
6	.20	.1575	.150	.1225	**.23**	.21	*.1866*
8	.34	.245	.225	**.20**	**.35**	.30	*.30*
10	.51	.3675	.2925	.28	**.53**	.42	*.441*
12	.65	.4725	.3825	.36	**.68**	.54	*.567*
15	1.03†	.63	.5625	.60†	**.96**	.90	*.819*
18	1.50†	.875	.765	.84†	**1.25**	1.32	*1.071*
20	1.80†	1.05	1.0125	1.12†	**1.50**	......	.....
22	2.40†	1.40	1.2375	.....	**2.00**	......	*1.44*
24	2.70†	1.575	1.4625	1.44†	**2.25**	2.16	*1.89*
27	4.50†	2.795	....	2.45†	**4.69†**	3.00	*3.34*
30	5.00†	3.096	. .	3.00†	**5.94†**	3.60	*4.06*
33	6.50†	4.14	....	3.55†	**6.88†**	......	*4.99*
36	7.50†	4.715	....	3.95†	**7.50†**	......	*5.42*

	3	5	8	12	24	36
Boston	$0.12	$0.185	$0.29	$0.55	$1.845†	$5.535†
Minneapolis	....	......	.40	.72	2.55	5.66†
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	*.13*	....	**.36**	**.72†**	**2.60†**	.....
Los Angeles	.	..				.....
New Orleans	.112*	.168*	.28	.476	1.82†	.....
Cincinnati	.111*	.1665	.259	.499	1.665	**4.92†**
Atlanta	.108*	.162*	.27	.459	1.75‡	.....
Montreal, *delivered*	.68‡	.45†	.70	1.35	4.50†	
Detroit	.102	.153	.238	.459	1.98†	6.15†
Baltimore	.117	.18	.273	.526	1.755	5.125
Kansas City, Mo.	.135	.19	.30	.54	2.16	
Philadelphia	.12	.18	.28	.54	1.80†	4.[illegible]†

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named.

	Feb. 1	One Year Ago
New York, 45% asphalt (at terminal)	$0.06	$0.05½
New York, 65% asphalt (at terminal)	.06	.05
New York, binder (at terminal)	.06½	.06½
New York, flux (at terminal)	.06½	.05½
New York, liquid asphalt (at terminal)	.07	.06
St. Louis, 50 @ 60% asphalt	**.0548**	.04½*
Chicago, 40 @ 50% asphalt	.05½	.05
Chicago, 60 @ 70% asphalt	.05½	.05½
Dallas, 45% asphalt	.04	.10
Dallas, 55% asphalt	.048	.13
Dallas, binder	.053	.15
San Francisco, binder, per ton	9.50†	13.00†

* Freight $21.75 per ton to Whiting, Ind.
† F.o.b. Oleum, Cal. Freight to San Francisco 80c. per ton.

ASPHALT—Price per ton in packages (350-lb bbl. or 425-lb drums) and in bulk in carload lots, f.o.b. points listed

	Package	Bulk
New York (*Mexican*)	$20.00	$16.00
Boston (*Mexican*)	19.50	16.00
Chicago (*Stanolind*)	[illegible]	*16.00*
San Francisco, *f.o.b. refinery*, Oleum, Cal	17.00*	11.00*
Dallas, (*Texas*)	*23.00*	*15.00*
Seattle "*D*" *grade* (*California*)	*21.25*	*11.00*†
Denver (*California*)	40.00	
Minneapolis *f.o.b. Twin Cities* (*Stanolind*)	*25.45*	*19.10*
St. Louis (*Mexican*)	**27.50**	*19.75*
Baltimore (*Mexican*)	21.00	15.00
Los Angeles, *at factory, Bakersfield* (*California*)		
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	22.00	16.50
Detroit (*Mexican*)	23.68	18.95
Cincinnati (*Mexican*)	22.50	19.50
Maurer, N. J. (*Trinidad and Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	18.00	15.50
Philadelphia (*Mexican*)	20.00	16.00
Kansas City (*petroleum*)	*28.80*	*22.80*

*Freight to San Francisco, 80c. per ton.

†F.o.b. Richmond, Cal.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York	5-in. granite, 30 blocks per sq.yd.	$4.45 per sq.yd.
Chicago	About 4x8x4 dressed About 4x8x4 common	3.60 per sq.yd. 3.15 per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M
Boston	5-in. granite	2.10 per sq.yd.
Atlanta	Granite	2.10 per sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	100.00 per M
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	100.00 per M
New Orleans	Granite, 4 x 8 x 4	3.25 per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	4x8x4 dressed 4x8x4 common	3.10 per sq.yd. 2.90 per sq.yd.
Kansas City	Granite	3.75 per sq.yd.
Philadelphia	Granite	130.00 per M.

FLAGGING—

New York	Bronx, 5 ft Manhattan, 4 ft Queens, 5 ft 6x20-in. cross-walk	$0.50 sq.ft .35@.40 sq.ft. .35@.40 sq.ft. 1.00 lin.ft.
Chicago	18 in. wide	.99 lin.ft.

CURBING—Bluestone per lineal foot, delivered in New York, costs $2.40@2.75 for 5x16 in.; $3.50@4.00 for 5x18 in. Class "A" straight, 5x16 in., $1.40 per lin. ft. delivered in St. Louis. 5x18 in., Chicago, $3 per lin.ft., delivered.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2.37
New York (*delivered*)	3½	16	2.63
Boston	3½	16	2.35
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50
St. Louis	3½	16	2.00
St. Louis	4	16	2.10
Seattle	4	16	Off market
Minneapolis	3½	16	2.09
Atlanta	3½	16	2.30
New Orleans	3	16	*1.75*
New Orleans	3½	16	1.95
New Orleans	4	16	2.25
Dallas	4	18	3.90
Baltimore	3½	16	none used
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	2.38
Kansas City	4	16	*3.15*
Philadelphia	3½	16	2.46

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel				Sand	
	1½ In.		¾ In.			
	Feb. 1	One Year Ago	Feb. 1	One Year Ago	Feb. 1	One Year Ago
New York	$2.00	$1.75	$2.00	$1.75	$1.00	$1.00
Denver	1.90	2.50	1.90	2.50	1.10	1.10
Chicago	2.25	2.00	2.25	2.00	2.25	2.00
St. Louis	*1.40*†	1.25†	1.50†	1.50†	*1.40*†	1.20†
Seattle	1.00	1.50	1.00	1.50	1.00	1.50
Dallas	2.25	2.00	2.25	2.00	1.87½	2.00
Minneapolis	1.75*	1.50	1.75*	1.50	1.00	0.50*
Cincinnati	1.40†	1.00	1.40†	1.50	1.15†	1.50
San Francisco	2.15	2.25	2.15	2.25	1.50	1.50
Boston	1.40	2.65	1.40	2.65	1.10	2.00
New Orleans	2.85	2.08½	2.85	2.08½	1.35	1.35
Los Angeles		1.35†	..	1.35†	..	1.20†
Atlanta	1.75†	1.85†	1.75†	1.85†	*1.24*†	1.25†
Detroit	2.25	2.00	2.25	2.00	2.00	2.00
Baltimore	1.86	1.40	2.13	1.60	0.70†	2.00
Montreal	1.25†	1.25†	1.50†	1.50†	1.25†	1.25†
Birmingham (Crushed slag used instead of gravel)					1.25†	1.25†
Philadelphia	1.70	1.50	1.75	1.57	0.66*	1.60
Kansas City	2.00	2.00	2.00	2.00	0.66*	1.20

New York—Grit, $1.75 per cu. yd.

Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.

* At pit.

† Per ton.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In.		¾ In.	
	Feb. 1	One Year Ago	Feb. 1	One Year Ago
New York	$1.65	$1.75@1.85	$1.75	$1.75@1.85
Chicago	2.25	1.60	2.25	1.60
St. Louis *delivered*	2.00	1.65@2.00*	2.10	1.65@2.00*
Dallas	1.80	2.93	1.80	2.93
San Francisco	2.15	2.25	2.15	2.25
Boston, *delivered*	1.85	3.00*	1.85	3.00*
Minneapolis, *at plant*	2.00	2.00	2.25	2.25
Kansas City	*2.25*	2.10	*2.25*	2.10
Denver	3.50	3.50	3.50	3.50
Seattle *delivered*	3.00	3.00	3.00	3.00
Atlanta	2.00*	2.00*	2.00*	2.00*
Cincinnati	*1.55**	2.37½	2.00*	2.08
Los Angeles	.	1.60*	....	1.70*
Detroit	1.90@2*	1.90*	1.90@2*	1.90*
Baltimore		1.75*	.	1.65*
Montreal	1.80*	2.00*	1.90*	2.10*
Birmingham *delivered*	3.20	3.20	3.10	3.10
Phildelphia	1.75*	1.70	1.60*	1.55
Pittsburgh	2.85	....	2.85	....
Cleveland	3.00*	....	3.00*	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
East Canaan, Conn	1.25	1.35	4.00	1.00
Easton, Catasaqua, Pa	1.00	1.00	2.00	0.90
Birmingham, Ala	1.00	1.00	1.00	1.00
Buffalo, N. Y., and Erie, Pa	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.20	1.20	....	1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2.00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$16.80@*$17.10*	$13.10	$3.75*	$3.00@$3.25*
Chicago	18.00	18.00	1.50†	1.40†
St. Louis	22.40	19.20	*17.75*‡	*17.75*‡
Boston	*18.00*	*13.50*	3.90*	3.00*
Dallas	22.50		....	2.50†
Cincinnati	15.80	13.30	....	10.75‡
San Francisco	22.00	16.00	....	1.75†
Minneapolis	25.50	21.00 (white)	1.55†	1.40†
Denver	24.00		....	2.70†
Detroit	19.50	17.50	....	18.25‡
Seattle *paper sacks*	24.00	.....	2.80†	.....
Los Angeles	.....	.....	....	.....
Baltimore	22.00	16.25	.....	.....
Montreal	21.00	21.00	15.00‡	11.00‡
Atlanta	23.00	20.00	2.25†	1.85†
New Orleans	.....	17.25	2.40†	.....
Philadelphia	15.50	14.50	13.00‡	12.00‡
Kansas City	25.60	24.00	2.40†	2.40†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.55, Sheboygan $1.45. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Feb. 1	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.50	1.60
Atlanta (Magnolia)	11.00 per ton	11.00 per ton
Cincinnati (Utica)	1.72	1.93
Boston (Rosendale) per bag	....	0.85@0.95
St. Louis (Carney)	1.75	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Feb. 1	One Month Ago	One Year Ago
New York, del. by truck	$2.60@2.70	$2.60@2.70	$2.20@2.30
New York, alongside dock to dealers	2.30	2.30	2.00
Jersey City	2.48	2.48	2.12
Boston	*2.75*	2.85	2.50
Chicago	2.05	2.05	1.97
Pittsburgh	2.14	2.14	2.02
Cleveland	2.36	2.36	2.26
Detroit	2.33	2.33	2.17
Indianapolis	2.26	2.26	2.21
Toledo	2.33	2.33	2.20
Milwaukee	2.22	2.22	2.18
Duluth	2.04	2.04	1.95
Peoria	2.26	2.26	2.13
Cedar Rapids	2.33	2.33	2.26
Davenport	2.28	2.28	2.21
St. Louis	2.35	2.35	2.20
San Francisco	2.71	2.71	2.84
New Orleans	3.30	3.30	3.20
Minneapolis	2.29	2.29	2.24
Denver	2.85	2.85	2.90
Seattle	2.90	2.90	2.94
Dallas	2.25	2.25	2.40
Atlanta	*2.50*	2.54	2.69
Cincinnati	2.39	2.39	2.35
Los Angeles	....	. . .	3.31
Baltimore	2.51	. . .	2.50
Birmingham	2.40	2.40	2.27
Kansas City	*2.35*	2.45	2.40
Montreal	*2.15*	2.40	2.65
Philadelphia	*2.41*	2.51	2.21
St. Paul	2.29	2.29	2.24

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind	$1.80	La Salle, Ill	$2.05
Universal, Pa	1.90	Hudson, N. Y	2.20
Steelton, Minn	1.85	Leeds, Ala	2.20
Fordwick, Va	2.20	Hannibal, Mo	2.10
Mitchell, Ind	2.05	Lehigh Valley District	2.10
Iola, Kan	2.10	Wyandotte, Mich	2.05
Mason City, Ia	2.05	Alpena, Mich	1.85

TRIANGLE MESH—Price per 100 sq.ft in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh, Mill	Warehouse New York	Chicag	St. Louis	Dallas	San Francisco
032	22	$0 85	**$1 13**	$0 92	$0 94	$1 172	$1 03
049	28	1 08	**1 44**	1 18	1.20	1 488	1 34
068	35	1 31	**1 76**	1.43	1.46	1 835	1 64
093	45	1 69	**2 26**	1 84	1.88	2 345	2 10
126	57	2 08	**2 73**	2 27	2.33	2 917	2 60
153	68	2.48	**3 25**	2 71	2.77	3.468	....
180	78	2.85	**3 69**	3.12	3.19	4.08	....
245	103	3.76	**5 05**	4.11	4.20	5.253	....
287	119	4 34	**5 90**	4 74	4.85	6 079	5 43
336	138	5 04	**6.80**	5 51	5.63	7.458	....
395	160	5.84	**7.81**	6 38	6.53	8.16	.....
PAVING							
036P	17	$0.65	**$0.84**	$0.71	$0.72	$0.897	.....
053P	24	.91	**1 14**	.99	1.01	1 284	.....
072P	31	1.15	**1 52**	1 26	1.28	1 601	.....
097P	40	1.48	**2.00**	1.62	1.65	2 06	.....
049R	24	.91	....	.99	1.01	1 264	....
067R	31	1.15	....	1.26	1.28	1 601	....
089R	40	1.48	....	1.62	1.65	2 06	...

(Chicago quotations merely nominal)

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27Dia.	2.3	$22 00	$20 39	**$20 72**	$20 78	$25 50
26 "	2.5	22 00	21 93	**22 33**	21 43	27 58
25 "	3.0	22 00	24 45	**24 93**	......	30 71
24 "	3.4	24 00	26 33	**27 10**	24 28	33 16
22 "	4.33	27 00	31 06	**32 27**	......	35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut New York	Chicago	St. Louis	Dallas	San Francisco
¾ and larger....	$2 00	$2 35	**$3 19**	$2 92½	**2 90**	$3 15	$3 30
⅝............	2 05	2 45	**3 24**	2 97½	**2 95**	3 20	3 35
½............	2 10	2 55	**3 29**	3 02½	**3 00**	3.25	3 40
⅜............	2 25	2 60	**3 34**	3 17½	**3 15**	3 40	3 55
¼............	2 50	2 65	**3 69**	3 42½	**3 30**	3 65	3.80

Includes 15c charge for cutting to lengths of 2 ft. and over.

Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¾ and larger	$2 10	**$2.60**	$3 50	⅜.....	$2 35	**$2 85**	$3 95
⅝ in	2 15	**2 65**	3 75	¼....	2 60	3 00	4 20
½	2 20	**2.70**	3 80	....	....	.. ..	....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common Feb. 1	One Month Ago	One Year Ago	Paving Block 3-inch*	Paving Block 4-inch*
New York (del.)...	$23.50	$23.50	$20 40	$42 00†	$50 00†
New York (at dock)...	20.00	20.00	14@15	....	
Chicago...........	11 00	11 00	11 00	34.00	42 00
St. Louis, salmon....	**16 00**	15.00	16 00	**36.50**	**41 00**
Denver, salmon.....	12 00	12 00	14 00	......	..
Dallas..............	*9 85*	10 90	11 00	no market	
San Francisco.........	15.50	15.50	15.50	......	
Los Angeles (del.).....	.....	....	15.50	(not used)	
Boston (del.)..........	20.00	20 00	17 00	**72 00**	**72 00**
Minneapolis (del.)....	*17@19*	18@19	15.00	......	43 00
Kansas City	14 50	14 50	14.50	...	..
Seattle	*13 00*	14 00	14 00	**50 00**	
Cincinnati...........	**18 00**	17 00	17.00	42 00	42.00
Montreal	16 00	16 00	16 00	**100.00‡**	*68 00*
Detroit (del.)	16.50@17 00	16.50@17	16 50@17	36 50	39 50@41
Baltimore (del.).......	18.00	...	20 00	40.00	45.00
Atlanta.............	10 00	10 00	9 00	39.00	.
New Orleans..........	15.75	15 75	12 50	......	.
Birmingham	12 50	12 50	10 50	.....	.
Philadelphia	20@28	20@28	16.00	40 00	48.00
Pittsburgh (del.)......	16.00	16 00	.	..	
Cleveland............	16 00	16.00		..	

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡Imported

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York Feb. 1 on Trucks*	New York One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12.	$0 123	$0 1112	$0 0674	$0 12	$0 088	$0 108	.
6x12x12...	1844	1667	0926		*110*	156	.
8x12x12...	.2305	2084	1263	1875	*150*	244	$0 2147
10x12x12...	....	.	1621	.	.18	.....	2653
12x12x12 ..	....	.. ..	1853		22	.. ...	3448

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston	*$0 10*	*$0 12*	
Minneapolis (f.o.b. cars)....	**0 736**	**.12125**	**$0 214**
Minneapolis (delivered).......	**0836**	**.1369**	**239**
Cincinnati	0859	.1611	
Kansas City	083	105	.
Denver.	065	.123	188
Seattle (delivered)	11	25	36
Los Angeles factory	..	...	..
New Orleans	12	.23	.36
Detroit (delivered)..........	09	175	.26
Montreal..............	*105*	225	30
Baltimore..............	10	.215	
Atlanta	0859	1615	..
Dallas	.115	....	..
Birmingham	.11	18	
Pittsburgh (delivered) ...	.068	.128	179
Cleveland	08	164	

San Francisco, Philadelphia, Atlanta, New York and Chicago quote on hollow partition tile

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburg and Birmingham together with quotations per 100 lb. from warehouses at place named:

	Pittsburgh, *Mill*	Birmingham *Mill*	Warehouse New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in. ..	**$2 10**	$2.40	$3.29	$4.40	$3.00	$3 02½	$3.25
Channel, 3 to 15 in. .	**2 10**	2.40	3 29	4.40	3.00	3.02½	3.25
Angles, 3 to 6 in., ¼ in. thick	**2.10**	2.40	3 29	4 40	3.00	3.02½	3.25
Tees, 3 in. and larger...	**2.10**	2.40	3 29	4.40	3.00	3.02½	3.25
Plates, ¼ in. thick and heavier	**2.10**	2 40	3.29	4 50	3.00	3 02½	3.35

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	Warehouse New York **Feb 1**	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
¾ in. and larger	$3.00	$3 85	$3.50	$3 75	$3 85	**$4.75**	$5.25
CONE HEAD BOILER							
¾ in. and larger.	$3.10	3.95	3 60	3 85	3.95	4.85	5.40
⅝ and 11/16........	3.25	4.11	3 76	4 00	**4 10**	5.00	5.55
½ and 9/16........	3.50	4.35	4 00	4 25	**4 35**	5.25	5.35

Lengths shorter than 1 in. take an extra of 50c. Lengths between **1 in. and 2 in.** take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.........	$2.70@2.80	$3 45	$4 00	$4 40	**$3.19**	$4.95
Cut..........	3.20@3.25	5 50	5.65	6 90	**3.29**	5.00

PREPARED ROOFINGS—Slate-surfaced rooting (red and green) in rolls of 108 sq.ft. **costs $1.95 per** roll in carload lots and **$2.20** for smaller quantities f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.50 per square (sufficient to cover 100 sq.ft.) in carloads; $5.75 in smaller quantities, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia. l.c.l., $5.90.

ROOFING MATERIALS—Prices f.o.b. New York, in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton.....................	$73.50
Tar pitch (in 400-lb. bbl.), per 100 lb	1 62½
Asphalt roofing (in barrels), per ton, f.o.b. plant*.....................	37.00
Asphalt felt (light), per ton, f.o.b. plant*.....................	67.50
Asphalt felt (heavy), per ton, f.o.b. plant*.....................	67.50

* Delivered in Metropolitan Dist., $3,00 additional.

SHEETS—Quotations are per **100 lb.** in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10...........	$2 50@**2 75**	4 10	$4 00	$4 35	$4 19
No. 12...............	2.60@**2.85**	4.15	4.05	4 40	4 24
No. 14.....	2 70@**2 95**	4 20	4 10	4 45	4 29
No. 16...........	2 90@**3 15**	4 30	4 20	4 55	4 39
Black					
*Nos. 18 and 20.	3 20@**3 35**	4.65	4 70	5 70	**4 70**
*Nos. 22 and 24..	3 25@**3 40**	4 70	4 70	5 75	**4 75**
*No. 26..............	3 30@**3 45**	4.75	4.75	5.80	**4 80**
*No. 28..............	3.35@**3 50**	4.80	4.85	5.90	**4.90**
Galvanized					
No. 10...............	3.35@**3 50**	4.85	4 85	....	**4.90**
No. 12 ..	3 45@**3 60**	4 95	4 95	5 85	**5 00**
No. 14	3 45@**3 60**	5 00	4 95	5 85	**5 00**
No. 17 to 21	3 75@**3 90**	5 10		6 15	**5 30**
No. 22 and 24	3 90@**4 05**	5 40	5 40	6 30	**5 45**
*Nos. 25 and 26	4 05@**4 20**	5 55	5 55	6 45	**5 60**
*No. 28	4 35@**4 50**	5 85	5 70	6 75	**5 90**

*For painted corrugated sheets add 30c per 1,000 lb. for 25 to 28 gage; 25c for 19 to 24 gage; for galvanized corrugated sheets add 15c, all gages.

LINSEED OIL—These prices are per gallon:

	New York Feb. 1	New York One Year Ago	Chicago Feb. 1	Chicago One Year Ago
Raw in barrel (5 bbl. lots)	$0 93	$0 77	$0 98	$0 80

WHITE AND RED LEAD—Base price in cents per pound

	Red				White	
	Feb 1		1 Year Ago		Feb 1	Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	**14 25**	**15 75**	12 25	13 75	**14 25**	12 25
25 and 50-lb. kegs	**14 50**	**16 00**	12 50	14 00	**14 50**	12 50
12½-lb. keg	**14 75**	**16 25**	12.75	14.25	**14 75**	12 75
5-lb. cans	**17 25**	**18 75**	15 25	16 75	**17 25**	15 25
1-lb. cans	**19 25**	**20 75**	17 25	18.75	**19 25**	17.25

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional.

	6–8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	**$35 00**	**$36 00**	**$37 00**	**$40 00**
3x6 and 8	**35 00**	**36 00**	**37 00**	**40 00**
4x4-6 and 8	**35 00**	**36 00**	**37 00**	**40 00**
3x10 and 12	**35 00**	**36 00**	**37 00**	**40 00**
3x14	**37 00**	**37 00**	**39 00**	**41 00**
4x10 and 12	**35 00**	**36.00**	**37 00**	**40 00**
4x14	**37 00**	**37 00**	**39 00**	**41 00**

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft
6x10	**$37 00**	**$39 00**	**$41 00**
6x14	**37 00**	**39 00**	**41 00**
8x10	**37 00**	**39 00**	**41 00**
8x14	**37 00**	**39 00**	**41 00**

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22–24 Ft.	20 Ft. and Under	22-24 Ft.
3x 4 to 8x8	**$49 00**	**$50 00**	**$50.50**	**$52 50**
3x10 to 10x10	**52 00**	**53.00**	**53 50**	**55.50**
3x12 to 12x12	**56 00**	**57 00**	**56.50**	**58 50**
3x14 to 14x14	**62 00**	**63 00**	**61 50**	**63 50**
3x16 to 16x16	**69.00**	**70 00**	**66 50**	**68 50**
3x18 to 18x18	**82 00**	**83 00**	**77.50**	**79 50**
4x20 to 20x20	**92.00**	**93 00**	**89.50**	**91.50**

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional Short leaf pine up to 14 x 14 costs $15 per M less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under				12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	**$62 00**	..	...	$60 00	**$78 00**	...
Seattle	.	**$28.00**	......	......	......	**$28 00**
New Orleans	**35 00**	.....	......	35.00	**40 00**	.
Baltimore	35.00	52.00	$52.00	60.00	50.00	53.00
Cincinnati	*40 00*	48.00	**48 50**	......	**55 00**	50 00
Montreal	50.00	50.00	40 00	38.00	78 00	90.00
Los Angeles	....			....	......	
Denver	.....	**41 00**	**44 00**	**41 00**	.. .	**41 00**
Minneapolis	45 50	42.75	41 00	.....	48.00	**44 75**
Atlanta	*33 00*	.....	.....	.....	*35 00*	....
Dallas	45.00	.....	....	.....	48 00	.....
Kansas City	*38.50*	47.00	47.00	49.50	52 75	
Birmingham	32.00	....	....	.....	40.00	.. ..
Philadelphia	45.00	39.00	40.00	44.00	55 00	39 00
Detroit	46.75	48 25	. .	.....	55.75	48 25
St. Louis	44.50	.....	.. .	.....	49.50	...

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	**$50 00**		....	**$55 00**	
Seattle	......	**$24 00**	.. .	...	**$26 00**
New Orleans, at mill	**80 .00**	.....	..	**39 00**	
Baltimore	65.00	43.00	$43.00	36.00	55.00
Cincinnati	**75 00**	77.50	68.50	*35.00*	*80 00*
Montreal	60.00	50.00	37.00	45.00	45 00
Los Angeles	....	.. ..	..	.....	.
Denver	....	**36.25**	**36 25**	.....	**36 25**
Minneapolis	48.50	**41 25**	38 50	43 75	**40 25**
Atlanta	*17 00*	.....	.....	*27.00*	. ..
Dallas	45.00	36 00	....	48 60	..
Kansas City	77.00	*38 00*	*38 00*	74 00	40 00
Birmingham	28 00	....	.....	**32 00**	.. .
Philadelphia	34.50	41.00	40 00	**55 00**	39.00
Detroit	*48 00*	40 00	.	*46.50*	*41 50*
St. Louis	50.00	.....	.	40 00	

Montreal—Up to 32 ft.; over which, $3.00 per M. ft. increase up to 30 ft.

Birmingham—Quotes carload lots, f.o.b. sidings. $1.50 additional per M. ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractors on large projects.

St. Louis—Wholesale price to contractors, $7@$11 per M. ft. additional.

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M. ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.315	Detroit	$0.295
Birmingham	.69	Kansas City	.735
Boston	.365	New Orleans	.515
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1 50†
Cincinnati	.295	Philadelphia	.325
Cleveland	.215	St. Louis	.43
Denver	1.275*	St. Paul	.595

* Minimum carload, 40,000 lb.

† Minimum carload, 50,000 lb., structural steel only; 80,000, lb. for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Feb. 1	One Month Ago	One Year Ago
$2@2.05	$2@2 05	$1.55@1 80

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	25%
Patent flattened strand, special and cast steel	25%
Patent flattened strand, iron rope	10%
Plow steel round strand rope	40%
Special steel round strand rope	35%
Cast steel round strand rope	27½%
Round strand iron and iron tiller	10%
Galvanized steel rigging and guy rope	12½ %
Galvanized iron rigging and guy rope	+7½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ⅝-in., 8 ft., ¾-in., 6; ⅞-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	*$0.16½*	New Orleans	**$0.18**
New York	.17	Los Angeles	....
Chicago	.18	Seattle	.18
Minneapolis	.20½	St. Louis	.17½
San Francisco	.16	Montreal	.30
Atlanta	*18½*	Detroit	.19
Denver	20	Baltimore	.18
Cincinnati	.20	Kansas City	.19½
Dallas	*.129*	Birmingham	.20½
Philadelphia	.18		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin	
	40%	60%
New York	$0.27	$0.30
Boston	.23	.25
Kansas City	.2225	.2525
Seattle	.165	.195
Chicago	.22	.25
Minneapolis	.189	.2094
St. Louis	.22	.25
Denver	.2025	.2325
Dallas	.29	.375
Los Angeles	....	.....
Atlanta	.23	.26
Baltimore	.215	.225
Cincinnati	.22	.25
Montreal	.195	.235
Birmingham, *delivered*	.20½	.22
New Orleans	.235	.265
San Francisco	.1625	.1925
Philadelphia	.25	.28

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.13	$0.17½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.17½	0.22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.19½	0.24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.25	0.34
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	**$16 50**	$11.50	**$16 00**
Stove plate	**14 00**	12.00	**16.50**
No. 1 machinery cast	18.00	16.50	20.00
Machine shop turnings	**10 00**	4.00	*9.50*
Cast borings	12@**14**	5.50	**11.00**
Railroad malleable cast	15.00	12.50	18.50
Re-rolling rails	**17 00**	13.00	**20 00**
Relaying rails	28.50	30.00	**27@32**
Heavy melting steel	16.00	...	.

SHIP SPIKES—Current prices per 100 lb.:

	San Francisco		Seattle
In.	Galv.	Black	Black
¼	$7 50	$6 00	$8.00
⅜	7 05	5 55	7.75
½	6 90	5 40	7.70

Pittsburgh base in lots of 200 kegs or more, $3 50.

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DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

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An Engineer Needed

LAST month the mayor of New York appointed to a commission "to survey traffic conditions and recommend methods for relieving congestion in the streets" a police magistrate, the commissioner of police, the license commissioner, a health department official and the corporation counsel. Have the engineers of the city no way of impressing upon the mayor that traffic is a problem on which the engineer might reasonably be expected to know as much at least as a lawyer, a policeman or a doctor?

For Better Building

A MINIMUM specification for the structural part of dwelling houses, prepared by an expert committee for the Department of Commerce and just published, contributes in a new way to the art of building. Its chief merit lies not in giving new facts or showing new methods of building, but in bringing together for the first time and making available for the information of the widest circles the essential elements of sound design of dwelling houses. It is certain to have the effect of raising the standard of building in this field; and the dwelling house, it must be remembered, absorbs nearly one-third of the total expenditures for building. Whether the specification carries out the original purpose of the committee's appointment, to promote economy in building by saving material and labor and by eliminating variation in building is not so obvious. It appears that the only direct economy brought about is the reduction of minimum wall thicknesses to 8 in. (brick) and 6 in. (concrete), and the approval of hollow brick walls, while in other provisions, notably those for firestopping, the new rules call for increased expenditure by requiring better construction—obtained through rather simple means. However, a large indirect saving should result, through the elimination of poor construction, with its attendant evils of quick deterioration, frequent repairs, and large ratio of fire loss.

A Minimum Code

WISELY the committee which formulated the new rules has given them the title of "Minimum Requirements." In emphasizing the "minimum" the committee has done a service to sound building administration which extends beyond the specific field covered. No set of rules of the kind can be an automatic and complete guarantee of safety, and even the most ample requirements would still contain the possibility of bad results. Rules for general application can, therefore, only set a minimum standard. This means that no one should go below but many should exceed the limit fixed, by building more strongly and more amply than the minimum. Present building practice under detailed building-code specifications largely ignores this viewpoint and looks upon code requirements as statements of good practice. May the new rules help to correct this faulty view.

Development of House Construction

ASIDE FROM the direct purpose of the report mentioned, its close relation to the trend of development in house construction is significant—perhaps more so than its economies or its instructional value. For a numben of years there has been active study throughout the country to develop new forms of construction, superior to standard frame-house practice and yet able to compete with it in cost. A dozen years ago monolithic poured concrete construction was heralded as the coming development in this direction. More recently, light steel framing covered with incombustible wall and floor surfacing has been the object of interest. Progress hitherto has been disconcertingly slow, but more rapid future progress is to be looked for. The establishment of a thoroughly studied minimum standard of house building under present methods of practice should tend to guide this progress along safe lines and, in addition, to stimulate effort to perfect new types.

The Passing of Chemical Precipitation

SEWAGE treatment by chemical precipitation, extensively used for many years in England, is classed as a thing of the past by George W. Fuller in the second of his Impressions, elsewhere in this issue. The process never gained the foothold in America that it did in England. For two decades it has rarely been adopted in either country for new works or extensions. The passing of chemical precipitation is due to the fact that it increases while the newer processes decrease the volume of sludge to be got rid of—and sludge remains, as was so well expressed long ago, the crux of the sewage problem. It was the septic tank and contact bed, the latter soon followed by the sprinkling or percolating filter, that threw chemical precipitation and some other methods into the discard. Mr. Fuller's conclusion is that the septic tank is also becoming a thing of the past in England. It should be noted that almost all the septic tanks in England are of the one-story or Cameron type, the two-story Travis tank never getting beyond Hampton, Norwich and perhaps one or two other places, while the Imhoff adaptation did not gain even that much ground on English soil, although well established in both the United States and Canada before the European War. Imhoff tanks are still widely used in North America, and constantly being recommended for new installations by many engineers. Whether England would have turned so far away from the septic tank as Mr. Fuller indicates had two-story tanks come in use as extensively there as here is an interesting question that cannot be discussed now. The fact is, however, that the Imhoff tank at its best, like other methods of sewage treatment, presents a sludge problem—a problem that will doubtless exist in some degree as long as cities exist. The hope of the future is the activated sludge process, but it still presents many problems for solution, as Mr. Fuller's concluding article will show.

Original Foundation Work

THE solution of an unusual and difficult foundation problem in connection with the construction of the Hudson River vehicle tunnel, as described in this issue, contains some striking elements of interest. First of these is the resourcefulness and thoroughness with which the manifold details of construction were worked out in the field. The essence of the undertaking was the plumb driving of the 24-in. pipes that form the casings for the piles. Carefully plumbing the first sections of each pile and drilling a hole ahead of each section of pipe solved this problem. Success in detail still depended on the plumbing devices, the tools for placing reinforcement and concrete, and the internal pipe cutter, all of which were worked out with praiseworthy ingenuity. The whole undertaking, moreover, represents a bold and original attack on an exceedingly difficult problem—that of sinking large piles through soft bottom to rock at a depth of 250 ft. Its successful accomplishment is an important contribution to the foundation art. It is possible that the methods used will have only limited future application. Disregarding cost, as a secondary consideration, it is necessary that the material to be penetrated shall be sufficiently stable to permit the drilling of the hole in advance of the casing, and, in the case of long piles, sufficiently stable also to give them the necessary lateral support. But subject to the limiting considerations in each particular case, it has been demonstrated that well-drilling methods can be used to put down a steel casing through soft soil, substantially plumb, to depths usually considered far beyond reach, and thereby to develop a firm foundation.

The Railroads Tackle the Port Problem

THE collective action of the trunk-line railroads that enter New York in retaining engineering counsel to undertake a study of the railroad transportation problem of that port is encouraging, although considerably handicapped from the start. It is to be regretted that the roads could not see their way clear to begin this study a year ago when the plan of the Port Authority was finally legalized, and when it was evident that sooner or later they would be required to define their position toward it and to indicate how far they would be willing to go in co-operating to solve the port terminal problem. If they had done this, they now would be in position to offer a positive and constructive contribution, backed by their united influence, instead of finding themselves once more in the rôle of "stand-pat" objector, to all appearances bent only on opposition to what someone else has proposed. But it is inconceivable that at this juncture the roads should fail to seize the opportunity to disclaim a dog-in-the-manger policy. Unfortunately, it is quite possible that the first phase of the investigation must be directed toward opposing the Port Authority plan before the Interstate Commerce Commission, but even here it seems possible to lay a foundation that will offer unmistakable evidence of a worthwhile structure to follow. Through their several spokesmen, the railroads just now are making a strong bid for public favor to sustain them through what promises to be a year of legislative storm and stress. But actions speak louder than words, and it is quite possible that the executives of the trunk lines entering New York have an opportunity to forward the campaign in defense of the railroad managements.

Voting on the Federation

IN ACCORDANCE with the decision of the Board of Direction, reached just before the annual meeting of the society, the American Society of Civil Engineers is to hold another referendum on the question of its affiliation with the Federated American Engineering Societies. The former ballot on this proposal, canvassed in November, 1920, was taken under conditions quite different from those that now prevail. Then the federation had just been organized and consisted of little more than an idea and a hope; today it has been in existence for two years and has written a record by which it may be judged. If, two years ago, the civil engineers rejected the federation on the strength of their estimate as to future developments, today they can act in the light of experience.

When the federation was organized, this journal, together with substantially all the other elements that composed the engineering life of the nation, bespoke for it the interest and support of engineers in every field, anxious lest there be lost an opportunity to try out a great experiment that offered promise of far-reaching benefit to the profession. We believed that good might be achieved through a closer co-operation between the various branches of the profession and through the creation of an agency that would voice worthily its significance in the life of the nation. At that time this idea was so new to the great body of the profession that we felt it incumbent upon us to aid in its spread. Today the idea is familiar to all.

In what degree the federation, as constituted, has risen to its responsibility—to what extent it has fulfilled the hopes of the great body of the profession that sponsored it—is now a matter of record. This does not mean that it would be fair to accept the record of two years as marking the ultimate achievement of the federation, but it does mean that in that record will be found a fair indication as to whether the machinery of the federation has been soundly contrived and efficiently operated, as to whether it is on the right track and making progress—in short, as to whether the existing organization is the answer to the need for which it was created. Opinions may differ as to the significance of that record; but it is there, to be read and interpreted according to the vision and the penetration of all who may be interested.

The issue is now before the members of the American Society of Civil Engineers, to be decided according to their individual judgments in the light of the facts before them. Under these conditions we feel no obligation to the profession comparable with that which impelled us to advocate the organization of the federation. Then the question was one of stimulating within the ranks of a profession a desire to translate a new and abstract idea into concrete reality; today the question is whether one society in that profession, which elected to bide its time and watch, shall decide to affiliate with an established enterprise of two years standing.

The issue, to be sure, is of vital concern to the members of the American Society of Civil Engineers, and the decision is in their hands—where it belongs. The influence and the resources of the society are in their keeping, to be applied as they think best toward forwarding the objects set forth in its constitution. The arguments pro and con, interpreting the record of the federation and setting forth its significance to their society, will be presented to them by committees of their own Board of Direction, familiar with its affairs and its interests. In the light of those arguments, supplemented wherever possible by individual knowledge and conviction on the subject, the membership-at-large will formulate the decision of the society.

Garbage Disposal and the Daily Press

TECHNICAL misinformation circulated by the daily press is voluminous and varied but no field is so persistently misinterpreted as that of garbage disposal. The latest flagrant example comes from the editorial pages of the Montreal *Star*, which is pleading for the substitution of incinerators for dumps. The editor says:

> The outrageous custom has been in vogue here for years of dumping garbage in open places, to the detriment of health, and also to serious monetary loss.
>
> Ever since Montreal has been a city it has made no satisfactory move to utilize its garbage for power-producing purposes. In well-managed European cities it is usual to make garbage plants pay very much over their cost of construction and maintenance.
>
> An expert on garbage destruction in this city is authority for the statement than an up-to-date method of burning the garbage would result in the corporation [city] reaping an annual revenue of over $100,000.
>
> Open-air dumps have been prime factors in the spreading of infectious diseases. Surely the horror of such dumps will not be tolerated much longer.

Who is this "expert" who says that Montreal could reap $100,000 annually from incinerators; which are the "European cities in which it is usual to make garbage plants pay very much over their cost of construction and maintenance"; what "infectious diseases" have been spread by or from garbage dumps in Montreal?

Such ill founded assertions in the daily press and by members of civic associations are largely responsible for the abandoned garbage disposal plants of various kinds scattered over the continent. These assertions sometimes help get large appropriations for garbage works which when built put a heavy burden on the municipal treasury, as should have been known and frankly stated as inevitable. After a time, money for maintenance and operation, or even for intelligent supervision, is not appropriated; nuisances arise that may be far worse than a well managed dump; and finally the plant is shut down.

A few well directed inquiries would show the Montreal *Star* and other daily papers with too much zeal and little or no reliable information, that garbage disposal at best can only produce a revenue that will help reduce the cost of collection and disposal; that in its very home in England the refuse destructor has never attained the fullness of use nor produced the amount of heat revenue commonly claimed for it; that today British cities are turning from destructors to other means of mixed refuse disposal; that the British Ministry of Health sanctions refuse dumping, if the refuse be covered according to prescribed rules; that it is the abuse and not the use of refuse dumping that is objectionable; that well regulated dumps, when sites can be found within reasonable hauling distance, may be less costly than incineration or any other method of disposal commonly feasible, and finally that there is no proof that infectious diseases are spread from open-air dumps.

It would seem unfair to dismiss this subject without a word of—perhaps excuse is as good a term as any—for the daily press. The multiplicity of the subjects with which it is expected if not forced to deal lays it open to a thousand chances to error. The technical press, with its staff of trained specialists, has difficulties enough in avoiding error. How, then, expect immunity from errors in the daily press which cannot possibly have specialists in more than a few fields? The answer to this is a question for the daily press itself, except that it must resort more often to experts as consultants; be sure that those it consults know their fields and have no axes to grind; use a large amount of plain, commonsense; and last but not least shun sensationalism and partisanship—at least when dealing with technical matters.

A Promise of Increasing Usefulness

IN ITS five short years of existence the Associated General Contractors has developed into a most virile and effective organization. Last week's convention in Los Angeles showed that its energies are not likely to abate even though the budget for the coming year will require some restriction of breadth of activity. There was the same clear appreciation of the external factors that handicap the efficient execution of constructive work, the same vigorous determination to take steps to remove them, and a heightened interest, as shown by the report of the committee on methods and the subsequent discussion, in the measures needed to increase the internal effectiveness of contracting organizations. The outlook for future usefulness is excellent.

To date the chief efforts of the association have been directed outwardly. It has been a center of energizing thought in the construction industry. The development of an equitable form of standard contract, the move to secure the correction of highway construction practice hampering to the contractor and not advantageous to the public, the agitation for reform in surety practice, the stimulation of standardization effort among equipment manufacturers—these are typical of its efforts to draw into co-operative relations other branches of the industry.

If the report of the committee on methods and its reception by the convention are an index of the trend, there will be equal virility in future in attacking problems within contracting organizations themselves. Much good work has already been done—as instanced by the preparation of standard estimating sheets and of a model form of financial statement, by the studies of depreciation rates and of labor turnover. But the work has hardly been begun. There are broad areas of prospective study of methods of doing work, on cost elements, on management. The technique of construction, so far as possible, needs to be mobilized and to be made generally available. Guesswork would tend to be eliminated with great resulting benefit to contractors and to the public.

Not the least important feature of the convention was the feeling of resentment and regret at the indictment of war construction officials and the suits against the cantonment builders. Nor was the resentment due primairly to the fact that the charges have been brought against friends, but rather to the consequent shaking of public faith in contractors generally. The feeling was but another evidence of the new "pride of calling" which the association in its brief life has developed among the contractors of the country.

With such a "pride of calling" and with a continuance of virile management there is renewed promise of steadily increasing usefulness.

Driving 250-ft. Piles for Hudson River Tunnel Shaft

Footings for Vehicle Tunnel Shafts Consist of 24-in. Pipes Driven 250 ft. to Rock, Filled with Concrete and Cut Off 70 ft. below Bottom of River

This is the first of a series of articles in which Engineering News-Record will, from time to time, describe the progress of the work on the New York-New Jersey vehicle tunnel under the Hudson.—EDITOR.

UNUSUAL methods were invoked to solve the foundation problem that arose in connection with the construction of the river shafts at the New Jersey end of the Hudson River vehicle tunnel now under construction between New York and Jersey City. When the two shaft caissons have been sunk through the Hudson River silt to their intended positions they will come to bearing on a pile footing now under construction. This footing consists of 24-in. steel pipes driven through 30 ft. of water and an average thickness of 220 ft. of soil to ledge rock, then unwatered, filled with concrete reinforced by hooped rods, and cut off at an elevation more than 100 ft. below mean high water and 70 ft. below the bed of the river. No precedents were available for the conduct of this work and substantially all of the methods used were original with the engineers, contractors and sub-contractors responsible for the project.

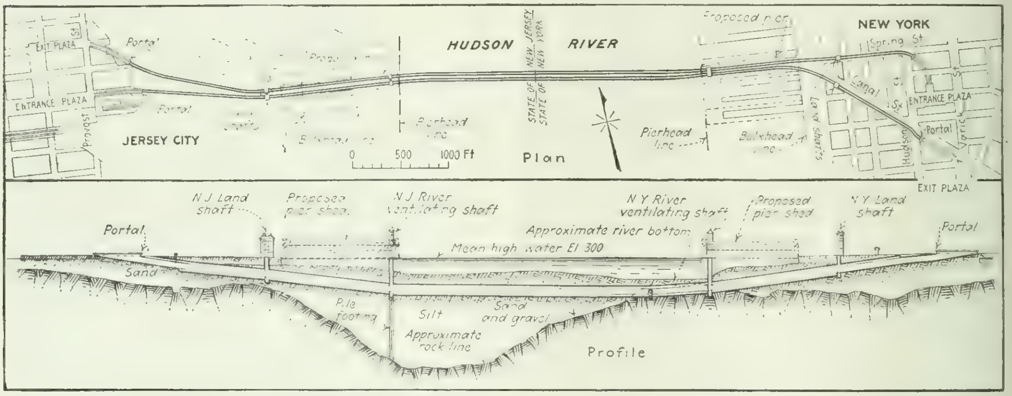


FIG. 1—ALIGNMENT AND PROFILE OF VEHICLE TUNNEL SHOWING PILE FOOTING FOR RIVER SHAFT

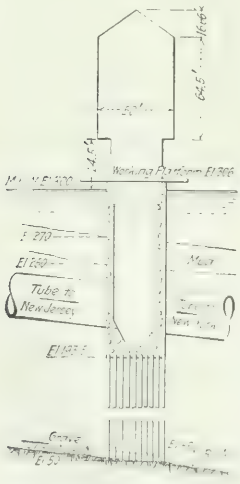


FIG. 2—VENTILATION SHAFT AND FOUNDATION

As was explained in the general description of the Hudson River vehicle tunnel project in *Engineering News-Record* of Feb. 19, 1920, p. 362, the two river shafts, located approximately at the pier-head lines on the New York and New Jersey sides of the river, are important elements in the scheme of ventilation for the tunnel. They play, however, no part in the driving of the tubes, this work being carried on from the land shafts on both sides of the river. The tubes will pass through the river shafts which will have been sunk to position before the shields reach them. The river shaft at the New York side is designed and will be sunk as one unit, through which both tubes will pass; at the New Jersey end there will be two units, one for each tube, built and sunk independently, but connected after they are in place by a cross-passage at the elevation of the tubes.

As the New Jersey shafts will rest in Hudson River silt at a depth of approximately 106 ft. below mean high water, special study was given to their foundations. As a result of this study there is being installed a pile foundation of unusual design and construction that will provide for the direct transmission of the ventilating-shaft load to the underlying rock more than 150 ft. below its base. Work on this foundation for the north caisson is now substantially completed and the experience that has been obtained upon it will be available in the construction of that for the south caisson, which will be undertaken in the spring.

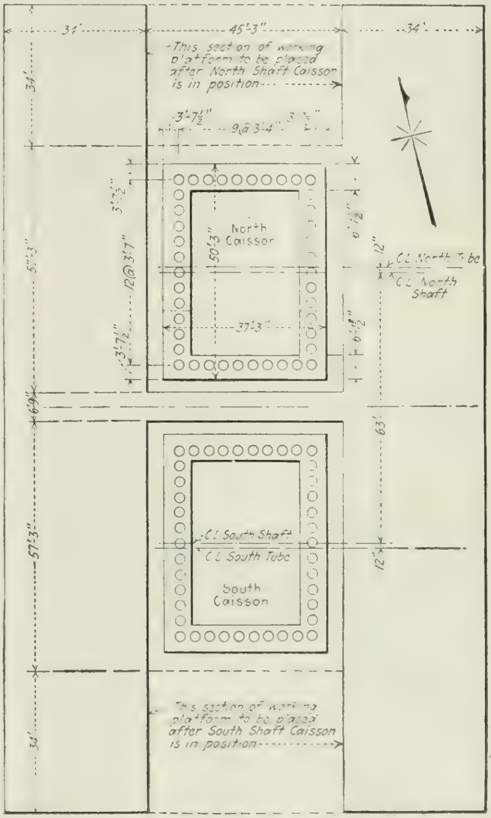
Foundation Conditions—Each of the two river shafts is 37 ft. 3 in. by 50 ft. 3 in. in plan. The caisson section of the shaft is 108 ft. 6$\frac{5}{8}$ in. high which brings its rim 2 ft. 1$\frac{1}{2}$ in. above mean high water. This, as shown in Fig. 2, is assumed as El. 300. The weight of each shaft, including the superstructure, fans, and other equipment, will be 10,155 tons, which will be reduced by a buoyancy of 6,109 tons, leaving a net weight of 4,046 tons to be supported. The unit load, therefore, amounts to 2.16 tons per square foot without considering the effect of wind loads on the exposed superstructure. When this is taken into account and no credit taken for the lateral support given to the shaft by the surrounding soil, the loading along the leeward edge of the bottom is increased over this net dead load by 30 per cent.

At the site of the shaft the river is about 30 ft. deep at mean high water. The bottom consists of 20 ft. of river mud, underlaid by about 195 ft. of Hudson River silt, and under that a 5-ft. bed of sand and gravel, which rests on bed rock close to El. 50. This makes a total depth from mean high water to ledge rock of about 250 ft. The foot of the shaft, therefore, will rest in Hudson River silt at El. 193.5, while the top of the stratum of silt lies at El. 250, or 50 ft. below mean high water. Although it is probable that the silt could bear safely the estimated load, there prevails so much difference of opinion concerning its physical character in place and its probable behavior under load that it was decided to provide direct support for the shaft by extending footings to the rock.

Design—The plan adopted calls for the provision under each caisson of 42 piles or columns of reinforced concrete extending from ledge rock to the bottoms of the shafts. As the entire weight of the structure would be supported on the piles, the load on each pile is estimated as 97 tons without considering wind loads. In the piles farthest from the center line this dead load may be increased by wind load to 126 tons per pile. Each pile consists of a steel pipe 24 in. in outside diameter and having a ⅜-in. wall, filled with concrete reinforced as shown in Fig. 3. The cross-sectional area of each pile, including the steel shell, is 452 sq.in., of which 9.4 sq.in. is reinforcement. Assuming the ratio of moduli as 15, this is equivalent to 141 sq.in. of concrete, which, added in place of the area of steel, is 584 sq.in. of concrete or equivalent. This, it will be seen, takes no account of the steel shell except to include its cross-section as an equal area of concrete. Under the dead load of 97 tons per pile this gives a unit stress of 333 lb. per sq.in., which, increased by 30 per cent to provide for wind load, makes 432 lb. per sq.in.

The reinforcement consists of six bars, three of which are 1¼ in. square and three 1⅛ in. square placed as shown in Fig. 3, and surrounded by ⅜-in. round spiral hooping on a 9-in. pitch. This is held in place by three vertical spacers of 1¼ x 1¼ x ¼-in. angles notched for the hooping. Clips fastened to every bar and spaced 18 in. center to center keep the reinforcement centered in the piles and prevent its coming into contact with the steel shell. Hooping and reinforcing bars were securely wired together throughout, and the reinforcement was assembled in lengths of approximately 20 ft. Each of these lengths or "baskets" was connected to the next one by U-bolts on the square rods, each of which was lapped 3 ft. 9 in. Spacer angles were spliced with ⅜-in. bolts. Reinforcement and splices are shown in Fig 3..

As the l/r ratio of these piles is about 300, they were not expected to act as columns, but a study was made of the resistance that would be offered by the silt to their bending. This indicated that they might safely



31'
45'-3"
34'
This section of working platform to be placed after North Shaft Caisson is in position
3'-7½"
9@3'-4"
3'-7½"
North Caisson
50'-3"
37'-3"
12@3'-7"
51'-3"
CL North Tube
CL North Shaft
6'-9"
63'
CL South Shaft
CL South Tube
South Caisson
57'-3"
12"
This section of working platform to be placed after South Shaft Caisson is in position
34'

FIG. 1—PLAN OF SHAFTS AND WORKING PLATFORM

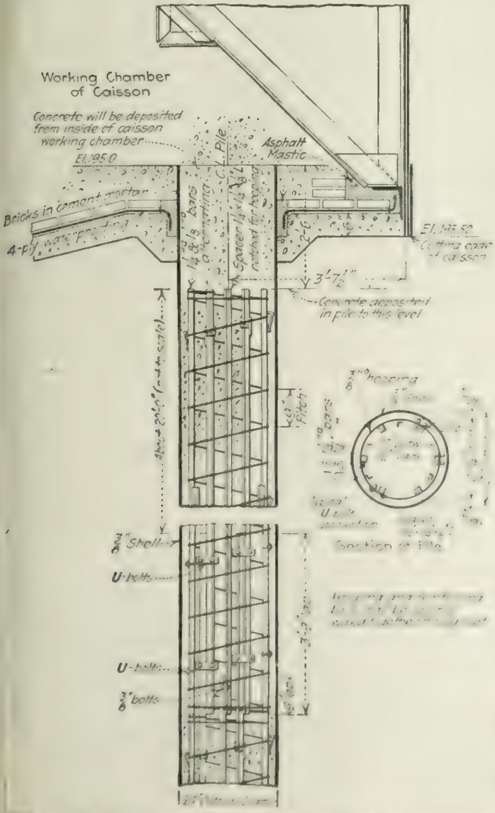


FIG. 3—PILE REINFORCEMENT AND SHAFT CONNECTION

be considered on the basis of their cross-sectional area without regard to their characteristics as to columns.

Construction—It will be seen that the installation of these piles involved unusual difficulties and that exceptional methods and special plant would be the rule. The problem involved, for each of the 42 piles, driving a 24-in. pipe through about 30 ft. of water and 220 ft. of bottom to a firm bearing on ledge rock, holding the pipe plumb while driving, placing the reinforcement and cutting it off at an elevation more than 100 ft. below the surface of the river, depositing the concrete up to that same level, and finally cutting off and removing the length of 24-in. pipe above that elevation. In the beginning experiments were made in depositing the concrete in the pipes under water, but results were not satisfactory and it was decided to unwater each pipe. This introduced a new requirement to the problem which not only necessitated the unwatering of the pipe but also made it possible to inspect the interior of each pipe before the reinforcement and concrete were placed. In effect each of these pipes constituted an open caisson rather than a pile in the usual acceptance of the term.

Operations were conducted from a platform built as shown in Fig. 4 at an elevation about 6 ft. above mean high water. In sinking each pipe three 20-ft. lengths of the 24-in. pipe were assembled and held in a vertical position by a derrick. The depth of water being about 30 ft., this brought the top of the second length just above the platform. The projecting 20-ft. length was then plumbed in both directions by the use of transit. Two 12 x 12-in. sticks, suitably notched out, bolted together, and laid horizontally on the deck of the platform as shown in Fig. 18, were used to clamp the pipe and to adjust it while it was being plumbed. When this had been done the sticks were fastened to the deck to serve as guides during the sinking of the pipe. As each 20-ft. length was sunk the next one added was plumbed by the same process.

Experiments conducted during the early stages of the work demonstrated that it would not be practicable

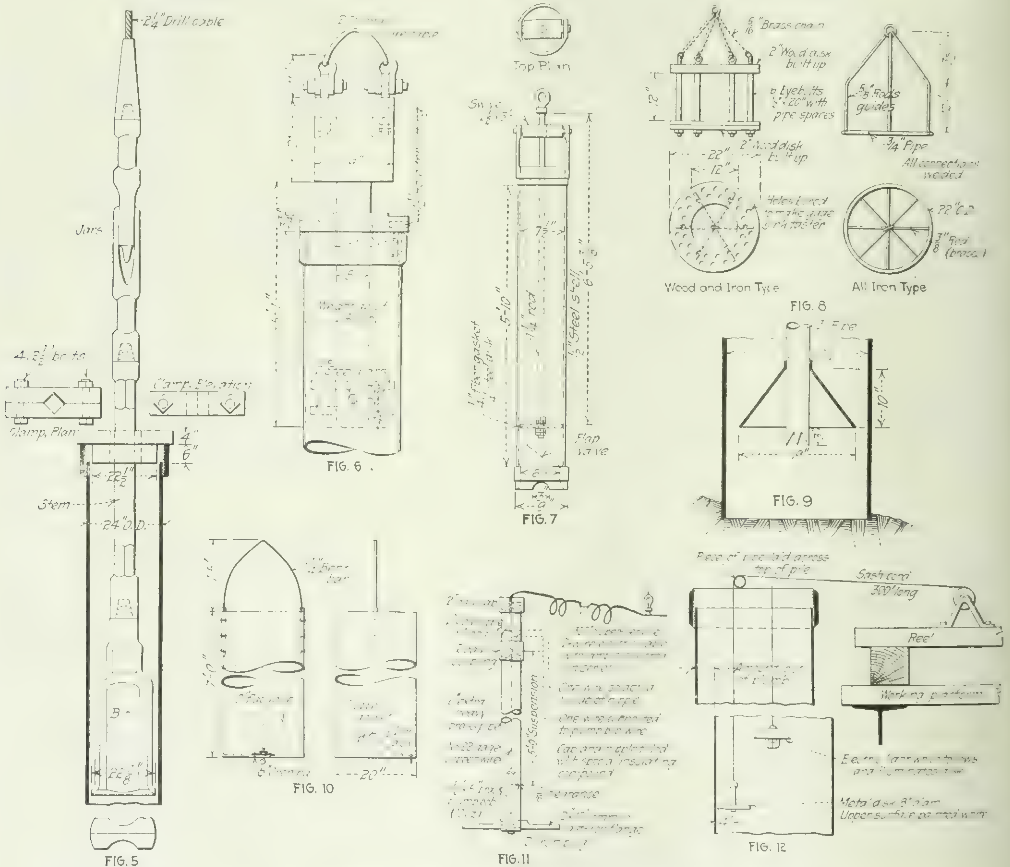


FIG. 5 FIG. 6 FIG. 7 FIG. 8 FIG. 9 FIG. 10 FIG. 11 FIG. 12

FIGS. 5 TO 12—SPECIAL EQUIPMENT USED IN SINKING 24-IN. PIPES

Fig. 5—String of well drilling tools showing clamp used.
Fig. 6—Hammer used to drive pipes.
Fig. 7—Bailer used in drilling ahead of pipes.
Fig. 8—Mandrels to test cross-section of pipes. The combination wood and metal type was found to work too slow and the all-metal type superseded it.
Fig. 9—Lower end of pipe used to clean out pile by jetting.
Fig. 10—Bailer used to unwater pipes.
Fig. 11—Plumbing device for use in pipe when filled with water.
Fig. 12—Plumbing device for use in pipe which has been unwatered.

to sink the pipes to so great a depth by power driving alone and that it would be exceedingly difficult, if not impossible, to insure their remaining plumb if an ordinary jet were employed. So recourse was had to well-drilling practice, by which the pipe or casing is sunk, length by length, into a hole that has been driven in advance to receive it. The drilling is done by a heavy cutting bit or "spud," which, with its string of accessory tools, is operated through the interior of the pipe already in place, the up-and-down motion being imparted by a machine at the surface operated on the walking-beam principle. As the soil is churned into suspension by this process, the drilling is stopped from time to time and the material raised to the surface in a bailer. A bit with its string of tools is shown in Fig. 5 and a bailer in Fig. 7. Three weights of bits were used on this work; 3,000-lb., 2,500-lb. and 2,000-lb. The 2,500-lb. bit was found to be most satisfactory for general use. Four machines were used on this work as shown in Fig. 17, two of them being No. 27 and two No. 23 Star Portables.

Whenever it becomes necessary to apply power to assist in the sinking of the pipe this usually is done by bolting to the string of tools a heavy steel clamp which is allowed to strike upon a flange or disc over the top of the pipe. The machine then operates as a driver, having a hammer effect equal to the total weight of the bit and tools. Such a clamp is shown in Figs. 5 and 18. In the beginning of this work this practice was followed, but it was found that the danger of accidentally dropping the tools down through the pipe was so imminent that driving was done by withdrawing the drilling tools altogether and using instead the 2,400-lb. hammer, shown in Fig. 6.

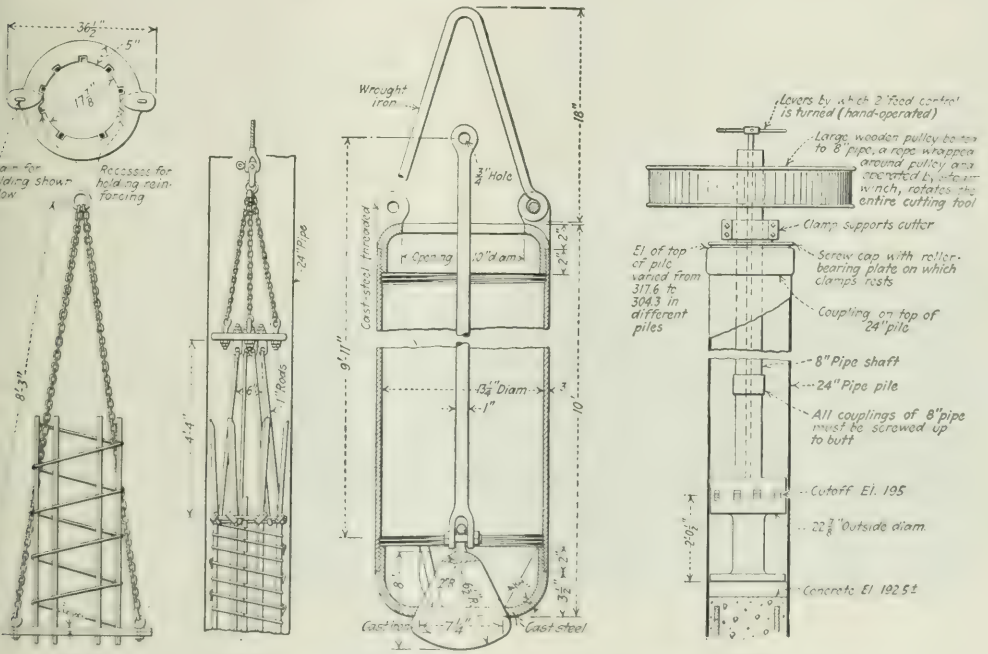

36½"
5"
17⅞
Chain for holding shown below
Recesses for holding reinforcing
8'3"
4'4"
6"
1" Rods
24" Pipe
Wrought iron
¾" Hole
18"
Cast-steel threaded
Opening
10" diam.
2¼"
2"
9'11"
1¾" Diam.
1"
3
10'
8
2.8
6.2
2"
3½"
Casting
7¼"
Cast steel
Levers by which 2 "feed control" is turned (hand-operated)
Large wooden pulley bolted to 8" pipe, a rope wrapped around pulley and operated by steam winch, rotates the entire cutting tool
Clamp supports cutter
El of top of pile varied from 317.6 to 304.3 in different piles
Screw cap with roller-bearing plate on which clamps rests
Coupling on top of 24" pile
8" Pipe shaft
24" Pipe pile
All couplings of 8" pipe must be screwed up to butt
Cutoff El. 195
22⅞" Outside diam.
2'0½"
Concrete El 192.5±

FIG. 13 FIG. 14 FIG. 15 FIG. 16

FIGS. 13 TO 16—SPECIAL EQUIPMENT USED FOR PLACING REINFORCEMENT AND CONCRETE

Fig. 13—Clamp for handling reinforcement.
Fig. 14—Hooks for lowering assembled reinforcement.
Fig. 15—Bucket for depositing concrete.
Fig. 16—Internal cutter for cutting off piles.

As the pipes were lowered it was found that the first three lengths, or 60 ft., would sink of their own weight to the level of the platform. The well-drilling machine then dug 20 ft. below the bottom of the lowest pipe by "spudding and bailing," after which another length of pipe was added at the top and the whole casing lowered 20 ft. The first four sections, 80 ft. of pipe, sank of their own weight in the hole thus prepared. The fifth, sixth, and seventh lengths and sometimes the eighth and ninth went down also without difficulty, sometimes under the weight of a 2,400-lb. hammer and sometimes with the assistance of a light tapping. The tenth section required driving and the eleventh, twelfth, and the thirteenth each went a litle harder, the thirteenth in some cases requiring very hard driving. When fragments of the ledge broken up by the spudding had been brought up in the bailer, the rock was further spudded just sufficiently to insure a level seating for the pipe.

It was found that within a few days after completion of the driving, 50 or 60 ft. of deposit formed at the bottom of each pipe due to settlement of the suspended silt that had been churned up by the spudding process. This deposit was taken out by spudding and bailing again before concreting was commenced. In order not to delay the work by withdrawing one of the four machines that were sinking the pipe a fifth machine of similar design but smaller size was installed to do this secondary cleaning.

Early in the work it was found that infinite pains were justified in preparing each length of pipe to avoid difficulty in coupling them to each other. The threads were ordered cut with ample clearance and collars having tapered threads were used to prevent damage during transportation and handling. When these collars were removed the threads were cleaned, first with a steam jet and then with a thread comb. If any threads were found to be burred or otherwise imperfect they were dressed by filing. The hammer struck directly on the upper coupling of each length rather than through a driving head screwed into the coupling. This was in accordance with ordinary oil-well drilling practice. After the organization was in good working order each of the four machines used sank one section of 20 ft. in 8 hr. or three lengths in 24 hr. The work was carried on continuously in three shifts.

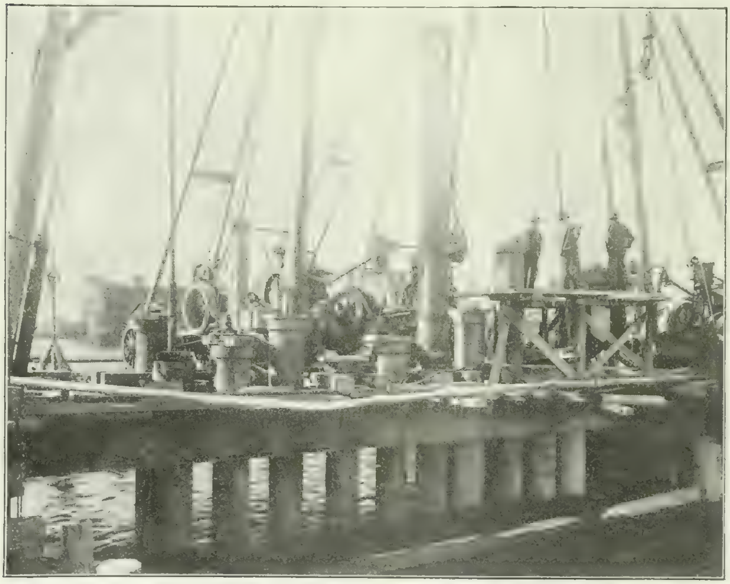


FIG. 17—GENERAL VIEW OF WELL-DRILLING PLANT

Here are shown the four well-drilling machines at work on the first row of piles. To the right of the center a length of pipe has just been added to one pile. Behind it is seen the pulsometer used for jetting the inside of the pipe to clean it. The machine to the left is set for driving a pipe, having a driving clamp fitted to its string of tools. A bailer is shown lashed to the under side of the boom.

After the sediment had been spudded and bailed the pipe was cleaned out by means of a water jet. This jetting was accomplished through a 3-in. wrought-iron pipe fitted at its lower end with an inverted funnel as shown in Fig. 9. Jetting was commenced with the bottom of the pipe about 20 ft. above the rock surface, the pipe then being gradually lowered to within 12 in. of the rock surface. Water pumped down through the 3-in. line by a No. 5 pulsometer pump rose outside of the funnel and was carried away over the top edge of the 24-in. pipe. When the bulk of the suspended matter had thus been carried off the process was reversed and water was pumped into the top of the large pipe by a 2-in. pump and withdrawn through the 3-in. pipe by means of the pulsometer. During this process the 3-in. pipe was lowered slowly until it rested on the rock. This entire cleaning process required from 5 to 6 hr. per pile, the actual pumping time being about 3 hr After the pulsometer began to discharge clean water the process was continued for about an hour, which was about the time required completely to change the water in a pile. A cage or mandrel was then lowered and raised in each pile to insure freedom from obstruction or deformation of the cross-section.

Concrete Bottom Seal—To unwater the pipes the bottom was first sealed with a plug of special concrete. All concrete was handled into the pile by a special 9-cu.ft. bucket, which is shown in Fig. 15. In forming the plug this bucket was charged first with 4½ cu.ft. of 2 : 3 mortar and 4½ cu.ft. of 1 : 1.6 : 3.2 concrete, which contained 25 per cent more cement than did the 1:2:4 specification concrete. Then followed two buckets of 1:1.6:3.2 concrete, the total of 27 cu.ft. forming the bottom plug. When this had been deposited it was allowed to set for at least ten days after which the water was bailed out by means of a bucket made of a 7-ft. length of 20-in. pipe with a flap valve at the lower end. When the water had been bailed to within 10 ft. of the concrete plug the top of the plug was spudded very lightly to loosen any laitance, which was then removed by bailing the remaining 10 ft. of water. The placing of each plug required about 20 to 30 min. and the bailing of the pile required about 2 hours.

Inspection of Interior of Pipe—Before the reinforcement was placed the interior of the pipe was inspected and tested for plumb driving. This was accomplished by the aid of a white disk, 8 in. in diameter, which was lowered at the end of a sash cord immediately below an electric lamp, the light of which was thrown by a reflector upon the top of the disk. This device, shown diagrammatically in Fig. 12, made it possible to observe the position of the disk all the way down the pipe and to note when it was just touching the pipe wall. Measurement from the upper edge of the pipe to the supporting cord indicated any variation from the vertical. Application of this test at 25-ft. intervals throughout the depth of each pipe showed no substantial variation from the vertical. Only four piles were out of plumb more than 12 in., or one half the diameter of the pipe; and one of these, which was 24 in. out, was the first pile sunk. One was 9½ in. out and one 8½ in., the remainder ranging from nothing to 7 in. off the vertical. This gratifying result is attributed in large measure to the practice of drilling the hole in advance for each 20-ft. length of pipe.

When the work was commenced and it was expected that the pipes would be completed without being unwatered, another device was prepared for this purpose.

This is shown in Fig. 11. It consisted of a 5-ft. length of 2-in. pipe having at its lower end a disk 10 in. in diameter. In the top of this 2-in. pipe was a waterproof plug, from the centre of which was suspended a plumb bob, and through which passed an electric wire connected with the plumb bob. Between this plumb bob and the inside walls of the pipe near its lower end was a clearance of $\frac{1}{16}$ in. all around. A wire was then led from the plumb-bob connection and another from the outside wall of the 2-in. pipe. These, together with the line from which the whole arrangement was hung, passed up through the 24-in. pipe to the working platform, where the wires were connected through an electric-light circuit to an electric lamp. It will be seen that so long as this apparatus hangs vertically the circuit will be incomplete, and the lamp will remain dark. If the device be tilted to one side sufficiently to bring the plumb bob in contact with the wall of the pipe the circuit will be completed and the lamp lighted. By this means it was possible to bring the edge of the 10-in. disk just touching the side of the pipe and by measuring the distance between the supporting line and the edge of the pipe at its upper end to detect any variation from the vertical. This device was used to plumb each pipe immediately after it was driven.

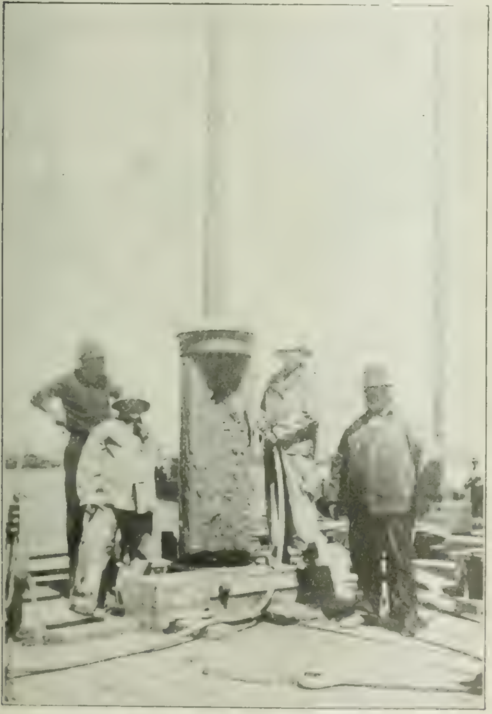


FIG. 18—WELL-DRILLING BIT

The bit has just been withdrawn from a pipe the top of which may be seen between the notched timbers by which it was plumbed and guided during driving. Behind the man to the right is seen the upper end of a string of tools in another pipe. The "jars" are just opposite the man's head and the clamp shown just below his elbow has been fitted to the stem so that the tools may be used as a hammer for driving the pipe in which they hang. Note that the clamp is absent from the tools that have been "spudding."

Placing of Reinforcement—As has been explained, the reinforcement was assembled into units or "baskets," each about 20 ft. long. A special clamp, shown in Fig. 13, was designed to grip each basket near its upper end. By this clamp the basket was lifted to position and held suspended from the top rim of the pipe, while the derrick swung the next length of basket to be attached. To facilitate this operation the clamp was applied just below the point at which would come the lower end of the splice. As each successive basket was added at the upper end the whole reinforcemnt was lowered, a careful tally being kept of the length that had been let down. The total length of reinforcement required for each particular pile was, of course, known in advance. As the upper end of the reinforcement in each pile must be at the elevation of the cutoff, more than 100 ft. below the level of the platform from which the work was handled, it usually was necessary to cut the upper length to fit, which was done by a blow flame. The reinforcement was lowered to position by means of an attachment shown in Fig. 14. This consisted of a heavy circular steel disk slightly smaller than the inside diameter of the pipe, and having on its top three eye-bolts from which it was suspended to the derrick line. Swinging from its under side were six hooks each about 1 ft. long attached by swivels on a circle of 6-in. diameter. When these hooks were engaged in the lift-

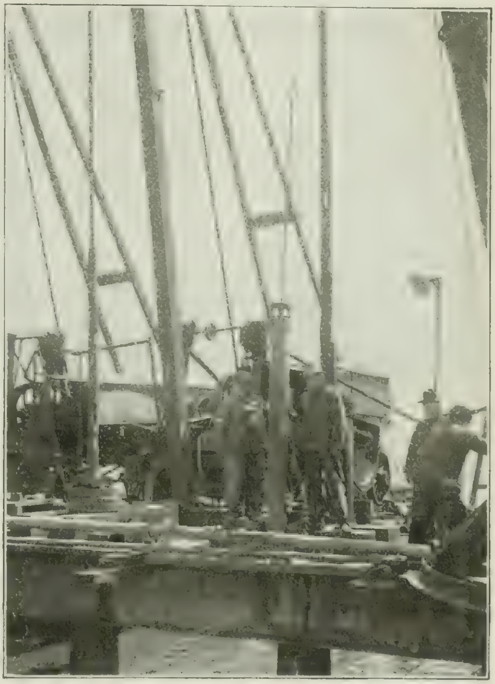


FIG. 19—BAILER USED IN DRILLING

After the silt has been churned up below the bottom of the pipe by the bit shown in Fig. 18, the material in suspension is removed through the pipe by means of this bailer. Near the left edge of the picture is seen a string of tools fitted with a driving clamp, while behind the right-hand man hang the tools that have been spudding for the pipe now being bailed. The flange through which the drilling line enters the top of the pipe is shown resting on the upper shoulder of the bit.

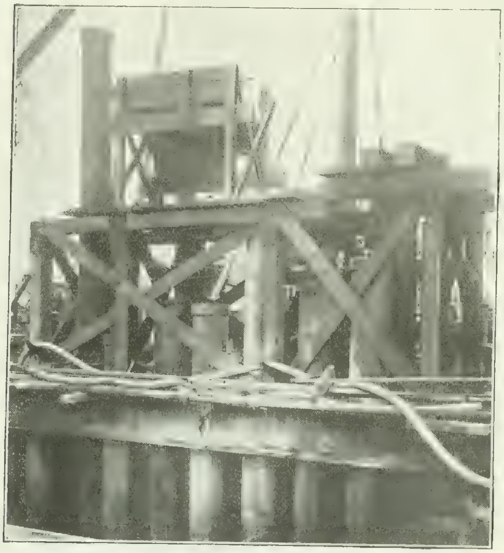


FIG. 20—PORTABLE CONCRETE BIN

ing rings of $\frac{3}{8}$-in. wire at the top of the reinforcement their lower ends were spread, as will be seen in the diagram. When the reinforcement had been lowered to position inside the casing and had come to bearing on the bottom the derrick line was slacked off just enough for the hooks to swing vertically into the center, thereby clearing the reinforcement, after which the disk was raised to the surface. The installation of the reinforcement in one pile required about 5 hr.

Depositing Concrete—Concrete was machine mixed on the working platform and was handled by derrick to a portable elevated bin or hopper shown in Fig. 20, from which it was drawn as needed for each pile into the depositing bucket. This is of special design and is shown in Fig. 15. It holds just enough concrete in one charge to fill 3 ft. of the pile. Because of the shape of its lower end and the design of the dumping gate, each time this bucket was lowered into the pile it penetrated into the surface of the concrete already deposited. This effected the discharge of the new concrete below the existing surface and reduced considerably the formation of laitance. The concrete was a 1:2:4 mixture using $\frac{3}{4}$-in. gravel as coarse aggregate. About $3\frac{1}{2}$ hr. were required to concrete a pile.

Cutting of Pipe—When concrete had been deposited to the cutoff level the pipe was cut off at El. 195 by means of an internal pipe-cutter of special design. This consisted of a cutting head as shown in Fig. 16 at the end of an 8-in. pipe. The extension and flange beneath it acted as a spacer to insure the cutter being kept at a constant elevation above the top of the concrete. A 2-in. pipe extending down inside the 8-in. pipe operated an expander in the cutter by which the cutting dies were fed outward as they penetrated the wall of the pipe. This cutter was at first operated by hand power at the end of an arm attached to the 8-in. pipe where it projected above the upper end of the pile. After the first few piles, however, steam power was used as shown in Fig. 16. It required about 6 hr. to set up the cutting plant, to cut a pipe, and then remove the plant.

After each pipe had been cut the upper section was withdrawn. To do this the pipe was capped by a wrought-iron cap and compressed air led into it. The upper section was then jarred loose by one of the well-drilling machines and by the air pressure inside the pipe.

Work on this foundation was begun on Aug. 1, 1922. At the present writing all the pipes except one have been driven, filled and cut off, and it is expected that all will have been cut off by Mar. 1. The average force employed has been about 35 men throughout 24 hours.

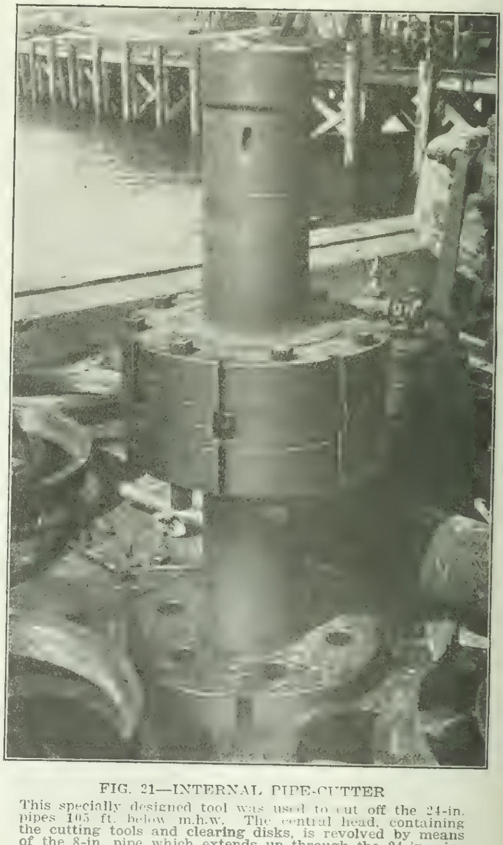


FIG. 21—INTERNAL PIPE-CUTTER

This specially designed tool was used to cut off the 24-in. pipes 105 ft. below m.h.w. The central head, containing the cutting tools and clearing disks, is revolved by means of the 8-in. pipe which extends up through the 24-in. pipe to the working platform.

Personnel—The work is being carried on under the supervision of the New York and New Jersey Bridge and Tunnel Commissions, Clifford M. Holland, chief engineer, Milton H. Freeman, engineer of construction, Miles I. Killmer, resident engineer on the work, and Ole Singstad, engineer of designs. Booth & Flinn, Ltd., are general contractors, for whom Leroy Tallman is general superintendent, Contract No. 4, and M. E. Chamberlain, chief engineer. The sinking of the piles was handled under subcontract by Sprague & Henwood of Scranton, Pa., N. R. Osborne, president. The tools and special equipment used in sinking the piles were designed and manufactured in the shop of the subcontractor.

Setting the Practical Limits of Terminal Unification

Analysis of the New York Port Terminals Problem to Determine a Reasonable Basis for Joint Terminal Facilities

By Frank R. Ford

Commissioner, the Port of New York Authority

Abstract of address delivered Sept. 21, 1922, before the Building Trades Employers' Association of Essex Co., N. J.

In December, 1921, the heads of the twelve standard railroads operating into New York sat on one side of a large table, in the Port Authority's office, and the six commissioners of the Port of New York Authority representing the states of New York and New Jersey sat on the other side, and unanimously agreed on the following as the first of nine fundamental principles needed for the port development: "Terminal operations within the Port District (New York) so far as economically practicable should be unified." As may be inferred from the language of this principle, there is a practical limit to the extent that terminal operations may be unified and it is of interest to determine just where this limit lies.

On the side of government, in order to lay down a comprehensive plan for economical port development, there have now been unified the several authorities of the federal government, of two states and, so far as desired by them, of 105 separate municipalities within the Port District. This unification is known as The Port of New York Authority, consisting of a commission of six members with officers and technical staff.

On the side of the railroads, terminal operations in certain places, including Chicago, St. Louis, Cleveland, Cincinnati, etc., have been unified as to the operation of certain facilities, including passenger stations, freight stations, warehouses, marine equipment, trucking, terminal bridges and belt lines. Under the stress of war, these and other railroad facilities were almost universally pooled by the U. S. Railroad Administration to increase efficiency, capacity and speed of operation.

The terminal problem in New York has become exceedingly complicated because of there being twelve standard railroads entering the Port District, in the main separately owned and operated, and each having its separate terminals, freight stations and port development. If these railroads were in one ownership and operation, there would be few problems except those of finance and design. This is exemplified in Brooklyn and Long Island where the Long Island R.R. is sole owner and operator. Another reason for the past delay in unification of rail terminals in and around New York is the wonderful system of inland waterways comprising its harbor, which form with the use of railroad car floats a "water belt line" that enables each railroad to reach all important parts of the Port District. But with increasing costs of operation, and with the need of deep-sea shipping for the waterfront in congested parts of the harbor, such as Manhattan and Jersey City, the time has come to augment this "water belt" delivery with facilities possessing greater efficiency and speed of operation.

Such improved facilities should include for Manhattan, freight operation by tunnel lines to freight stations and warehouses located away from the waterfront. All parts of New Jersey, Long Island and the Bronx within the Port District should be joined by standard belt line railroads connecting with all rail lines entering New York. The east and west sides of the port should also be joined by a freight tunnel line which the Port Authority has located under the Upper Bay between Greenville and Bay Ridge. Each railroad by itself would not be able to finance the large capital expenditures required for a separate modern freight terminal system of this character, nor would the limit of space in the congested areas and the necessity for enlarged capacities for future operations permit of more than one system of this character which therefore must be jointly used.

The railroads have in the past generation spent enormous sums upon new and extended passenger facilities and terminals in and around New York, and have improved their main-line tracks to a point of high efficiency, but during this period they have spent comparatively little on freight terminals in this section. Passenger traffic after all may be considered as a by-product of the commercial activity of a community which is represented by its freight traffic, and it is to care for the future growth of the freight terminal facilities that the Port Authority was created. When the railroad freight service breaks down, it occurs at the terminals and results in an embargo. In recent times of business activity this has occurred frequently in this port.

It is to remedy these antiquated, inadequate and separated port facilities that the plans of the Port Authority have been prepared. The need exists. The Port Authority has prepared physical plans as well as plans for financing and operation, and if the railroads do not consider them the best plans, they should present something better. The present Transportation Act maintains generally the competitive principle for railroad operations, but recognizes that in certain cases unified terminal operation is desirable and may be enforced by the Interstate Commerce Commission. Unification is most necessary in large metropolitan areas such as the Port of New York District where congestion is greatest, where construction costs are at a maximum and where the greatest need exists for expediting freight movement, for reducing terminal costs of operation and for enlarging terminal capacities for the future.

Now what is the practical limit for terminal unification? In the Port of New York District I believe this limit should include the following classes of service:

I. Joint services such as; (a) Interchange between railroads, or (b) Movement completely through the terminal area. This joint service should be provided by belt lines such as the inner, middle and outer belt lines of the comprehensive plan of the Port Authority, which would provide modern efficient facilities for these movements.

II. Service in congested areas such as Manhattan Island where there is; (a) Not sufficient physical area for separate service, or where (b) Separate terminals would involve too great expense for each company. This condition is provided for by the automatic electric system devised by the former bi-state Port Commission and adopted with modifications in the plan of the Port Authority.

III. Service requiring comprehensive deliveries over the entire Port District where use of equipment in joint operation would much cheapen the expense and facilitate the service. This service should include marine equipment such as tugs, lighters and car floats, and should include also store-door deliveries by a modern system of motor trucks.

IV. Service involving contact with great ship terminals with their attendant warehouses and industrial developments. These great terminals would include municipal terminal developments such as Port Newark, and private terminals such as the Bush Terminal which should not be served merely by one or two railroads.

The present freight terminals in the Port District are in many parts inefficient and antiquated and probably return directly to the railroad companies much less than a reasonable income. It is believed that in addition to reducing the already high terminal costs now paid by the public, unification to the extent outlined above would also produce an enlarged return upon the present railroad investment.

Under the Port Authority law of the states of New York and New Jersey as approved by the federal Congress, the Port of New York Authority has the right to own, construct and operate these terminal facilities or to lease them to an operating company under the supervision of the Port Authority. The securities to be issued by the Port Authority will be tax exempt but not guaranteed by either state, and hence will entail no charge on the taxpayers. The facilities constructed must by their economic savings provide for the interest on these securities. Consequently I believe that the Port Authority is in position to be of immediate and large help in the reorganization and reconstruction of these facilities and that they will result in a decrease in living costs both to the public and to the railroads.

Traveling Crane Has Turntable to Swing Locomotives

Engines Transferred from Longitudinal Shop Track to Transverse Track by Rotating Hoist on Trolley of Crane

AN OVERHEAD traveling crane which can revolve or turn a locomotive as well as carry it from place to place is a novel type of equipment installed recently in the River Rouge repair shop of the Detroit, Toledo & Ironton Ry. at Detroit, Mich. This crane, shown in Fig. 1, has a span of 56 ft. and a hoisting capacity of 100 tons.

In the layout of the shop, a longitudinal through track at one side, on which the engines enter and leave, serves transverse repair tracks and pits, so that it is necessary to swing each engine through a right-angle turn in transferring it to and from the repair track. This movement was effected formerly by the use of two traveling cranes, each with a single trolley, but the work was slow and inconvenient, since the two cranes were independent units and great care was necessary to operate them in unison when handling a locomotive.

To facilitate these transfer movements the new crane was designed, having its single hoisting trolley equipped with a turntable, so that the crane can perform four independent operations: (1) Hoisting, (2) longitudinal travel, (3) transverse travel, and (4) horizontal rotation. With this combination the crane can pick up a locomotive on the through track, carry it along the shop to the specified repair track, transfer it to the repair pit and finally lower it upon the repair track. A special advantage claimed is that the engine need not be raised high enough to pass over other engines, but need be raised only clear of the rails. The installation of this crane was much simpler than the provision of an outdoor transfer table to serve the repair tracks, besides which the pit for such a table would have taken up considerable yard space already required for other purposes.

The swinging operation of the traveling crane is effected by special construction of the hoisting trolley, which consists of two parts, as shown by the drawing, Fig. 2. The upper frame carries only the hoisting mechanism and has on its underside a combination ring gear and roller path. The lower frame, which is mounted on wheels on the crane bridge, has a set of conical rollers supporting the roller path and has also horizontal guide wheels to hold this path and the upper frame in position. On the lower frame are mounted two

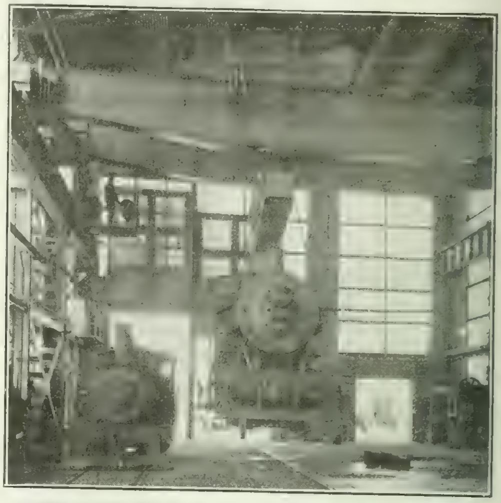


FIG. 1—TRAVELING CRANE TURNS LOCOMOTIVES

The hoisting drum is on a turntable on the traversing trolley and has two rope falls carrying a swing beam from which the engine is suspended by slings.

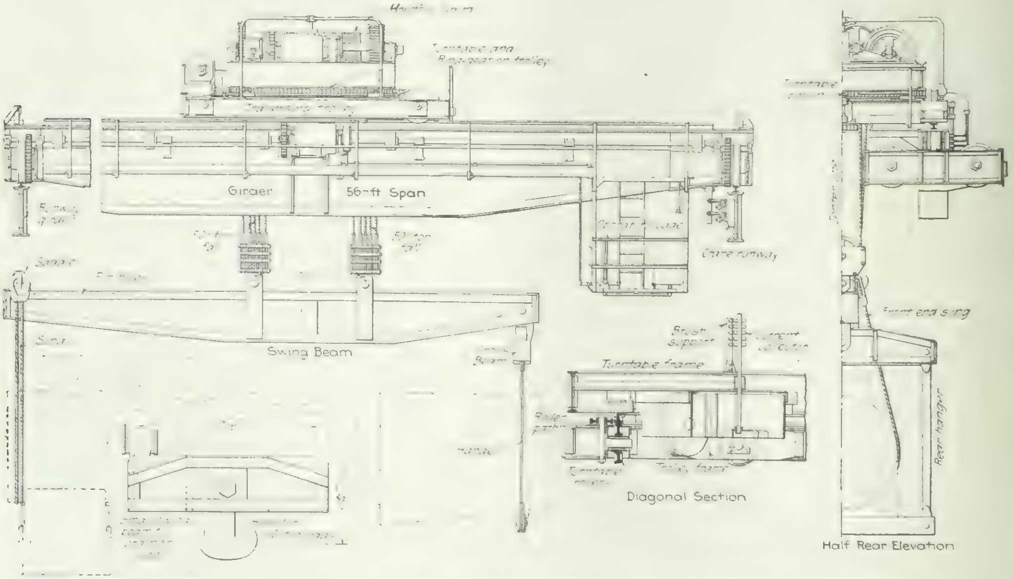


FIG. 2—TRAVELING CRANE WITH TURNTABLE HOIST MOUNTED ON TRAVERSING TROLLEY

motor-driven mechanisms for swinging and cross travel. The former drives a pinion engaging the ring gear of the upper frame. A complete revolution can be made in one minute, but in ordinary shop work only a half revolution is required for each movement. The crane bridge is of practically standard construction.

A long hoisting drum on the trolley carries two 50-ton rope falls spaced 7 ft. c. to c. and carrying a swing beam 34 ft. long. Adjustable slings on this beam provide for handling engines of different lengths. At one end of the beam is a pivoted transverse member with hangers to engage a cross beam placed under the engine frame, or under the firebox if a boiler is being handled. This rear sling has two positions of adjustment. A traversing saddle on the other end of the swing beam has two heavy horns for cable slings which engage the engine frames or the front end of the boiler. When this saddle is shifted to the desired position it is secured by a bolt through the swing beam. Since the two falls are on one drum the hoist operates as a unit. Provision can be made for an auxiliary hoist of smaller capacity, but such an attachment is not considered desirable on account of the possibility of its load interfering with the lifting beam. For other work than handling locomotives the long swing beam can be detached from the fall blocks and replaced by a 7½-ft. beam with a single 100-ton sister-hook (Fig. 2).

This combined revolving and traveling crane was designed and built by the Shaw Crane Works (Muskegon, Mich.) of Manning, Maxwell & Moore, Inc., New York, N. Y.

Cracks in Concrete Reservoir Forced by Icing Process

Ice and Salt Spread on Floor Hastened Cracking and Gave Opportunity to Forestall Leakage and Foundation Damage

A CONCRETE lined reservoir for storing part of the water supply of a small Western city was recently built during the summer months when temperatures were rather high. After the reservoir was finished and had stood empty for 60 days, about 60 lineal ft. of cracks appeared at construction joints in the floor. A few weeks later, with the reservoir roofed over and the concrete in the floor somewhat cooler, more cracks appeared until their total length was over 1,000 feet.

It was then decided that all the cracking that would be likely to occur should be made to develop quickly if possible so the cracks could be filled with waterproof compound and thus prevent the damage to reservoir foundation and the loss of water by leakage that could be expected if the cracks did not develop until after the reservoir was in service. In fact, the most extensive cracking was not thought likely to occur, if the reservoir were left to take its natural course, until the lowest temperatures of water were reached, which would be sometime during the winter when the reservoir would be full, of course. The ice treatment, described herein, within a few hours and at a very small cost, showed the exact location of 600 lineal feet of cracks in addition to the 1,000 ft. already mentioned. All the cracks were then cut open so they could be made watertight and after a thorough waterproofing job the reservoir was put in service with much more confidence as to its future performance than would otherwise have been possible.

The reservoir is circular in plan, 160 ft. in diameter, has vertical side walls 18 ft. high and is covered by a roof supported on columns extending up from the reservoir floor. The floor slab is 6 in. thick and was cast without any expansion joints.

A ton and a half of ice was brought to the reservoir, delivered to the highest point on the reservoir floor and broken up with a sledge hammer into pieces not exceeding about 6 in. in maximum dimension. The cracked ice was spread over the entire floor area with a coarse-bristle broom that would spread the cold water as well as the ice itself. A total of 250 lb. of rock salt was sprinkled over the broken ice as the spreading was being done. About 500 lb. of ice was broken up at a time and spread over an area of 500 or 600 sq.ft. After the ice had remained on this area for an hour or so inspectors brushed the surface clean and looked for cracks. Some of the cracks developed by this process were ⅛ in. wide. All cracks were marked their full length with white chalk.

SPREADING CRACKED ICE ON RESERVOIR FLOOR

The ice arrived at 11 a.m., was broken up and spread by one man and by 3 p.m. the 600 ft. of new cracks had been located and marked with chalk. The cost of ice, salt and labor was less than $20. Due to the heat of the surrounding air and concrete, the cracks which opened under the icing process all closed again within a few hours and were then not visible even with the aid of a microscope.

After the ice had all melted and had flowed out through the reservoir drain, a few hours were allowed for the floor to dry out thoroughly and then all cracks were treated with a special carbon mastic. Before applying the compound all cracks were first opened up with chisel to afford a V-shaped joint that would give the compound an opportunity to make an effective water seal in the cracks. When such work is done under cool or damp weather conditions, gasoline is ordinarily burned on the concrete to remove the moisture as most waterproofing compounds require a dry surface. On this job, however, due to the hot weather, the surface was dry enough for waterproofing in a few hours. The chiseling open of all cracks and finishing the entire surface with waterproof paint cost about $1,000.

Because the cold water temperature in winter will never be as low as that to which the pavement was subjected by the ice and salt, it is believed that no further contraction cracks will develop in the floor slab.

The repair of the reservoir was carried out by the Waterproof Paint Co. of Lankershim, Cal.

Water Consumption in New Jersey Declines

The average daily per capita water consumption in New Jersey was 114 gal. in 1914, 117 in 1918 and 109 in 1921, according to records compiled by the Water Resources Branch of the State Department of Conservation. H. T. Critchlow, hydraulic engineer, says the decline is due mainly to the increased use of meters. The population supplied in 1921 was about 2,950,000 and the volume 321,880,000 gal. daily.

The Present Status of Sewage Treatment in England—II

Impressions Based on Visits to Various Works and Interviews with British Specialists in January, 1923, Presented with a View to Current American Problems

By George W. Fuller
Consulting Engineer, New York City

Mr. Fuller's first article, published Feb. 1, p. 206, dealt with Administration and Public Policy Questions. The final article will be on The Outlook for the Activated-Sludge Process. In the present article Mr. Fuller shows that small detritus tanks, rather than the American type of low-velocity grit channels, are used in England, as also mechanically-cleaned racks rather than fine screens; that chemical precipitation is a thing of the past and that plain sedimentation and flow-equalization tanks rather than septic tanks are generally used, with separate sludge digestion as a notable feature of the Birmingham works; and that contact beds have lost the standing they had ten to twenty years ago, giving place to sprinkler beds, the latter being supplemented with humus tanks of larger capacity than at the outset.—Editor.

Status of Older Types of Treatment

THESE comments are directed toward certain basic principles. No pretense is made of dealing with numerous interesting details which might elucidate some of the English experiences, but which on the whole would probably obscure the vision in arriving at various ratings for certain types of works that are described at length in numerous local reports and set forth in various aspects in the reports of the late Royal Commission on Sewage Disposal. Such details, furthermore, would be beyond the scope of these notes in which it is sought only to record some of the outstanding experiences from practical operations on a sizeable scale.

At the outset the attention of the reader should be directed to the fact that practically all sewerage systems in England are built on the combined plan and that the dry-weather-flow (d.w.f.) usually ranges from 30 to 50 U. S. gal. per capita per 24 hours. During storms the authorities require that flows up to 3 × d.w.f. shall be treated as sewage and that flows from 3 to 6 × d.w.f. shall be treated as storm water.

Composition—The composition of the sewage in many English cities is materially influenced by the trade wastes which enter the sewers. The influence of this factor naturally varies greatly, as would be expected from the prevalence of different types of industries at different cities, such as cotton cloth mills at Manchester; wool scouring establishments at Bradford; woolen cloth mills at Leeds; steel mills at Sheffield; iron-working plants at Birmingham; and pottery works at Stoke. It is not easy to say how these wastes, varying greatly with different stages of industrial activity, influence the quantity or texture of the sludge or the readiness with which it is deposited as the sewage flows through the tanks. Neither is it known just how these wastes influence the separation of colloidal matters or the decomposition of organic matters or the formation of non-odorous compounds with the sulphur which in some form is bound to be released as bacterial processes effect the breaking down of organic substances into simpler forms. As to bacteria, it is probable that bactericidal influences are encountered in some instances, but it is remarkable how nature provides that bacterial processes can establish themselves on a regimen that is hard to upset. Gas-house wastes and strong acids sometimes prove bothersome but on the whole the bacteria play their part in the economy of nature surprisingly well.

Comparison of experiences with treatment works dealing with strictly domestic sewage and those receiving trade wastes as well indicates that, apart from the question of cost, the advantage is usually with the latter, at least so far as aerial nuisance is concerned.

Detritus Tanks—The English seldom use grit chambers, as is the case in America, where the mineral matter is separated in a series of channels at a velocity of 8 to 12 in. per second during a flow of from 60 to 100 ft. Instead, they install tanks holding 1/100 to 1/12 d.w.f. with little or no regard to velocity through them. The purpose is to deposit the bulk of the coarser solids where they can be readily and frequently removed by grab buckets or otherwise, without disturbing the regimen of the main tanks, or increasing the cost of sludging the latter. This program is negotiable in England where all sludge is ordinarily disposed of by barging to sea, pressing, lagooning or trenching on land. But these tanks afford a much greater clarification for the effluent of the detritus tanks than is the case with grit chamber effluents in America. Here is a factor which lessens to a substantial extent the apparent difference between the suspended matter in English and American sewages, due to different volumes of sewage per capita.

Screens—None of the so-called fine screens found in America and on the Continent of Europe were noted in England where are used only stationary bars, cleaned by moving rakes and brushes. The new plant at Leeds has screens with a ⅝-in. clear space.

Chemical Precipitation—So far as known chemicals are not used at any works to promote the deposition of solids in town sewage. During the war precipitants were not procurable. Now their benefits are not considered commensurate with their cost. At Bradford use is made of sulphuric acid to crack the grease entering the sewage from wool scouring works. This is a flotation rather than a precipitation process. Garfield says that he tried SO_2 about twenty years ago but adheres to the use of acid because it is more controllable, although somewhat more expensive.

Sedimentation Tanks—The effluent of detritus tanks is subjected to plain sedimentation in open tanks with floors having a slope of about 1 per cent. Sizes vary but several good recent designs show the capacity to be 15 to 18 hours in times of dry-weather flow, thus providing 5 to 6 hours for the storm sewage of 3 × d.w. flow.

Equalization Tanks—Storm flows from 3 to 6 × d.w.f. are treated as storm water. Local practice varies. In some cases in addition to storm-water tanks and filter beds there are quite large tanks in which storm flow is stored for later application to the regular sewage beds. Surplus tankage from the days of septic tanks seems to be used at some places for these "equalization tanks." Full knowledge of sedimentation at English works calls for capacities of detritus tanks, sedimentation tanks and equalization tanks, and also a record of just how the several tanks are operated during dry-weather and wet-weather periods.

Septic Tanks—At only a few large works do tanks seem to be employed as formerly to serve jointly the purposes of clarification of the sewage and the digestion of the sludge. The open septic tank seems to have largely disappeared, partly because of air nuisance and partly because the managers desire a more uniform, convenient and economical program for sludge removal than is permitted by such tank operation. No new projects contemplate septic tanks so far as known. At Manchester some scum appears on the tanks during the summer as a feature incident to a convenient program for removing the sludge and barging it to sea. On the other hand Watson at Birmingham takes unusual care in summer to clean his sedimentation tanks about once a week and free them of all putrefying deposit that might so seed the sludge later to be deposited in them.

Two-Story Tanks—I saw no signs of any new installations of either Travis or Imhoff tanks, of which there were three or four installations each prior to the war. They seem to be regarded as expensive in comparison with single-story tanks, and not very adaptable to storm-water requirements. The Imhoff tank at the Withington works of Manchester is an efficient clarifying arrangement but produced much foaming at first and at intervals during its eight or nine years of service. The surface of the scum in the vents on Jan. 2 was about 30 in. above the flow line in the sedimentation chamber. Drying beds handle the digested sludge satisfactorily with about 1.5 sq.ft. per person served by them.

Separate Sludge Digestion—Probably the most impressive performance in satisfactorily handling the sludge of a large inland city is found at the Birmingham works where for over ten years Watson has operated his vast separate digestion tanks. These are rectangular, about 400 ft. long, 15 ft. deep, built of ashes, and lined with precast concrete slabs 2 in. thick. They are in two groups, one near the plain sedimentation tanks at Saltley and the other near Minworth where the sprinkler beds and humus tanks are located. There are two sets of pipes connecting each tank or basin with the neighboring pumping station. As undigested sludge is pumped into each tank great care is taken also to pump into the same 15-in. inlet pipe well digested sludge for seeding. In the tanks septic action causes a heavy scum to appear with clear water intermediate between it and the sludge at the bottom. It is the intent to have the sludge remain 2½ months in one tank when the contents are completely removed to a second where the digestion period is also 2½ months, making a total period of 5 months. The secondary tanks are at Minworth where the sludge from the humus tanks is daily discharged to the digestion tanks. The sludge from a million people is dried on 50 acres of ash beds, filled 3 or 4 times per year to a depth of 18 in. This is removed as a layer about 6 in. thick of air-dried sludge with a water content frequently as low as 35 to 40 per cent. As soon as the sludge layer is dry enough to walk upon a shovel hole is dug every 5 ft or so in each direction to let rain water disappear. In this way each year some 400,000 tons of wet sludge is reduced without odor nuisance at either tanks or drying beds to some 35,000 tons of about 40 per cent air-dried sludge, having an organic nitrogen content of 1.5 to 2.5 per cent, dry basis. Watson sells this for 3½ shillings per ton as a fertilizer filler. A recent contract for a small quantity is for 5 shillings per ton. (Unless otherwise stated long tons of 2,240 lb. are indicated throughout this article.)

Sludge Barging—Barging to sea is still the method of sludge disposal in use at London, Manchester and Salford. The annual costs at the Davyhulme plant at Manchester last year were about £33,670 for sending to sea 203,206 tons of wet sludge.

Sludge Lagooning—This is practically an uncontrolled arrangement for separate sludge digestion—which I found Watson had been using in 1912. It is now being used by Bolton at Bury with satisfaction other than for disturbances formerly encountered at intervals from heavy accidental discharges of black ash from chemical works. Compared with the present Birmingham program its principal disadvantage is the absence of seeding all entering sludge with proper kinds of bacteria. Further, when an area is completely filled it is necessary to move to another location, unless the expense of removing wet sludge is met. Against these disadvantages of lagooning are questions of economy, when compared with the present Birmingham program.

Sludge Trenching—This is a well-known method which I found in use at the Withington works, Manchester. Sludge is applied to trenches dug by hand 3 ft. wide and 18 in. deep and is covered with the aid of a plow. Unless the soil is fairly porous the drying period is quite long and the required area is larger.

Sludge Pressing—Makepeace is pressing a mixture of sludge from all his tanks at Tunsall and Hanley. When the activated-sludge plant at the latter place goes into service he will deliver the surplus sludge to the inlet of his detritus tank which holds two hours flow, dry-weather basis. The mixed sludge will be pressed. At the new works at Leeds, Hart will press a mixture of sludge from the primary sedimentation tanks and his humus tanks following sprinkler beds. This primary sludge here does not press as well as formerly, due to the shutting down of discharges of lime and ferric chloride, thus probably requiring at times the addition at the press house of both lime and iron. The sludge cake will be used as formerly in filling low land. After thorough drying there is a limited market for the sludge on land needing lime. Screenings are sold to rhubarb growers.

Sludge Utilization—The outstanding experience in England in this field is that of Garfield at Bradford. During the war he sold annually about £150,000 sterling of grease, of which sum perhaps £50,000 was net. Now the market is poor but he is producing 20 to 25 tons daily of 98 per cent grease which in limited quantities can be sold for £8 10s per ton. This is nearly down to pre-war prices, although labor and supplies for production are nearly double. Before the war he was selling much pressed sludge cake with about 2 per cent nitrogen content to France, but transportation charges have killed that enterprise. I was interested to note that he was running his own boiler plant with dried sludge cake and melted grease. To crack the sewage and get the grease to rise to the surface of the flotation tanks he adds sulphuric acid in quantities to show an excess of acid to methyl orange indicator of 80 to 120 p.p.m. This figure varies a good deal with the different volumes of sewage flow and of wool scouring wastes in it. The judgment of the trained attendants as to "cracking reaction" seems to be guided more by observation than by the results of chemical tests, which do not seem to be enhanced by observations of the PH point.

Contact Beds—These beds are not entitled to the standing which they had twenty or even ten years ago. The reasons are that their total cost is too much for the work done and that they are relatively unadaptable to increased loadings at times of storm flows. They have suffered from containing too much fine material but it is doubtful if for large plants their adoption is ordinarily warranted in the light of present knowledge, even if by their use pumping is avoided, when compared with other types. Some contact beds are being cleaned for the third or fourth time, and in some instances are being converted into sprinkler beds, as at Bury. Cleaning operations are influenced somewhat by the unemployment question, but are being fairly held at a minimum at Sheffield, pending the construction of activated-sludge plants, and at Manchester, where the latter method is being actively investigated with two units in service and a third unit now building. Where such a shift in type of plant is made, it is on the basis that it is cheaper to install the activated-sludge method than to recondition the contact beds. I saw no signs of use of the American custom of installing contact beds for small residential communities or institutions, whereby beds are built of 1 to 2-in. stone, filled through open-jointed tile lines laid beneath the surface of the stone, and followed by humus tanks and sand beds.

Sprinkler Beds—These beds, variously called percolating or trickling filters, have shown an excellent record in England. The beds of coarser material have shown no signs of serious clogging and those of fine material have a better record than contact beds. During storm flow the English sprinkler beds seem to work satisfactorily at double the dry-weather flow or double the maximum daily rate of dry-weather flow. Flies have seldom proved bothersome and are said at Birmingham to be controllable by emptying the influent pipe system and applying a single dose of chloride of lime solution. Beds of fine material do not have fly complications and do not require any following humus tanks. Against this are the costs of raking and scraping fine beds and their ultimate removal and washing. During hot weather objectionable odors have been noted in the vicinity of several works of this type and this has been a factor in the abandonment of septic tanks and in the adoption of methods of preliminary treatment whereby the sewage is sent to the beds in as fresh a condition as practicable. While spray jets have not been given up, it is noteworthy that traveling distributors are being installed at most of the new works. In some instances, as at Leeds, this is said to be due to cheaper cost. At Birmingham I understand that work will soon be started on an activated-sludge plant to be installed at Minworth to treat the influent of the sprinkler beds. This is to remove colloidal matters and put the filter influent on an oxidizing basis at all times. The aerating tanks will hold about one hour's dry-weather flow. The Minworth filling beds are 43 acres in area, 6 ft. deep, of material 1 to 2 in. in size. They serve a population of about 850,000, a loading of 3,300 persons per acre-foot.

Sprinkler beds are a part of the two largest sewage-works now under construction. At Leeds, Hart is building 30 acres of 6-ft. beds, with the stone or gravel screened to between 1 and 3 in., to serve about 500,000 population, the sewage from which is highly charged with trade wastes. Garfield has recently started to build 60 acres of sprinkler beds for Bradford, 6 ft. deep, of fine coal, say ⅛ to ¼ in. The beds will clog sooner or later but instead of washing the clogged coal he proposes to remove and burn it, restoring the beds with new coal. He is thus developing a coal storage project, which is not without its advantages in a large industrial center. As a foolproof arrangement the sprinkler bed is entitled to the highest rating.

Humus Tanks—These tanks are being built somewhat larger than formerly and more effort is made to check quickly the inlet velocity. They are mostly of the Dortmund type, with hopper bottoms and peripheral outlet weirs. The slopes usually range from 50 to 60 deg. Vertical velocities are to be kept at less than 8 ft. per hour at maximum rate of flow. The Leeds tanks will contain 6 hours d.w.f. and the aim is to provide a detention period of two hours during maximum flows at times of storm. Sludge is ordinarily removed daily.

Land Treatment—Not much is heard of land treatment for the main flow of sewage, as distinguished from sludge, although some of the older engineers still adhere to the earlier view that ample land areas do much towards stabilizing at times the performance of sewage-works. On the other hand, when land is overdosed and it becomes "sewage sick" real nuisances are produced. This is said to have been the experience of the sewage farm at Withington and it is understood that similar experiences were had at Aldershot where army activities greatly overtaxed local facilities. Mention has already been made of applying sludge to land in trenches or in lagoons and more will be said in connection with the activated-sludge process.

In passing mention may be made of the use of artificially prepared land at Chester on which a part of the excess flow of sewage was found to be applied. About five acres of a refuse dump some 6 or 7 ft. deep have been arranged as intermittent filter beds to which settled sewage is said to be applied in doses of about 75,000 gal. per acre. (Unless otherwise stated Imperial gallons are used throughout this article.)

A Peculiar Reinforced-Concrete Building Failure

An unusual cause of failure of a reinforced-concrete building under construction at Hersfeld, Germany, is reported in *Beton und Eisen*. The structure was a two-story factory building, with columns, floors and roof of reinforced concrete. The entire reinforced-concrete work had been completed, and on the day of the accident the forms were stripped. While the concrete was setting, with no men on the job, an iron erector working on an adjoining building attached to the base of one of the column forms the tackle for lifting up some 70-ft. steel roof trusses. The horizontal pull of this tackle on the form while the concrete was green destroyed the integrity of the column, it is believed. When the forms were removed there was a large diagonal crack in the column near the base, and an hour later the structure collapsed, killing five workmen.

Street Intersections Mapped Out by Means of Contours

Contour Diagrams Explained—Working Out Grades at Intersections—Example Illustrating Difficult Grade Combination

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An UNDERSTANDING of roadway shapes is helped by making contour diagrams. Fig. 1 illustrates four cases: two with curbs at equal elevations, one case having a longitudinal grade, the other none; and the remaining two with curbs at unequal elevations, one case with and the other without longitudinal grade.

Surface drainage flows to the gutters along lines normal to the contours, and the slopes along these lines are combinations of the longitudinal and transverse grades. This is the reason that the transverse grade should decrease as the longitudinal grade increases, otherwise unreasonably steep slopes toward the gutter are introduced. A roadway on a longitudinal grade corresponds to a topographical ridge and the contours are always convex down hill. Contours convex uphill outline valleys and are met with only at roadway intersections. Even there, except in the vicinity of catch basins, every effort should be made so to merge the roadway surfaces as to introduce as few contours, convex uphill, as possible.

After a little experience intersections can be mapped out quickly and successfully by means of contours. One inch equals ten feet is a good scale for an intersection plan since then an engineer's scale may be used in laying off contour intervals along the gutter and other grade lines. For instance, with a 6 per cent slope and 0.1 ft. vertical interval, the sixty parts to the inch scale reads to hundredths of a foot in elevation, and a space of ten-sixtieths on the scale represents the contour spacing. Similarly a space of twenty-fiftieths on the fifty parts to the inch scale represents the contour spacing for a V.I. of 0.1 ft. on a 2.5 per cent slope; and the engineer's scale in like manner has a wide application. Scales for slopes, for which the engineer's scale cannot be used, can be provided by using cross-section paper with ten divisions to the inch. The spacing of the horizontal lines on the paper may be assumed to be 0.1 ft. For example, if a 2.3 per cent slope is drawn, the abscissas of the points of intersection of this slope with the horizontal lines give the contour spacing.

Grades at Intersections—Working out the grades for street intersections requires judgment, the exercise of which may be somewhat elastic as regards details. Certain general rules may be stated, however, and these can best be explained by examples. After determining the grades, a contour map of the intersection serves as a check since from it the engineer can picture the appearance of the completed pavement.

In Fig. 2, a 40-ft. roadway on a 4 per cent grade, is intersected by a 30-ft. roadway on a 1 per cent grade. These grades having been originally established only along the center lines of the roadways are increased slightly, where they traverse the blocks between intersections, by any flattening that may be necessary within the intersections. The original center line grades are, however, close enough approximations for determining the cross-section from the formula $T = 0.266\ (16 - L)$, in which T = the transverse grade from the quarter point to the curb, $\frac{T}{2}$ = the transverse grade from the quarter point to the center line, and L = the longitudinal grade. For the sections *Aa* and *Bb*, with L = 4 per cent, we have T = 3.2 per cent and for the sections *Cc* and *Dd*, with L = 1 per cent, we have T = 4 per cent.

The easiest point to begin working grades is the corner of the intersection, *cB*, where two descending grades meet. A catch basin has to be placed at this corner and the elevations of the tangent points may be approximately equal. With assumed elevations for the tangent points of curb at a corner, intermediate points may be determined as in Fig. 3. Produce the longitudinal grades 4 per cent and 1 per cent of the tangents, to *I*, their intersection in plan. Compute the elevations at this intersection. If the elevation of *B* is 100, the 4 per cent grade gives 99.60 at the intersection; and with *C* also 100, the 1 per cent grade gives 99.90. By drawing intermediate tangents to other points on the circular curb the elevations of these points may be readily computed as indicated. Often in the field, curb setters use this method. The curb tangents are produced by stretching strings, with other strings indicating the intermediate tangents. Laying off on these latter the distances to their tangent points establishes the circular curb elevations.

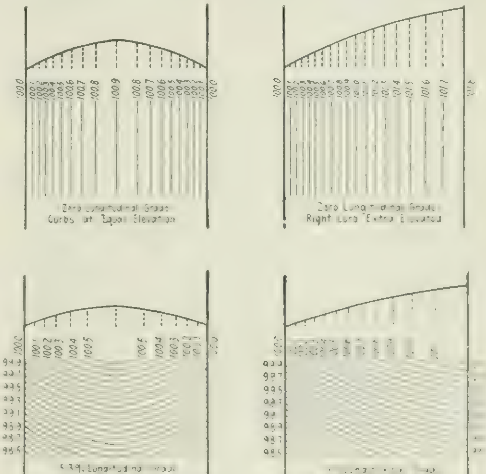


FIG. 1—FOUR ELEMENTARY ROADWAY SHAPES REPRESENTED BY CONTOURS

The maximum permissible difference in elevations at the intersection, in plan of the grade tangents, is obtained when the tangent point elevations are equal. This difference at the intersection may be decreased to zero which gives the maximum permissible difference in elevations at the tangent points. In Fig. 3 the maximum difference at *I* equals 0.3 ft. and, when this is reduced to zero, the elevations along the connecting grade line are lowered as indicated by the second set of figures with 100 as the elevation of *B*, and 99.70 for *C*. Profiles along the curb for the two sets of elevations are shown at the bottom of the figure. If the 4 per cent and 1 per cent grades were ascending toward the corner instead of descending these profiles would apply as convex upward instead of concave.

The profile with tangent points at equal elevations is usually a good one to use when it is necessary to provide for a catch basin at a corner. The profile at the other extreme (that is, with the grade lines intersecting in a single elevation at *I*) merges best with the longitudinal grades on the tangents. Often a profile has to be chosen lying between the two extremes, the choice being a compromise.

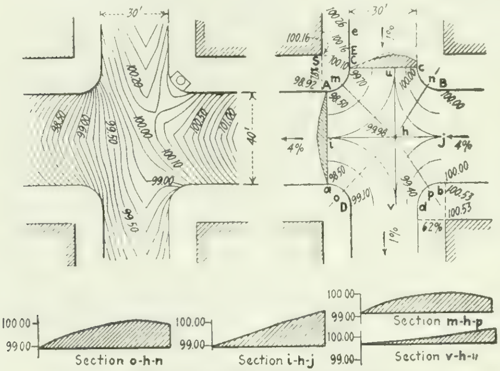


FIG. 2—GRADES AT STREET INTERSECTION

Returning to Fig. 2, while the necessity of a catch basin between *c* and *B* is one reason for not placing *c* lower than *B*, another reason is that, to do so would make a slight depression that would interfere somewhat with smooth passage from the 30-ft. roadway across the 40-ft. roadway.

Having tentatively determined the elevations at the corner of the intersection chosen for a point of beginning, the first question to be decided is, what cross-section to use for the 30-ft. roadway. The 40-ft. roadway is on the more important of the two streets and it is desired to carry it through with as little change in its 4 per cent longitudinal grade as practicable. This means that the right-hand gutter of the 30-ft. roadway has to be higher than the opposite gutter. The maximum extra elevation that can be given is obtained by the use of a section having a mean cross-slope of $\frac{1}{2}(T + \frac{1}{2}T)$ or 3 per cent, which gives a drop from *c* to *C* of 0.9 ft. A cross-section continuously falling from one gutter, across the roadway, to the other, is somewhat objectionable from the standpoint of appearance, unless the general lay of the land is steep—steeper than the 4 per cent of the present instance. As much rounded shape as practicable should be given a roadway and the cross-section drawn with a full line will be tried, which gives a fall from *c* to *C* of but 0.3 foot.

Now, if *L* on the 40-ft. roadway, across the intersection, is maintained at 4 per cent, the drop from *B* to *A* is 2.0 ft., thus giving a drop from *C* to *A* of 1.7 ft. and making the sidewalk slope so steep as to be objectionable. A 10 per cent sidewalk slope, though it may be exceeded under exceptional conditions, should ordinarily be assumed as a limit for corner locations at a simple intersection such as the present one. It is to be decided whether to reduce the sidewalk slope by lowering *C* or by raising *A;* the former by changing the shape of the cross-section *Cc*, the latter by reducing *L* across *B* to *A*. A reduction in *L* across the intersection increases *L* along the 40-ft. roadway traversing the block beyond the intersection. On important traffic highways, in cases where the grade is close to the maximum, and accordingly any increase would be objectionable, grades have been used as steep as 5 per cent across minor street intersections. Generally though, a 3 per cent limit should be adopted, which in the present example, based on a gutter elevation of 100 at tangent point *B*, gives a gutter elevation of 98.5 at *A*. A drop of 0.3 ft. from *c* to *C* gives a gutter elevation at the latter point of 99.7. A curb height of 0.5 ft. may be used at *A* and 0.4 ft. at *C*, thus taking up 0.1 ft. of their difference in elevation, and leaving 1.1 feet.

If *S* is the intersection of the building lines, a level line from *E* on the curb of the 30-ft. roadway gives a tentative elevation for *S*, since generally it is desirable to have *S* at least no lower than *E*. An elevation of 100.16 for *S* gives a slope of 7.8 per cent from *S* to *A*, the tangent point on the 40-ft. roadway. Other features of the intersection being properly taken care of it is well to have this slope as much less than 10 per cent as is practicable. If a satisfactory sidewalk slope above *A* can be obtained in no other manner, the break in the slope, which has been assumed along the line *SE*, may be moved further up the street, for instance to *e* at El. 100.26. This would mean that for the small area of sidewalk between this latter break and *SE*, drainage would be toward the building line. Even if there were an opening into a building just above *S*, a slight step-up at the entrance would stop water from flowing in, and since the slope past *S* and toward *A* is steep, drainage would be well taken care of. If buildings are well set

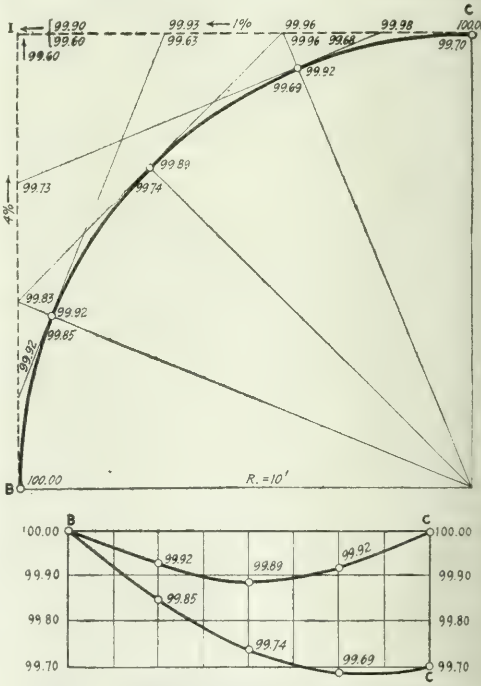


FIG. 3—MERGING GRADE LINES ON STREET

Where there are two elevations written at one point, the upper ones relate to *B* = 100 and *c* = 100; the lower, to *B* = 100 and *c* = 99.70.

back from the sidewalks and only parking lines intersect at S, a coping between the grass and the walk would direct water from e at El. 100.26, past S; and in such cases it is very common to find the break in the slope a number of feet uphill from the line SE.

The next step is to decide on the cross-section of the 40-ft. roadway. This decision depends somewhat upon the lay of the land on either side of the street, but in view of the fact that the intersecting street is on only a 1 per cent grade, undoubtedly a symmetrical section will be satisfactory. Accordingly, with a gutter elevation of 98.5 at A, we may decide upon 98.5 for a. At B the gutter elevation is 100 and at b, also 100.

In making an assumption for the gutter elevation at D, it is desirable to have it such that a line drawn from C to D continues the 1 per cent grade. This gives 99.10 as the elevation of D. From D to d the same roadway cross-section is used as was adopted for Cc, and the gutter elevation at d is 99.40. It should be noted that the tangent points C, c, D and d, lie in a plane, and also that A, a, B and b lie in a plane.

The surface of the 30-ft. roadway is to be warped into that of the 40-ft. roadway. Circular curves are drawn between the grade lines in the roadways, connecting points in the sections Aa, Bb, Cc, Dc. Elevations along these connecting curves are determined as in Fig. 3, leaving in the center of the intersection a space still undetermined. This space is controlled by the central point h. Sections mhp, nho, uhv, and ihj all pass through the point h, and it is an easy matter to determine an elevation for this central point that will provide satisfactory shapes for these sections. The elevation chosen for h is a matter of judgment, but when the contours are drawn and desirable improvements become apparent, the elevations of points previously determined on the connecting circular curves may be altered.

A Difficult Example—Fig. 4 illustrates an acute intersection with a difficult grade combination. The east and west street with a 4 per cent grade is a 56-ft. traffic highway while the roadway of the diagonal local street is 30 ft. wide and is on a 6 per cent grade. Before proceeding with the discussion of grade determinations, it should be noted that the lengths of circular curb used at the four corners are equal, which balances the intersection in plan.

It is desirable to carry the traffic highway through the intersection with as little disturbance of its normal cross-section as practicable. The local street is of secondary consideration. The hill along the traffic highway is steep enough to justify an unsymmetrical section. The high point of the crown is placed 10 ft. from the uphill curb and T and $\frac{1}{2}T$, in accordance with the formula, for $L = 4$ per cent, are taken as 3.2 per cent and 1.6 per cent, respectively. These values are used only on the uphill side of the crown, however; while, because of the exceptional layout of the intersection, 2 per cent and 4 per cent are used on the remainder of the cross-section, thus increasing what would be the normal difference in elevation between the uphill gutter and the downhill gutter. The cross-section of the local street is treated in like manner.

The intersection as developed gives close to the maximum permissible grades at the corners A and D. Undoubtedly though, at these acute corners the ground back of the sidewalks will be on such steep slopes that retaining walls will be necessary and, this being the case, plenty of length may be taken for the warping of one sidewalk into the other, thus making unnecessary excessively steep grades. A hair pin turn on the side of a hill, such as the present instance, of necessity entails more than ordinary grades on the turn; and sometimes the most practicable way to pass from the sidewalk on the lower street to that on the switch back is by means of steps.

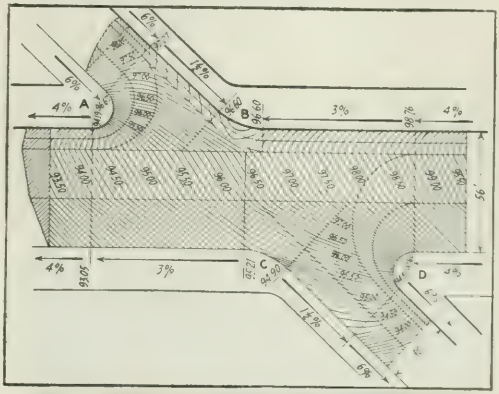


FIG. 4—DIFFICULT ACUTE ANGLE INTERSECTION

From the figure it is seen that the traffic highway is favored to the extent of carrying practically one-third of its width clear through the intersection on an unbroken 3 per cent grade. It is apparent that if this were but a 1½ per cent grade, only one-half as many contours would be crowded into the corners A and D. Through his choice of roadway cross-sections and longitudinal grades across the intersection the engineer may introduce practically any desired sidewalk grades at A and D. A feature worthy of particular notice is that the points represented by 96.67, 97.27, 96.60, 94.82, 94.22 and 94.90 all lie in one plane; similarly the points represented by 95.21, 93.05, 94.19, and 96.60, 98.76 and 97.62 all lie in one plane.

New York State Highway Bridge Statistics

Out of 33,800 highway bridges in New York State, a survey made some time ago shows that 67 per cent are 5 to 20 ft. in span, 24 per cent are 20 to 50 ft. in span, and 9 per cent are over 50 ft. Only 3,587 bridges are located on state or improved county roads, while more than 30,000 are on township and unimproved county roads. The former were separately inspected for the purposes of the survey, and is was found that 2,500 bridges (average length about 25 ft.) had a load capacity of 15 tons or over, while 1,090 bridges (average length 32 ft.) had less than 15 tons capacity. As to condition, is was estimated that about 75 per cent of them were in good condition, 15 per cent in fair condition, and 10 per cent in poor condition, while most of the bridges on township and unimproved county roads were in poor condition. A special inspection was made of 251 bridges on three principal state highway routes; less than half were found capable of carrying a 15-ton load, and 51 had a capacity of 5 tons or less. There were found among the number three bridges that had been condemned, and five others that were in unsafe condition. The annual expenditures for bridge construction and repair on state and county highways have for over ten years exceeded $1,000,000, while they were nearly $3,000,000 in 1920 and $2,500,000 in 1921.

Wire and Willow Mat Revetment on the Missouri River

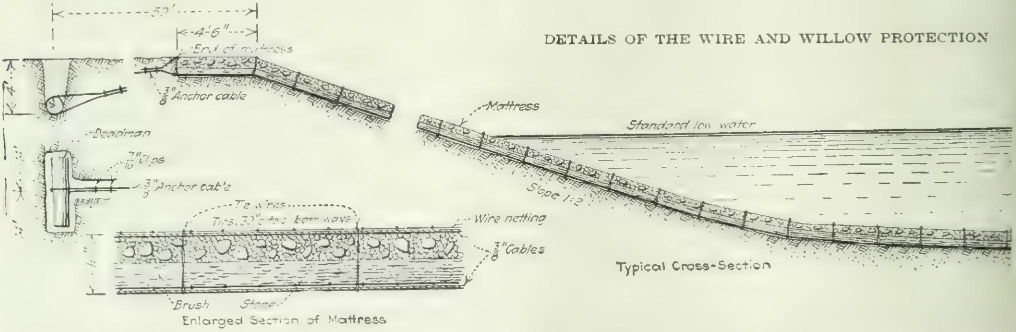
Wabash Railway Protects Its River Line Against Erosion—Wire Mesh Encloses Brush and Rock—Force and Equipment

BANK revetment with a continuous flexible mattress composed of two layers of wire mesh with filling of brush and rock has been applied recently at two points along the Missouri River below Kansas City, Mo., where bank erosion threatened the Wabash Ry. This protective system was developed in 1915 by A. O. Cunningham, chief engineer of the Wabash Ry. (see *Engineering News*, Nov. 30, 1916, p. 1022). It has been applied at several points, but the recent work is somewhat modified from the original design by the use of heavier wire mesh. Work done in 1921 and 1922 includes 2,000 ft. at Hull's Point, Mo., about 27 miles east of Kansas City, and a stretch of 1,000 ft. at DeWitt, 65 miles below Hull's Point. At these places the railway track is 75 to 400 ft. from top of bank.

Hydraulic grading of the river bank is the first step, dressing it to a slope of 1 on 2, or 1 on 3 where the distance from the railway is sufficient. This slope extends from low-water level to top of bank, an average height of 15 ft. For this grading there is a pump scow 19 x 70 ft. with cabin enclosing a 100-hp. boiler and a duplex pump giving a pressure of 140 to 160 lb. in a 4-in. hose line about 100 ft. long. A ¾- or 1-in. nozzle on the pipe is manipulated by an operator on the bank. In the ordinary earth, clay and sand encountered on this work the progress averages about 5,000 square feet in a 10-hour day.

Galvanized wire netting of 6-in. rectangular mesh and composed of No. 9 wires is used for the mattress. In some of the earlier work triangular mesh fabric was used, having No. 10 longitudinal wires and No. 12 or No. 14 for the web diagonals. Experience has shown that the heavier wires give longer life and better service, especially for that portion of the mattress which is above the low-water line. The mesh, 4½ ft. wide, is delivered in rolls of 330 ft.

In construction, the bottom layer of mesh is placed with the 4½-ft. strips parallel to the channel, the adjacent strips being sewed together with No. 9 soft galvanized wire to make up the required width. A 6-in. layer of willow brush bundles at right angles to the channel is laid on the wire, and then a second layer of bundles parallel with the channel. Rip-rap stone is distributed uniformly over the brush and then the top layer of netting is placed in strips at right angles to those in the bottom layer. Vertical tie wires or stitches of No. 9 soft galvanized wire are then placed 30 in. apart in both directions and are drawn tight by means of a special device. These tie wires bind the upper and lower mesh firmly together, holding the stone in place so as to prevent shifting of this ballast when the mattress is launched.



DETAILS OF THE WIRE AND WILLOW PROTECTION

COMPLETED MATTRESS AT DeWITT, MO.; WABASH RY

Bar-growth willows from ¾- to 1½-in. in diameter are placed in the original bundles, which are 6- to 10-in. in diameter and 8 to 25 ft. in length. Care is taken to break joints. Riprap stone ranging from 20- to 125-lb. pieces is placed usually by hand from barges for the submerged portion and from the bank for the shore portion of the mattress. Wheelbarrows are used in some cases for distributing the stone.

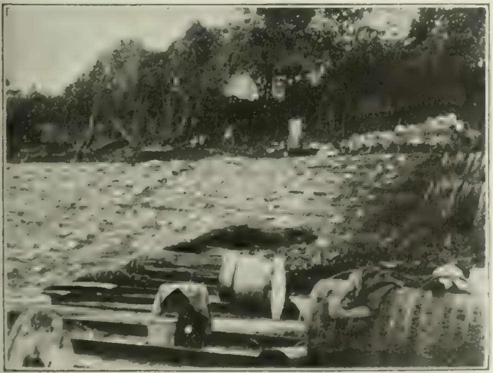
When this type of revetment was first introduced the mattress was carried up to the low-water line, above which the slope was paved with rip-rap stone. In recent work, however, the railway has had the mattress extended to the top of the bank, as shown in the drawing, since it is less expensive than stone paving. If protection is needed after the life of this exposed portion, the mattress can be renewed or stone paving laid, as may be desirable. Where the bank is unstable and has a tendency to slip or slide, the mattress protection has an advantage over stone paving in that it places much less weight on the slope. Anchor cables of ⅜-in. galvanized strand are placed entirely across the mattress at intervals of about 14 ft. and attached to deadmen, as shown.

That portion of the mattress which is to be submerged is built on a barge provided with steel sills laid across the deck and having their ends on the upstream side curved downwards to assist in launching the mattress. In starting the revetment a roll of brush poles and rock is built to a diameter of 15 or 18 in. for the full width of the mat and is attached to ½-in. cables led upstream to deadmen or anchors. To this is connected a 20-ft. length of mattress, built up as described. When this section is completed, the barge is pulled downstream by means of a cable and steam capstan, thus launching the mattress into the water.

That part of the mattress above low-water line is built in place and continuous with the portion placed from the barge. This part of the mattress usually silts up after a rise of water in the river.

Floating equipment varies according to the length of haul for willows and rock, which for the Hull's Point work was about two miles. For a contract of moderate size this equipment comprises usually the following: Quarterboat to house and feed a crew of 40 men, a steam or gasoline towboat, a pump scow for grading the bank, a mattress barge 24 x 80 ft., three brush barges 24 x 100 ft. and two rock barges 20 x 100 ft.

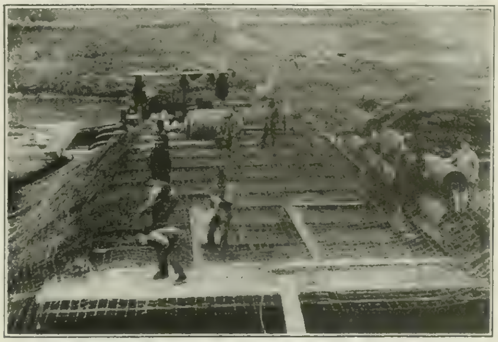
About 15 men are required in building the 70-ft. width of mattress on the barge, and 15 to 25 men for the mattress above low-water line. The standard width of mattress as built on the barge is 70 ft., but it has been built to a width of 100 ft. Its weight averages 222 to 250 lb. per square foot in air. About 100 ft. of 70-ft. mattress are built and sunk in a 10-hour day. For each 100 square feet of mattress there are 200 sq.ft. of wire mesh, 20 tie wires 5 ft. long, 50 lin.ft. of ⅜-in. cable, 45 lin.ft. of lacing wire, ¾-cord of brush and ¼-cu.yd. of stone. One deadman is provided for each 1,200 sq.ft. of mattress. This consists of a 12-in. log 4 ft. long buried in a trench which is thoroughly backfilled and tamped.



BUILDING SHORE PORTION OF MATTRESS

None of the revetment has been in use long enough to determine its life. The work done in 1915 with the lighter type of wire mesh is in good condition where it is silted up. Where it is exposed, some of the No. 14 wires are broken, but the heavier wires now used will give a longer life. An extra cast of galvanizing would also help toward longer life. This type of mattress adjusts itself to irregularities in the bed of the stream; it also can be laid at high or flood stages in the river. To protect a bank which is being undermined the mat can be built on top and allowed to fall as a protective curtain when the bank caves in beneath it.

This work on the Wabash Ry. is done under the direction of A. O. Cunningham, chief engineer, the designer of this system of protection. The field work is in charge of William H. Bush, drainage engineer, Wabash Ry. The contractor is the Kansas City Bridge Co., with George F. Maitland as its engineer of construction. In addition to its use on the Wabash Ry. this type of mattress revetment has been used by other railways, by the Prairie Pipe Line Co. to protect its submerged oil-pipe across the Missouri River, and by the Little River drainage district on 900 ft. of its main diversion channel near Cape Girardeau, Mo.



BUILDING WIRE AND BRUSH MATTRESS ON BARGE

To Minimize Stresses in Laminated Wood

Extensive tests have been carried out at the Forest Products Laboratory, Madison, Wis., for the National Advisory Committee for Aeronautics, to study the factors which produce internal stress in wooden members built up by gluing together thin sheets of wood. These internal stresses are of greatest importance in airplane propellers because of the high service stress. It was found that expansion and contraction due to moisture variation differ in radial and tangential directions in all species of wood tested, but least so in mahogany, where the amount of shrinkage from green to oven-dry condition is a little over 5 per cent tangential and between 4 and 5 per cent radial, while for North American hardwoods the tangential shrinkage ranges from 7 to 10 per cent and the radial shrinkage from 4 to 7 per cent. The ratio of the two shrinkages affects the action of laminated members containing both plain-sawed and quarter-sawed material. The investigators (A. L. Heim, A. C. Knauss and Louis Seutter) recommend in their report on the tests (Report 146, National Advisory Committee for Aeronautics) that all propellers be covered with aluminum leaf or other moisture-proofing, that propellers for extreme service be made wholly of quarter-sawed stock, that for moderate service all plain-sawed stock be used, that the mixing of plain and quarter-sawed stock is permissible for moderate service when the ratio of radial to tangential shrinkage is not lower than 0.75, and that care be taken to keep the moisture content of wood under all conditions below 15 per cent, to prevent softening of the glue and separation of the laminations.

Technical Progress of A. G. C. Shown By Committee Reports

Associated General Contractors Receive Constructive Reports on Contract Forms Seasonal Labor, Immigration, Apprenticeships and Cost Estimating

ORGANIZED activities of contractors are represented in a remarkable way by the reports of the committees of the Associated General Contractors of America in convention last week at Los Angeles, Calif. Except four of these reports relating to internal affairs of the association, all have an industrial and technical significance of wide concern. In particular the reports on methods, on legislation and on labor, interest construction engineers. Outstanding as a specific committee accomplishment is the joint agreement with the committee of the American Association of State Highway Officials on equitable provisions of highway contracts.

Internal Affairs

About a 50 per cent growth in twelve months is reported by the committee on membership. Exactly, the increase is 525 new members but as 175 members have been lost the net increase is 350 and the total membership is 1,404 compared with 1,054 at the beginning of 1922. There are now 33 chapters of the association, 13 of which were added in 1922. The continuation of the *Index*, the *Constructor* and the *"News Letter"* as periodical publications is recommended by the committee on publications. Stating its duty to be primarily to act as a jury on fair dealing the committee on ethics offers the Golden Rule as the complete code of ethics of the association.

Contractual Relations

Bonding practices, uniform contract forms and fair practices in highway contracting were constructively presented in three reports of such length that conclusions only may be given.

Uniform Contracts—As a result of the past year's work the committee on contracts makes the following recommendations:

1. That the work of the Joint Conference on Standard Construction contracts be continued, and that contractors in each locality through local conferences urge architects and engineers in their districts to become thoroughly familiar with the work of this contract conference and give it their support.
2. That contact be made with the American Institute of Architects for the purpose of adopting a standard form of proposal for private building work, and to confer upon other matters of mutual interest in the building field, falling outside the scope of the Joint Conference.
3. That a standard form of subcontract and proposal be drawn up jointly with subcontractors to enunciate principles in accordance with those of the major contracts.
4. That the standard document of the American Institute of Architects should receive official approval of the A.G.C. pending final adoption of the Universal Forms, and that members of the A.G.C. insist upon the use of these documents for building contracts.

Bonding Practices — Public lettings are seriously demoralized by the present bonding practice. The three principle points brought out by criticisms are as follows:

First, the determination of responsibility does not rest with the public official, but is fixed by the qualifications of any bidder who can secure bonds.

Second, bonds, especially bid bonds, are given so promiscuously that almost any person desiring to bid on construction can make the necessary bonding arrangements.

Third, to cover the inevitable losses of promiscuous bonding, the premium has been raised some several hundred per cent in the last few years.

Whether the practices complained of are universal or whether confined to certain companies, in any event the entire bond situation appears to need a thorough investigation.

The present demoralization of public lettings and the failures of performance that are common in various types of construction, are a strong reminder that it is in the interest of all three parties concerned that any injurious practices in the bonding market be discontinued. The committee recommends that the Association attempt to investigate this matter in co-operation with public officials and representatives of the bonding companies, and that a joint committee of these three interests if possible, report upon the means of establishing sound economic practices and a code of ethics in the field of contract bonding.

Equitable Highway Contracts—Working with a committee of the Association of State Highway Officials with W. R. Neel, state highway engineer of Georgia, as chairman a special committee headed by H. H. Wilson, Winston & Co., of the Associated General Contractors agreed upon the following recommendations:

1. *Contract Surety*—That where permitted by the law the highway department permit the substitution of approved negotiable securities for bond; the value of the securities deposited, except in extremely hazardous work, to equal not more than 35 per cent of the contract amount.

> (The exclusive use of surety bonds is believed to have resulted in the promiscuous bonding of irresponsible contractors, thus increasing the hazard rate, which in turn has been met by greatly increasing the bond premium; also the fulfillment by the surety frequently entails many difficulties of legal procedure.)

2. *Bidders Bond*—That proposals for highway work require that no bidders bond will be acceptable, unless accompanied by satisfactory assurance that the surety will bond the bidder for the contract, if awarded to him.

> (The promiscuous writing of Bidders Bonds, which, in some localities, carry no assurance that the surety will bond the contractor for the work, is believed to exert a demoralizing influence upon public lettings.)

3. *Payments*—That where possible, monthly payments be made not later than a definite calendar date; that final payment be made within a specified time after the contractor has fully performed his contractual obligations; or where final payment is necessarily delayed, that a semi-final payment be made in such amount as the department may consider safe.

> (Construction companies are bound to material manufacturers and other commercial concerns by auxiliary contracts, which require payment within a limited time, and failure of the department to make prompt payments to the construction company may entail difficult emergency financing.)

4. *Acceptance of Work*—That portions of the road, when satisfactorily completed, be accepted and paid for in sections of reasonable length, and maintenance by contractors terminated.

> (Funds retained by the department after portions of the work are satisfactorily completed, involve unnecessary interest charges in the cost of construction and complicate its financing.)

5. *Maintenance* — That the maintenance guarantee on highways, after they have been accepted, be divorced from the construction contract.

(The combining of maintenance and construction in a construction contract introduces uncertain elements of expense which should not properly be included in the construction cost.)

6. *Classification* — That where feasible the following be provided for: (a) Excavation to be classified; (b) No two kinds of work to be included in a single unit where it is practicable to separate them, and (c) Over-break or slides to be paid for at a proper rate, where the engineer is satisfied that the work is properly handled and that the breaks or slides are not due to the contractor's negligence.

(A comparison of excavation prices between contracts providing for classification and those using a single class indicate that a proper classification which enables accurate estimating, is productive of lower prices, and a separation of the different classes of work into individual units appears to have a similar effect.)

7. *Adjustment of Compensation*—That provision be made for an equitable adjustment of extra expense entailed by: (a) Delays and suspension of work, due to acts or omission of department; (b) Unusual increase or decrease in the original unit quantities; (c) Rejection of materials after once inspected and approved, and (d) Acts of God, and other causes manifestly beyond the contractor's control.

(It frequently becomes necessary for the highway engineer to delay or suspend work through no fault of the construction company, or to take other action which disrupts the procedure and introduces extra cost that cannot be foreseen. It is believed economically unsound for a construction company to assume certain risks.)

8. *Overhaul*—That a reasonable free haul limit, preferably not over 500 ft., be employed and that some standard means of computing overhaul be adopted.

(The great variety of methods in use for computing overhaul and their uncertainty have made it difficult to pre-determine accurately the cost of such hauling.)

9. *Retained Percentage*—That ten per cent be retained on monthly estimates.

(An excessive retained percentage on monthly estimates increases the interest charges of the work; and ten per cent in conjunction with the surety bond or securities is believed to afford ample protection to the state.)

10. *Force Account*—That on force account work the allowance for indirect and overhead expense be set at 10 per cent of the direct labor and upon those amounts and upon the material a ten per cent profit be allowed.

(The settlement of force account work has often been subject to dispute and the use of modern equipment has increased in both the proportion of overhead expense and the difficulty of ascertaining its amount.)

11. *Stock Piling*—That, under conditions satisfactory to the department, payment for material delivered be included in monthly estimates.

(The transportation system of the country is unable to serve adequately the needs of highway construction during certain months, thus making it advisable to stock pile materials, but many responsible companies are prevented from financing stocks of sufficient quantity.)

12. *Arbitration*—That limited arbitration, which will reserve final decision to the engineer in all matters pertaining to prosecution of the work, but will provide for settlement of claims for compensation, be included in construction contracts.

(The settlement of controversy under highway contracts by arbitration has shown that not only the number of disputes and court actions is reduced, but that the arbitration itself is seldom resorted to; and that the engineers' hand is thereby strengthened.)

13. *Administration* — (a) That contracts be promptly awarded and certified checks returned within a specified time where possible; (b) That written orders be given by the Department for all important instructions and especially instructions to suspend or shut down the work, the latter to state reasons of suspending or shutting down; (c) That unless a plan for prosecution of the work is given at the time of sending out proposals, the contractor be allowed to pursue his own plan except in emergencies and providing his prosecution of the work is satisfactory; (d) That inspection of materials be made at the source when practicable and at least before unloading from cars; (e) That the departments discontinue publication of the monetary amount of estimates in advance of the letting of work, and (f) That every effort should be made to secure the highest possible type of inspectors and field engineers.

14. *Day Labor Construction* — That true and accurate cost accounting, showing overhead and indirect expense, be required on all construction work performed by state or county forces, an exception to be made only on miscellaneous work not properly designated as construction.

(It is to the public interest to know the true cost of any public work that the department or other agencies of the state may be called upon to perform by day labor.)

15. *Legislation*—That an effort be made to modify existing laws in conflict with those recommendations.

Methods

Indicating the character of its past activities and the work contemplated the committee on methods lists the following:

1. That the Association continue its co-operative work with other associations in formulating standards and simplifying dimensions in the field of materials and equipment production.
2. That the contact formed with equipment manufacturers during the past year be strengthened, and that the joint work of these agencies be extended to all subjects of mutual interest.
3. That a meeting be arranged with officials of the income tax unit to establish rational values for the depreciation of construction equipment, and to provide contractors with information to assist them in properly making out their returns.
4. That the Association continue to improve safety measures in the construction industry and co-operate with the National Safety Council in its investigation and presentation of improved safety methods and devices.
5. That the Association join with other associations of engineers, architects and manufacturers to further the study of seasonal fluctuations in industry and devise means, as far as possible, for their elimination in both the basic industries of construction and in other lines of production.

Commenting on waste from seasonal construction the committee points out that it is recognized that one of the most fruitful sources of waste in the construction industry is due to seasonal let-down. Organizations are disrupted, men leave the building trades for other work, and new ones must be trained at the beginning of the next construction season. This applies not only to building work but to many types of engineering or public work construction. It is the duty of contractors in co-operation with engineers and those in other industries to remove as far as possible the unnecessary peak. The committee proposes to push its investigation of this subject and seek, in conjunction with other industries during the present year, to find the necessary means for making these industries continuous.

In response to many requests from construction companies who have not yet "found themselves" in the field of estimating and cost accounting, the committee has undertaken to draw up a set of standard estimating sheets which will serve a three-fold purpose as follows:

1. An estimating check memorandum which will give the estimators something to check against, as a precaution against omitting any items of cost from the estimate.
2. Convenient means of tabulating the different quantities and building up the unit cost.
3. A basis for a cost accounting system.

Two of the sheets have been released, the General Building Summary Sheet and the Job Overhead Summary. Other sheets will be released during the present year.

Legislation and Labor

Announcing its advocacy of a federal department of public works and its support of legislation to reduce tax-exempt securities the committee on legislation takes up particularly new legislation affecting immigration. For such legislation the following fundamental principles are suggested:

1. Immigration should be regulated and selected both in quantity and in quality.
2. No more immigration should be admitted of any nationality than we can wholesomely assimilate and in a reasonable length of time wisely incorporate into our body politic.
3. No more immigration should be admitted than can find steady and useful employment without endangering normal American standards of life, labor and wages.
4. The numerical regulation of immigration should be flexible. When industrial depression sweeps the country, all labor immigration should be promptly stopped. But the doors should again be opened when prosperity returns. It should be possible to take either step without waiting for special Congressional action.
5. The closing and opening of our doors should be scientific. It should be based on assured and accurately compiled facts and statistics from every part of the country.
6. The law should be general. The principles should be applied equally to every nation and people without arbitrary discrimination.
7. The law should be courteous to all. It should be possible, without humiliating any, to exclude completely particular types of immigration which definite experience shows to be difficult to assimilate and absorb.
8. The law should provide for the sending of expert examiners to the lands from which immigration mostly comes —this for the sake of both progressive immigrants and for that of our own land.
9. The law should make possible a wise distribution of new immigration. The flow should be restricted or entirely stopped from given peoples, to already congested areas, and encouraged to go to those parts of America where it is desired.
10. The new immigration policy should be distinctly patriotic. It should favor immigration from peoples easily assimilated and check it from other lands. It should guarantee equal treatment and a square deal to all aliens now in the United States. It should provide for higher standards for naturalization and then grant the privileges of citizenship to all who qualify. It should look to the creation of a substantially homogeneous people having a common mind and a wholesomely functioning democracy.

Naming restricted immigration as the principal reason for labor shortage the committee on Labor emphasized lack of apprentices as a secondary cause. The report says:

> The situation resolves itself into two problems, the first to provide, as quickly as possible, mechanics to supply the present shortage. The second to provide means for the education of mechanics in lieu of the present apprenticeship system. To assist in solving the first problem, we recommend: (a) That men now engaged on construction work as building laborers and otherwise, who show an aptitude, be employed as helpers to the skilled mechanics, be permitted to do any work their experience warrants. In a short time they could execute much of the plain work, releasing the older and more skillful mechanics for the most intricate work. (b) That there be established by employers, under their control, special trade schools where the age limit and scholastic requirements be waived, and the only conditions for entrance be an aptitude for and a willingness to learn a good trade. These schools should teach merely the handling of tools and the rudiments of the trade, leaving skill and efficiency to be acquired on the job, where experience has shown it is most successfully acquired.
>
> The second problem is to provide means to insure a supply of mechanics to care for the normal growth of the Nation. To do this all building trade organizations and persons interested in the construction business, should inaugurate a campaign to attract young men to the trade; showing how interesting, profitable and honorable mechanical vocations are.

Chemical Warfare Service to Help in Marine Piling Study

THE Committee on Marine Piling Investigations of the National Research Council announces that it is to have some assistance in its study from the Chemical Warfare Service of the Army. The Bureau of Yards and Docks of the Navy Department, the Engineer Corps and the Quartermaster Corps of the War Department, and the Department of Commerce are placing funds at the disposal of the Chemical Warfare Service for investigations upon substances which are poisonous or repellent to marine wood boring animals and also upon the ways in which these poisons are effective. C. H. Huston, assistant secretary of the Department of Commerce, has been designated by the President as government representative on the Committee on Marine Piling Investigations in order to assist in arranging for the co-operation which these several government bureaus can contribute toward these investigations.

The investigations, themselves, will be designed to determine the relative toxicity of creosotes, commonly used for timber preservation, upon the species of shipworms and also upon the limnoria or gribble. There are also several other groups of substances which are highly toxic to most animals and with which it may prove to be possible to impregnate timber with sufficient permanency to persist for a long period of years. Some of these may be found to be even more potent in protecting timber and cheaper to use than creosote.

The points of attack in these experiments will be two: (1) to find the best substances for impregnating timber which will be poisonous to shipworms after they have entered the wood, and (2) to find substances which will prevent shipworm larvae, as they float about in the water, from settling upon the timber, by altering the nature of the surface of the wood so as not to attract the larvae to settle on it in the definite way in which fresh timber seems to attract them. It may be that different groups of substances may be found for meeting these two purposes, and that the latter method will prove to be the more practicable for protecting timber, provided the wood can be impregnated deeply enough to always present an inhospitable surface no matter how much the timber may be injured by bruising. It is also not impossible that means may be found for poisoning the water in the vicinity of wharves so as to kill off the larvae during the breeding season without seriously injuring the fishing and oyster interests of adjacent localities. Such a method, if found, would be of enormous value in the saving of structures built of unprotected timber which might be unexpectedly attacked by wood boring animals.

These investigations will be wholly under the direction of the Chemical Warfare Service, but they represent a distinct chapter in the plan of investigations of the National Research Council's Committee on Marine Piling investigations and will be carefully co-ordinated with the other work of that Committee.

Comparative Deflection Tests Favor Motor Stages

Pavement Deflections Observed on Test Road Under Truck, Touring Car and Stage—Static Moving and Impact Tests

A SERIES of tests was carried out at the Pittsburg test road in California to determine the comparative amount of pavement deflection caused by several types of vehicles. Particular attention was given to the comparison of the ordinary touring car, the typical motor stage with a load of fifteen passengers, and a solid-tired truck with exactly the same total weight as the loaded stage and also the same distribution of weight on front and rear wheels.

The accompanying series of curves in which the results are depicted graphically show that the deflections caused by the truck range up to a maximum of more than twice those caused by a stage of exactly the same weight. Quite unexpectedly the tests also showed that the use of air-pressure shock absorbers materially increased the pavement deflections when making the impact test.

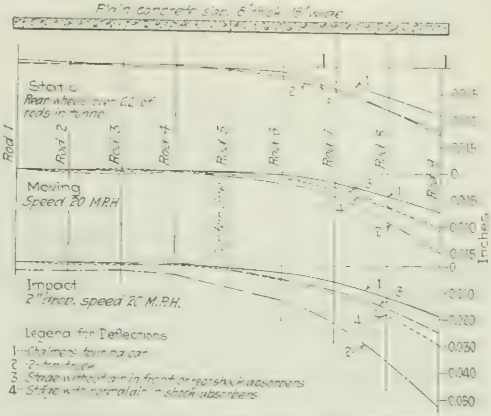
Pavement deflections were read by the use of rods whose tops were embedded in the concrete pavement and whose lower ends extended down into tunnels beneath the roadway where movements of the rods were read accurately by means of micrometer gages. A detailed description of methods of making tests on this road was published in *Engineering News-Record*, Dec. 29, 1921, p. 1048. In the issue of June 29, 1922, p. 1066, there appeared an extended report on the effect of heavy traffic on the concrete pavement.

WEIGHTS AND DIMENSIONS OF VEHICLES USED IN COMPARATIVE TESTS

Vehicle	Total Weight (Pounds)	Weight on Front Wheels (Pounds)	Weight on Rear Wheels (Pounds)	Length Wheel Base	Width Tread	Tires
Chalmers Touring Car	5,530	2,070	3,460	11 ft.-[illegible]	4 ft.-8 in.	Pneumatic
Two-ton truck	8,740	3,700	5,040	13 ft. 8 in.	[illegible] ft.-7 in.	Solid
Motor Stage Line Bus	8,740	3,700	5,040	16 ft.-8 [illegible]	4 ft. 8 in.	Pneumatic

Attention was first directed to the effect of shock absorbers when stages of the same weight distribution and differing only in the use of shock absorbers showed different deflections in the impact test. To eliminate any differences that might be due to the individual cars, tests were then run using the same car several times successively with and without air pressure in the cylinders of the shock absorbers. These comparisons were made in several runs, in addition to those shown in the accompanying diagrams, always with the result that greater deflections were recorded when the shock absorbers were in use.

The method of making the impact test was to lay across the pavement a plank 2 in. thick and to vary its distance from the deflection rods until positions were found where vehicles passing over this obstruction and dropping to the pavement again gave a maximum rod reading for each of the several speeds at which deflections were to be recorded. The edge of the plank presented to the approaching vehicles was beveled off to a feather edge to allow the vehicle to rise up on it easily. In all records shown in the accompanying curves, the wheels on one side of the vehicles were kept over rod No. 9, nearest the edge of the pavement.



THE CURVES SHOW DEFLECTION OF PAVEMENT UNDER IMPACT AND FOR STATIC AND MOVING LOAD

Deflections for three vehicles are shown comparatively in each of the three tests. In the impact curves note that shock absorbers increased pavement deflection.

The curves shown herewith are typical of the several runs made and were selected to show, in a general way, the materially greater deflection of the concrete under the impact of a truck, even though its total weight and weight distribution were identical with the motor stage. The truck used was a standard 2-ton type with wheelbase, tire and spring equipment typical of trucks in this class.

The work at the Pittsburg test highway was carried out under the joint direction of the U. S. Bureau of Public Roads and the California State Highway Commission with Lloyd Aldrich and John B. Leonard in charge of all tests.

Indiana 1922 Road Construction Mileage

During 1922 the Indiana State Highway Commission contracted for 110.78 miles of concrete road and 7.07 miles of brick pavement according to Carl Gray, chief engineer. Of this mileage there was completed up to the close of the fiscal year, Sept. 30, 63.43 miles of concrete and 3.52 miles of base for brick and 0.17 miles of brick pavement. Carried over from 1921 were contracts for 17.02 miles of concrete and 34.64 miles of grading and structure work. The commission desires to contract for 160 miles of hard pavement in 1923, approximately one-third of which has already been let. In its contracts the commission insists on storage of considerable material before starting work for the purpose of continuing operations in case of railroad congestion.

From Job and Office

Hints That Cut Cost and Time *For the Contractor and the Engineer*

Steam Shovel Cuts Snow Removal Cost

By C. C. Kilby
General Contractor, Hartford, Conn.

One steam shovel and three five-ton trucks have been found in Hartford, Conn., to be capable of moving approximately the same amount of snow as can be handled by fifty men and ten teams. This means that the city of Hartford recently effected a saving of $138 a day in snow-removal work by the use of mechanical methods over hand means previously resorted to.

STEAM SHOVEL USED IN HARTFORD SNOW REMOVAL
By the use of steam shovels the city of Hartford was able to effect a saving of $138 per day in snow removal over hand shoveling previously resorted to.

The cost distribution is made as follows:

50 men at $3.50	$175
10 teams at $9	90
Total	$265
Steam shovel	45
Three trucks at $25 each	75
Two pit men at $3.50	7
Total	$127

The steam shovel cost includes coal and crew.

The steam shovels used were ⅝-yd. machines on caterpillar type traction, with 16-ft. booms, 14-ft. dipper handles and boom hoists for controlling the booms.

Use of the shovels was resorted to after a heavy snow storm which culminated in a 6-in. fall of hail, seriously blocking street traffic in Hartford the week ending Dec. 30. Vigorous measures were decided upon to clear the streets. Snow plows had been used both by the city and the Connecticut Co. on the principal arteries of travel, but these left two deep, wide windrows of snow and ice piled up from 4 to 6 ft. high on each side of the trolley tracks.

A test run was made to determine whether a steam shovel could handle the frozen material, particularly the slippery sheet of ice which coated the pavement. Records in the office of the writer who was the contractor on the work show that it takes an average of five minutes to load a five-ton truck by steam shovel. The trucks were equipped with side-boards and the snow was compacted with the dipper, so that approximately 8 cu. yd. were loaded on each truck.

It was also found that steam shovels removed the heavy cake of ice which incrusted the pavement beneath the piles of snow, no hand picking being required. Another interesting observation was that the work of the steam shovels seemed to increase the morale of the hand shovelers employed on the streets elsewhere.

A Reinforced Encased Tile Culvert

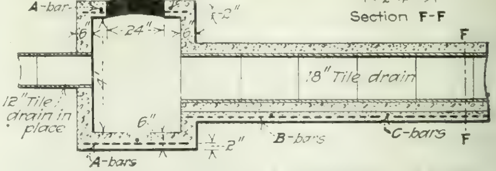
By Paul L. Fetherston
Resident Engineer, Michigan State Highway Department

Nearly all failures in highway culverts occur when the structure is placed on an unstable soil such as muck or quicksand, without any special precaution being taken to insure success.

The catchbasin and encased tile shown in the sketch were designed to be self supporting in muck and have proved to be so after being in place a season.

Several pipe and tile culverts had failed at this location in years past because of uneven settlement, and so when the road was taken over as a federal-aid project this structure was placed.

Section F-F shows the footing in detail. It is reinforced with ¾-in. longitudinal bars and ½-in. transverse bars which are spaced as indicated. This footing carries a standard 18-in. encased tile. The regular encasing and the footing are poured as a unit so that there is no construction line between them.



Reinforcing Steel

Kind	No.	Length	Size	C. to C.
A	6	3′-6″	½″ ⌀	
B	2	46′-6″	¾″ ⌀	
C	10	2′-0″	½″ ⌀	4′-0″

ENCASED TILE CULVERT SELF SUPPORTING IN MUCK

As indicated in the sketch, the surface water and that from a 12-in. land drain is collected in the catchbasin and discharged across the road into an 18-in. drain.

In placing the culvert the excavation was carried to a depth of 6 in. below that required for the concrete and tile, and then backfilled with gravel which was tamped into place. This was done to prevent the muck from mixing with the concrete when poured.

Welded Steel Tower Built in a Cave

By Howard L. McLean
Stockton, Calif.

TWO hundred feet underground, in a cave near Vallecita, Calif., a 100-ft. spiral steel stairway electrically welded throughout has recently been completed. The stairway is surrounded and supported on the outside by a lattice tower 6 ft. 10 in. in diameter. The core of the structure and the inner support for the stairs is a 10-in. pipe. Due to the narrowness of the entrance passageway this pipe and all the other material had to be taken into the cave in lengths of less than 20 ft.

A small shelflike opening or ledge in the wall of the main chamber of the cave marks the end of the entrance passageway. Here, a hundred feet above the floor, the construction of the tower started. First a reinforced concrete landing platform was laid, enclosed for safety's sake with a steel railing. Two 10-in. I-beams extended from this platform to a point 8 ft. from the ledge, where the tower was to start. These beams served as the anchoring points for four ⅜-in. plow steel cables.

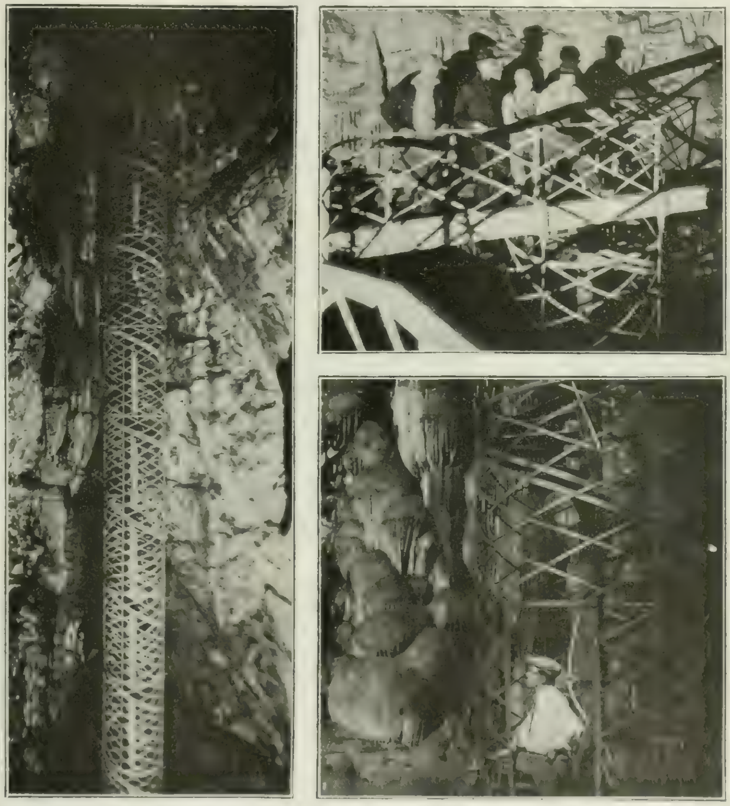
A small electric hoist served to raise and lower men and materials from this point.

Ten steel rings ⅜-in.x2-in. with four short pieces of ¾-in. pipe 5 in. long welded on the circumference, were threaded on the cables. The rings were spaced ten feet apart and held in place by pouring babbitt into the pipes around the cable. The lower ends of the cables were anchored in a block of concrete in the cave floor. Turnbuckles, at the point of anchorage, made it possible to tighten the cables.

The basket work of the tower was built up from the bottom in 10-ft. sections. To place the 2x½-in. Armco iron bars in their spiral position for welding, a cylindrical frame was used. This frame looked like a straight-sided barrel with every other stave knocked out. Two men bent the bars to the spirals marked off on the inside of the frame. Each bar made one complete turn in 10 ft., crossing the other bars at 1-ft. intervals. As each 10-ft. section was completed the frame was raised and hooked over the next horizontal ring.

To form an outer support for the 150 steps, one double spiral of 2x¾-in. iron was put in the basket work. The inner end of the step was welded to the core of the tower. A Z-shaped templet, placed on the step last welded in position, insured the proper rise and spacing of the next one. The steps are 14 in. wide at the outer edge and 8 in. at the inner. When the tower was completed it was given a coat of marine enamel.

The tower is very compact in structure. The central pipe is mainly the inner support for the stairs, but also serves as a ventilating pipe and conduit for the electric light wires. Around the central pipe is a spiral handrail. This is also used as a drainpipe to carry away the seepage water from the concrete landing platform.



STAIR TOWER 100 FEET HIGH BUILT IN A CAVE

Pipe core, steps and spiral strip enclosure electrically welded together. Left—Completed tower. Upper right—Landing at top of tower. Lower right—Foot of tower

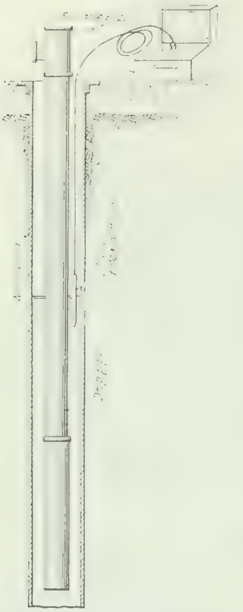
Indirect lighting was a feature during work on the tower. Five 300-watt lamps, equipped with reflectors, which directed the light against the white walls of the cave, gave an excellent illumination.

This welded type of tower was adopted as a result of competitive bids received by the owners of the cave for a tower and stairway. A bid of $12,000 was submitted for a structural steel tower 12 ft. square at the base and having a stairway winding around the outside. The estimated weight of this bolted structure was 27,000 lb. The bid for the welded tower and stairway which has been described was $3,000. The weight of steel used in its construction was 6,150 lb. A. H. Tangemann, a welding engineer of Stockton, is responsible for the design and construction of the tower and stairway.

Measuring Well Water Depth

By Charles Brossman

Consulting Engineer Indianapolis, Ind.



PORTABLE SET FOR WELL WATER MEASURING

A SIMPLE yet accurate means of determining the depth of water in a well is explained in the following paragraphs:

A ⅝-in. brass tube, perforated at the bottom to allow the water to enter, is inserted in the well. Inside of this tube is a cork float, on the top of which is a metallic cap which makes contact with the two wires leading to the buzzer above. As soon as the tube is immersed in the water the float rises, contact is made and the buzzer signals. By this method one can tell the level of the water at any height and in any test. We have found this very valuable and accurate.

In very many cases electric current is not available and as this outfit used by us is portable, it is very convenient.

Laying Concrete Road in Cold Weather

By Crosby Tappan

Superintendent of Construction,
Pennsylvania Highway Department

THE PENNSYLVANIA State Highway Department through its construction bureau, completed last November the concreting of 22½ miles of road between Trout Run and Blossburg, Pennsylvania. Before this date, the temperature had already fallen as low as 19 deg. F., and it was necessary to devise methods of heating concrete materials and protecting the concrete as it was poured, as well as preventing freezing of the subgrade.

The subgrade in advance of the mixer was kept covered by canvas placed over the forms. It was found that this gave sufficient protection to prevent freezing of the subgrade. Flame throwers, burning kerosene, were installed on the mixers and kept burning continually while concreting was going on. The mixing period was lengthened from 1½ to 3 minutes.

As soon as the concrete had been finished, wooden frames covered with heavy canvas were placed over it. Under these shades were hung small oil stoves, which were kept burning until the concrete had set enough to support the weight of straw, when the frames were removed and light canvas strips were laid on the concrete. On the canvas there was placed at once 12 in. of straw. Especial care was taken to see that the outside of the road forms were well covered with straw to prevent freezing of the edges of the concrete. By taking these precautions, the road was finished in a satisfactory manner.

From Job and Office

Hints that Cut Cost and Time

Novel Use of Steam Shovel in Filling Over Box Culverts

By G. W. McAlpin

Pt. Pleasant, W. Va.

IN FILLING around box culverts a unique method was successfully used during the past season by the Tulley Construction Co. on road work in Mason County, W. Va. Instead of dumping material from wagons at the edge of the fill and shoveling against the sides of the culverts, or using slip scrapers until teams could pass over and dump, a large pile of material was first made near the edge of the culvert. This material was placed as near the edge of the dump as wagons could efficiently work.

The steam shovel was then brought up and proceeded to push this material ahead of it into the hole and against the side of the culvert. Teams were used on other work while the shovel was thus engaged. Material was quickly leveled in this fashion on both sides of the culvert ready for teams to dump.

Unique System Used in Signaling From Material Tram Car

IN ORDER to signal to the hoist house from any point on an inclined tramway used for the transportation of material in the construction of the Pit River power plant No. 1 in California, a unique and efficient method was employed by the Pacific Gas & Electric Co. A signal was sent over a pair of wires by bridging them with a signal pole, completing the circuit, and ringing a bell at the hoist house, thereby notifying the engineer. The signal consisted of a 10-ft. pole carrying a hinged metal arm for bridging the two wires, the hinged feature allowing shorting of the circuit regardless of what position the operator might be in. The signal wire was always accessible to the signal man who rode on the tram car.

SIGNAL DEVICE FOR TRAM CAR

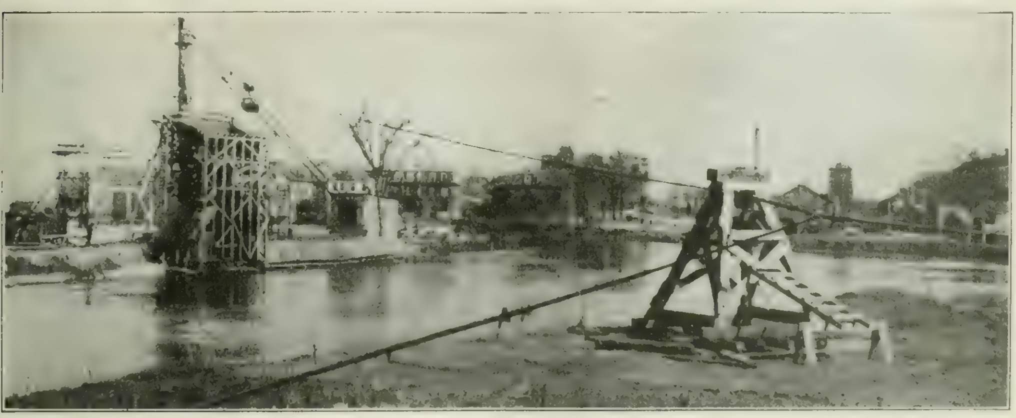
The tramway paralleled the penstock line and was about 2,000 ft. in length. The car was operated by a cable and electrically driven hoist. It hauled pipe for the penstock, cement and reinforcing material, etc.

From Job and Office

For Contractor and Engineer

Dragline Used Successfully in Power Canal Deepening

IN WIDENING and deepening the hydraulic canal and forebay for the Cohoes Power & Light Corp., excavating equipment was demanded which could handle wet material, as it was imperative that the hydroelectric plant be kept in operation. After considerable study of the situation D. F. Pelletier, field engineer in charge of the work for the contractors, Sanderson & Porter, decided upon the installation of a 400-ft. span, 1-cu.yd. dragline cableway excavator. Most satisfactory results were secured with this plant, it is reported, and during the first month of operation, the cableway excavated 7,200 cu.yd. of earth, all under water. During the next month the plant handled 4,650 cu.yd. of earth and 2,630 cu.yd. of rock, or a total of 7,280 cu.yd. Material excavated ranged from a sticky mixture of clay and loam to shale rock, which was handled with very little blasting. During part of both the months mentioned the cableway was in operation 18 hr. per day.



EXCAVATING UNDER WATER WITH DRAGLINE EQUIPMENT

The excavation was done in connection with the modernization of the hydro-electric plant to furnish power to various industries which have hitherto taken power from the canal by individual plants, in most cases using inefficient waterwheels of obsolete design. The new power house and gate house were completed some time ago. The power house is located at the foot of a cliff, giving penstocks a vertical drop of 100 ft. to turbines. Penstocks are 11 ft. in diameter and 190 ft. long.

Almost 100 years ago the first Cohoes company was organized, obtaining control of all water-power rights on the Mohawk River, just above the point where it enters the Hudson. A dam was put in a short distance above Cohoes Falls and after several replacements the present masonry dam, 1,443 ft. in length, was built in 1865. From this dam, located about a mile above the power house, the canal leads to the forebay and gate house. Head gates are provided at the entrance of the canal, and a spillway below to regulate the canal level.

The photograph herewith reproduced shows the cableway spanning the 300-ft. width of the channel and delivering spoil to a hopper on top of the cliff overlooking the river and power house. From the hopper the material was sluiced to the river bank and graded to make a fill adjacent to the power house. Water for sluicing was raised to the hopper from the canal and forebay by a 6-in. centrifugal pump.

The movable tower at the tail end of the cableway permitted excavating a large fan-shaped area at one set-up. Hence, only a few moves of the mast, hopper, pump, and sluice were required.

According to the engineer for the contractor the estimate of earth-excavation cost was 51c. a cubic yard, and of rock excavation, $1.03 per cubic yard. This rock excavation figure does not include drilling or blasting. Sluicing of material to the spoil bank is included in both costs. The best day's record was 547.5 cu.yd.

The material from which this article has been written was supplied by Sauerman Bros., whose dragline excavating equipment was used.

Cost of Winter Cement Storage for Road Construction

By Walter S. Anderson
J. J. Dunnegan Construction Co., Shenandoah, Iowa

THE State of Illinois now requires that all contracts in 1923 shall have a provision incorporated demanding that 33⅓ per cent of the cement required to complete the contract must be stored. If not so stored a penalty of 15c. per barrel will be exacted, and the amount deducted from the money due the contractor. In other words, the state directs that the cost of storing this amount of cement be included by the contractor in the bid price he submits.

In this connection the experience of the writer's firm at Neponset, Ill., in 1922, where it stored 12,500 bbl. of cement, will be of interest. The special storage building erected was 50 x 120 ft. in plan by 12 ft. high. Roof, walls and floor of No. 2 shiplap were nailed to 2x4-in. studs spaced 3 ft. The roof was covered with one layer of 2-ply roofing paper. Floor boards were laid loose on a 12-in. thickness of cinders and covered with two loose layers of 2-ply roofing. Cement was unloaded at a flat price of 3½c. per barrel by men who had handled our cement all the previous season. Our cost sheets show a total initial cost for the building complete of $1,180 and with a salvage value of $600, leaving a net cost of $1,210, which gives the following cost per barrel:

Building (approx.)	$0.10
Unloading	0.035
Insurance, damaged cement, interest	0.015
Total	0.15

For storing smaller quantities the unit cost would increase while for larger quantities it would be correspondingly less. In our judgment the cost of rehandling the cement is not appreciably greater than handling the cement from cars direct. Everything considered, the price of 15c. per barrel established by the State of Illinois is reasonable and fair under present conditions.

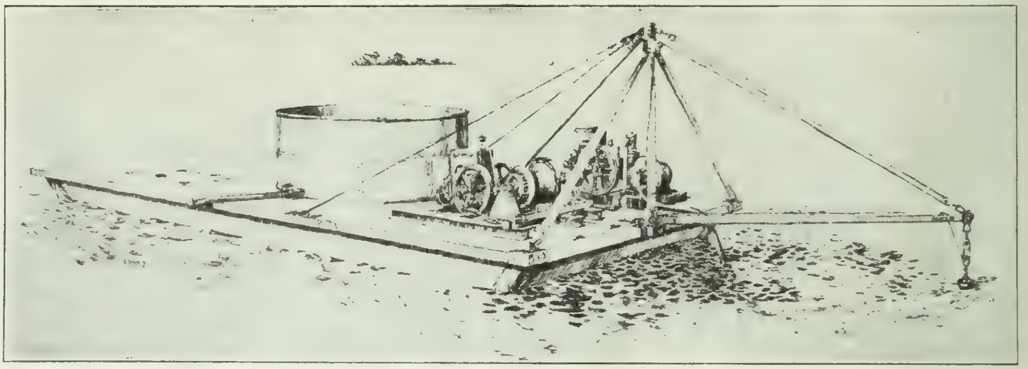
From Job and Office

Hints that Cut Cost and Time

Reclaiming Surface Oil From Baltimore Harbor

By N. C. McLoud
Baltimore, Maryland

MUNICIPAL and port authorities have taken keen interest in an outfit for the removal, by suction, of surface oil from the water in Baltimore harbor. The apparatus was devised by Bancroft Hill, Baltimore harbor engineer and president of the Harbor Board, and was built in the city's workshops.



SUCTION-SKIMMER REMOVES SURFACE OIL FROM WATER

The salient features are a pump mounted on a scow and operated by a small engine. Connected with the pump is a pipe with its mouthpiece submerged an inch or so in the water. The mouth is held in place by a chain suspended from a projecting boom rigidly attached to the bow of the scow.

On board the scow this pipe discharges into a good-sized settling tank, in which the oil and water taken up by the pipe are allowed to settle and separate, after which the water is drawn off through a discharge pipe at the side of the tank. The oil is then burned or stored in barrels. The tank is portable and may be taken ashore.

The pump-scow has its fixed station and responds, like a fire-boat, to calls made by the inspector who patrols the harbor in search of surface oil.

Harbor Engineer Hill makes the statement that one large shipyard disposes of waste oil estimated by the yard's superintendent at 20,000 bbl. annually. Much of the surface oil comes from the tanks of steamers which go to repair yards. This oil is unfit for use because it is full of scale and water and has lost life through the roasting heat of the steam coils used to heat the oil to make it flow.

The presence of oil from this and other sources causes a serious fire menace and its removal is highly desirable. Many port authorities believe that Baltimore has solved the problem.

Cost of Peen-Hammering Concrete Road Surface

By T. M. Ripley
Division Engineer, New York Commission of Highways, Hornell, N. Y.

CONCRETE road surfaces are to be finished, according to the New York State specifications, as follows:

> The surface of the top course shall be tested with a ten (10) foot straight edge laid parallel with the center line of the road upon any portion of the surface, and any depression or other regularity exceeding one-half (½) inch shall be satisfactorily eliminated as directed.

In conforming to these specifications on certain road work in 1922 it was necessary to dress down the pavement at various places over a distance of about 7,000 ft. The places dressed were naturally very irregular in shape but from a close inspection and estimate it was determined that an area equal to 687 sq.yd. was dressed over at a cost of $571.50 which is equal to $0.83 per square yard.

This work was done late in November and early in December, there being one foreman and from three to ten laborers engaged. There was a total of 180 hours foreman and 1,030 hours labor which at the rate of $0.60 per hour for the former and $0.45 per hour for the latter, gives a total cost of $571.50. The work was done by hand; each laborer using a 6-lb. peen hammer.

From Job and Office

For Contractor and Engineer

Device Supports Finishing Machine in Concrete Street Paving

By G. E. Wright

Assistant City Engineer, Gloversville, N. Y.

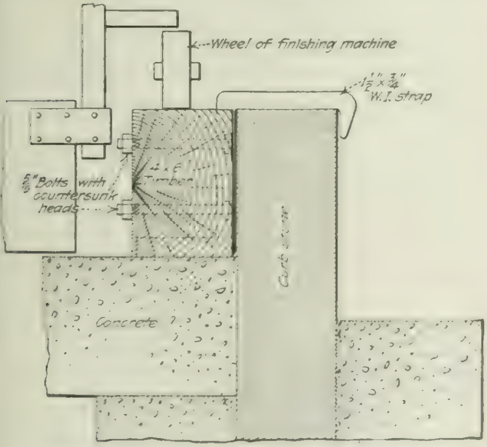
On account of numerous driveways which break the continuity of the curb line, it is impractical to support a heavy finishing machine on curbs in concrete street paving. Every time a driveway is encountered the machine must either be jacked upon a plank and readjusted to grade, or carried on loose planks on top of the curb, both of which methods are unsatisfactory.

To overcome this difficulty the writer devised a method of supporting the machine along the outside of the curb by means of a 4x6-in. timber hooked to the curb by a series of heavy iron straps. The sketch indicates the method employed.

The timbers used usually were 16 ft. long so that driveways could be easily spanned and the concrete paving made a continuous operation. In case the 16-ft. length was insufficient, an extra 5-ft. length was provided.

Inasmuch as the gutters were 6 in. deep, a 4x6-in. timber made the street surface flush with the bottom of the finishing machine supports. Therefore the use of the timbers in no way interfered with pouring the concrete.

The straps were countersunk in the timber and were so spaced that one was placed about a foot from either end, the two other straps dividing the intervening space into thirds. This spacing of the straps seemed the most desirable to offer the greatest rigidity to the device. The straps were made of $\frac{3}{4}$-in. x $1\frac{1}{2}$-in. wrought iron or steel stock and were fastened to the timbers with two small bolts with heads countersunk on the curb side. Large wooden screws were tried but because of rough handling these soon pulled out.


Wheel of finishing machine
$1\frac{1}{2}$" x $\frac{3}{4}$" W.I. strap
$\frac{5}{8}$" Bolts with countersunk heads
4 x 6 Timber
Curb
Concrete

TIMBER SUPPORT FOR FINISHING MACHINE

A 4x6-in. timber 16 ft. long is hooked to the curb by a series of iron strap hooks. [illegible] the under side of the timber

On this work, which was done for the city of Gloversville under contract by Morrell Vrooman, Inc., an adjustable gage was used which weighed about 1,000 lb. when set for a 26-ft. roadway.

The work was in direct charge of the writer under H. J. Hanmer, city engineer. The contractor's superintendent was George M. Nagany.

Portable Plant Used in Replacement of Pipe Line Sills and Cradles

The decayed condition of the wooden cradles and sills on the wooden stave pipe line of the Northwestern Electric Co. on the White Salmon River hydro-electric plant in Washington, has made it necessary to replace approximately 1,200 cradles. This pipe line is 13 ft. 6 in. in diameter, 4,987 ft. in length and is supported on wooden cradles set on wooden sills. The wooden sills and lower cradle ties have decayed and are being replaced with wooden cradles on reinforced-concrete sills. As some of the cradles were in worse condition than others, it was necessary to replace them in the order of their respective deterioration.

POURING CONCRETE SILLS FROM TRACK ON PIPE LINE

In order that this might be accomplished economically, it was necessary to provide equipment which could be readily moved from point to point. A concrete mixing plant was located at a central point directly on the pipe line where all material could be supplied by gravity chute from a near-by road. A 24-in. gage track with 4-in. x 4-in. fir rails protected with strap iron was laid on top of the pipe line for its full length. A 3-hp. motorboat engine provides the motive power for the concrete dump car shown in the accompanying illustration. This motor is capable of pulling the two dump cars used on the job at a speed of from 3 miles to 4 miles per hour and in addition handles all cradle material. Two hoppers with "elephant trunks" were constructed for handling the concrete.

The "elephant trunks" were made of sectional iron pipe to conform to the curvature of the pipe line so that the concrete could be placed in the forms without the necessity of hoeing or shoveling. The equipment is provided with removable dolly wheels which can be easily attached and the whole apparatus towed with the gasoline motor from one location to another. Portable forms are used for the concrete sills, which are 18 ft. x 12 in. x 18 in. and are reinforced with steel bars.

An average of eighteen sills per week is poured, which indicates rapid progress considering the occasional long moves.—*Electrical World*.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

A Word for the Chief with Faith in His Men

Sir—In engineering offices there are two kinds of employers. Did you ever meet them? One expects you to follow the beaten track. He seems to want you to stop thinking except as he directs. No one dares to disagree with him and you avoid asking questions for fear he will tell you not to use your pet stunt for economizing. You feel like saying, "Get off my back." The other drives with a loose rein; says, "Go ahead, and think it out for yourself."

An engineer is not a private soldier. Methods of unquestioning obedience all right for the army don't go in an engineering office, where every one ought to take an *intelligent* interest in the job. Often the man actually doing the designing or planning is in a better position to decide difficult questions than the chief engineer or chief draftsman whose mind is on other jobs; yet the subordinate, if he has a good chief, will often want to ask advice, talk over points, and feel for possible reasons.

A plague on the man over you who withholds reasons, who seems to be keeping something up his sleeve he doesn't choose to tell; until you wonder whether there *is* any reason or whether it is just bluff. Engineering is not poker.

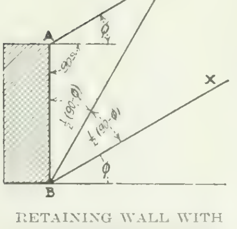
Blessed be the boss who can command respect by his superior judgment, experience, and knowledge, but yet has the grace to say, when he really doesn't know, "You know as much as I do about this; follow your own judgment." For such a one I would work early and late with a happy heart.

SUBORDINATE ENGINEER.

Jan. 24.

Retaining-Wall Pressure With Sloping Surcharge; Inconsistent Formulas

Sir—The discussions of the "equivalent liquid pressure" method of figuring the stresses resulting in bins and retaining walls, in various recent issues by Jacob Feld and Edward Godfrey, were of unusual interest to me. I have questioned the current methods of design and some ten years ago tried to stimulate discussion which might result in more light on the subject, but failed to attain this object.



RETAINING WALL WITH SLOPING SURCHARGE

An interesting point about the sloping-surcharge formula is brought out by the following example: The wall is surcharged with the same material which composes the backfill, in other words it retains a sloping embankment at a certain height. For simplicity we will assume a rectangular section of wall, the inner line being AB, retaining an embankment the surface of which is AZ, forming an angle ϕ, equal to the angle of repose of the material with the horizontal. The line BX from the bottom of the wall is parallel to this top surface. Bisecting the angle ABX we have plane BC forming the angle $\frac{1}{2}(90-\phi)$ with the vertical, while the wedge ABC is a measure of the pressure against the wall AB. In the triangle ABC, the angle at B is $\frac{1}{2}(90-\phi)$, that at A is evidently $90+\phi$, so that the angle at C must be $\frac{1}{2}(90-\phi)$ to result in 180° for the triangle; in other words, the triangle is isosceles with the side AB equal to the side AC. The area of the triangle is $\frac{1}{2}h^2 \cos \phi$, and the weight of this wedge per foot width of wall is $\frac{1}{2}wh^2 \cos \phi$.

On the other hand the standard formula for the total pressure P which a wall would have to resist, in retaining an embankment with sloping surcharge equal to the angle of repose of the material retained, is $\frac{1}{2}wh^2 \cos \phi$, which is identical with the total weight of the wedge to be retained.

This is evidently inconsistent as compared with a non-surcharged wall, in which case the weight of the wedge is $\frac{1}{2}wh^2 \tan \frac{1}{2}(90-\phi)$, while the pressure is $\frac{1}{2}wh^2 \tan^2 \frac{1}{2}(90-\phi)$, or somewhere between one-half and six-tenths of the weight of the wedge retained.

There seems to be no reason why the weight of the wedge retained, modified by the factor $\tan \frac{1}{2}(90-\phi)$, should not be used for figuring the pressure against a wall, with the angle of repose reduced for long sloping surcharges, which tendency is evident on railroad embankments and is usually taken into consideration. Slopes of 1½ to 1 are figured for heights of embankment up to 10 or 15 ft., 1.6 to 1 for heights up to 20 or 25 ft., and 1.7 to 1 above this figure.

We would then, I believe, have some consistent method of figuring retaining wall pressures for various conditions.

M. HIRSCHTHAL,
Concrete Engineer.
Delaware, Lackawanna & Western R.R.

Hoboken, N. J., Jan. 5.

In Defense of Broadcasting

Sir—In your recent editorial on "Broadcasting Practices" you absolved the operations of WJZ from commercialism in broadcasting the discussion on "The Human Factor in Industry" held at the joint meeting of the American Society of Mechanical Engineers and the American Economic Association, but you did not touch upon the motives that lay behind this undertaking. May I be permitted to explain what these motives were?

One of the useful things that radio gives promise of doing is to assist in conveying to the public the plans of engineers for the promotion of social progress. An effective medium between our economic, industrial and scientific leaders and the public at large has always been badly needed. It is notoriously difficult to interest the average man in abstract ideas. He will not attend meetings or lectures; he will not read articles on subjects that do not apply to his own personal and immediate needs; and if the views of engineers are "popularized" in the newspapers, they are apt to be sensationalized and distorted beyond recognition.

Radio, however, appears to offer a solution to this problem, because it can bring facts to hundreds of thousands of people without the slightest physical or intellectual effort on their part. Investigation of A.S.M.E.-A.E.A. broadcasting showed that thousands of listeners were surprised to discover that engineers and economists do not always "crunch dry bones" at their meetings, but sometimes discuss matters of the livest interest in a thoroughly intelligible manner, and that they are actually interested in workmen as human beings and not merely as producers of profits.

For over a century, the effort has been made to educate the American people into a distrust of the expert, a contempt for the intellectual, and a fear of the vested interest. Radio, by presenting the real facts of the case to the public, can do much to counteract such teaching. Surely, no newspaper, however yellow, can convince those who heard the engineers-economists broadcasting that the ideals of the speakers on that occasion are contrary to public welfare. To make clear to the American nation that its true leaders are not the demagogues, but the thinkers and the doers of constructive things, would be a great achievement. Radio is the most satisfactory instrument yet devised for attaining this end.

Of course, not all engineering meetings should be broadcasted. Too many papers are indeed "dry bones" for the majority of people. But wherever possible, meetings concerned with single topics of wide human importance should be given to the world by radio.

W. N. EASTON,
In Charge.
WJZ Radio Broadcasting Station

Newark, N. J., Jan. 10, 1923.

The Ventilation Question Again

Sir—I feel that some reply is necessary to Professor Winslow's letter regarding ventilation, as published in your issue of Dec. 28, p. 1133.

It seems to me that Professor Winslow's letter is quite likely to create the impression that modern ventilating methods are a failure, and that we might just as well step back fifty years or so to window ventilation. The spreading of this impression would be most harmful to the public health.

In the first paragraph Professor Winslow calls attention to the fact that "air conditioning as a factor in building up vital resistance should be emphasized"; then in the second paragraph he shows that the research work done in New York "makes it clear that overheating of occupied rooms is a factor of the first importance in reducing efficiency and increasing respiratory disease"; then, again in the third paragraph, he says that modern ventilation ideas put emphasis on temperature control. All of these points argue against window ventilation. The statement that the supplying of 30 cu.ft. of air per minute per person is "positively harmful, since such an excessive air supply tends to overheating, discomfort, and increased respiratory disease" should not be accepted as a fact. It is not at all necessary that the supply of any stated volume of air should tend toward either overheating or discomfort, the elimination of these objections being a simple engineering proposition.

I believe that the majority of people in the construction industries will agree with Mr. Harris that "windows are for light only." Where is there any judgment shown in making windows a given height for lighting purposes, then cutting off part of this at the bottom by the insertion of a board to deflect the air when the window is open?

The use of open windows and gravity exhaust ducts for the removal of vitiated air is entirely dependent upon atmospheric conditions, and it has been thoroughly demonstrated that in systems of this kind, rooms on the leeward side of the building will be found getting air from the corridors and exhausting it through the windows, rather than through the exhaust ducts. This, of course, means they are not getting fresh air. This system will not allow temperature control of air conditioning; the temperature control feature being entirely dependent upon the whims of the occupants of the room, and in the case of a school house, this usually falls to the judgment of the teacher, leaving thirty or forty children to take their ventilation as the teacher sees fit.

Professor Winslow's closing statement must have been written without thought, as the amount of heat required is the same, irrespective of whether the fresh air is forced in by a fan system or is allowed to make its way in through open windows or other openings provided. The only way the gravity system could ever require less heat than a fan system would be if the air supply by the gravity system was not the same as the fan system, and this would be a condemnation of gravity ventilation.

St. Louis, Mo., Jan. 5, 1923. F. J. McMorran.

Sir—I trust that I may be permitted space to rebut some of the foregoing criticisms of my letter of Dec. 28.

In the first place I want to make it clear that the New York State Commission on Ventilation found window ventilation alone, without gravity exhaust ducts, most unsatisfactory, so that we would by no means advocate returning to the practice of fifty years ago. Our conclusions as to the adequacy of window ventilation plus the gravity exhaust duct are not based on *a priori* opinion but on the results of four years of intensive experimentation. The statement that "an excessive air supply tends to overheating, discomfort and increased respiratory disease" is a fact and the elimination of these objections is not "a simple engineering proposition." If there is a flow of 30 min.-ft. through a room the face and other exposed parts of the body will be chilled if the temperature of the air is not raised; and if the temperature of the air is raised the clothed portions of the body will be too warm. Furthermore, with a large air flow it is impossible to avoid a nonuniformity of conditions from moment to moment in different parts of the room that is prejudicial, as our investigations have shown, not only to comfort but to health. Against Mr. McMorran's statement that the system of window ventilation and gravity exhaust will not allow temperature control of air conditioning we must set the results of our exhaustive investigations which show that the conditions maintained by this system are actually substantially superior to those obtained by fan ventilation.

Finally I must dissent from the statement that I was writing "without thought" when I emphasized the financial saving involved in the window inlet and gravity exhaust system. The gravity system requires less heat precisely because it requires less air than the fan system and this is not "a condemnation of gravity ventilation" because a lessened air supply is precisely what is needed for comfort and for health.

The heating and ventilating engineers cannot be held in the least to blame for the unsatisfactory results which have been obtained from their systems. They have faithfully attempted to fulfil the hygienic requirements of an earlier day which called for a large air supply. The physiological studies of the last twenty years have shown that these older standards were fundamentally in error and the work of the New York State Commission makes it abundantly clear that such an excessive air supply as 30 min.-ft. is uncomfortable, unhealthy and expensive.

New Haven, Conn., Jan. 16. C.-E. A. Winslow,
Professor of Public Health,
Yale School of Medicine.

Paint to Prevent Rusting Between Plates

Sir—In an editorial in this journal of Dec. 21, 1922, p. 1,053, attention is drawn to the danger of rust between plates, etc., in bridgework caused in some cases by an insufficient number of rivets. Painting the surfaces prevents rust.

On the heavy Ohio River bridge at Sciotoville, Ohio, Mr. Lindenthal required on such surfaces a red-lead paint containing 40 lb. pigment to a gallon of oil, probably the heaviest paint which had been used for that purpose. Suppose this spread at a rate of 500 square feet per gallon, it would be about 0.003 in. thick, or the total filling is 0.006 in. Is this enough to fill the space left in such places, or would it be better to have two such coats provided? The cost of the paint on these small areas would be inconsiderable. The requirement cited, moreover, represents the best practice; usually the paint is not more than 25 lb. red-lead to the gallon, and if left to the discretion of the shop painters, 18 lb., and the film is not more than two-thirds the above thickness.

I have been told that paint in these places does no good; that when hot rivets are put in the rivet-holes the paint is all burned out. This is not true. In the first place, the pigment, no matter what it is, is incombustible. Second, while true enough that some pungent-smelling smoke comes up from the hot rivet, from the burning of the minute amount of oil in the film when the hot rivet touches it, this burning does not spread far; oil is not injured by a temperature of 600 deg. F., and the mass of metal in the steel plate does not get heated to that temperature, more than a very minute distance from the rivet, so that the destruction of the paint is almost or quite negligible. The smoke of the burning oil may penetrate the crevice and discolor it for a small distance from the rivet-hole, but that is only dirt on the paint-film; it may not look well if it is cut open, but it indicates that there was not enough solidified paint to fill the crevice. It is chiefly the sight of the smoke and its smell which alarms the inspector, and nearly all of this comes from burning off the paint under the flange of the rivet-head, entirely outside the joint; this should always be taken care of by an extra coat on rivets, as has been practiced by some careful engineers for 25 years past.

Moreover, the first field coat ought to be just as good paint as the shop-coat; too often it is not. This whole matter of bridge-painting is entitled to more serious consideration than it often gets. A. H. Sabin.

New York, Jan. 11.

A French Endowed Hydraulic Laboratory

Sir—*Engineering News-Record* of June 24 and of July 8, 1920, contained articles of interest to the advocates of an endowed hydraulic laboratory in the U. S.; a laboratory intended to do work in practical hydraulics, after the manner in which that kind of work is done in astronomy, in endowed astronomical observatories. Quite recently, John R. Freeman, then President of the American Society of Civil Engineers, and others advocated before a Sub-Committee of the U. S. Senate the establishment of such hydraulic laboratory by the government, for the uses and in support of the several governmental departments. As a further news item, and record of world progress made in this line, it may be noted that the "Société Hydrotechnique de France" has been constituted at Grenoble, largely, or mainly, by the efforts of Augustin Blanchet of Rives, Isère, a paper manufacturer, on the same spot where his forebears have toiled these 300 years, originally as iron-masters. In November last, the laboratory of the Société was inaugurated in the presence of members of the French government, and of many engineers and others.

An account of the banquet and speeches made there, would indicate that this "beautiful scientific and industrial initiative" bids fair to make many valuable contributions to our common knowledge of practical hydraulics.

New York City, CLEMENS HERSCHEL.
Jan. 29, 1923.

What the Sales Engineer Does

Sir—The letter from A. W. Bedell and the editorial that appeared in *Engineering News-Record* of Dec. 28, 1922, are interesting. What do most of the so-called sales engineers actually do? This question appears in the editorial. Speaking from three years experience, as a sales engineer, I would say a sales engineer gives advice to engineers and sells materials, although in some cases as stated in the editorial, he may not have authority to close an order. However, this is not generally the case.

Technical advice is usually given to engineers. No city engineer or even consulting engineer becomes thoroughly acquainted with materials, their manufacture, comparative qualities, adaptability for various uses, length of life, etc., as a sales engineer in his particular line. It is never good policy for a real sales engineer to give advice to a man not in the engineering profession. If he does, he antagonizes the engineer with whom he interferes and as the majority of materials are sold through engineers, the man interested in sales is cutting his own throat.

Besides giving advice, the sales engineer, in collaboration with practicing engineers, actually designs. During the past year in the office of the firm with whom I am associated, we have designed one water-works pumping station, changed details of design on one rapid sand purification plant, designed one complete distributing system and five extensions to various water-works systems as well as a number of small siphons and layouts for pressure regulating and Venturi meter installations. Remuneration for such designs in every case has gone to the practicing engineer and in some instances the firm the writer represents has not received the order for materials. But in every case we have acquired the good will of the customer—a valuable asset only to be purchased with good service.

The sales engineer actually acts as a consulting engineer, in his particular line, to other engineers. He is a specialist. His recommendations are based on intimate and confidential knowledge of materials that is not even available, sometimes, to a practicing engineer. The ethics of the profession are still with an engineer after he becomes interested in the commercial end of the game. We have recommended a number of times, materials for certain uses or locations carried by our competitors, and the competitors, most of whom are sales engineers, often return the compliment. If you advise a customer to buy an article which does not suit his needs he will find it out and his good will is lost.

There are not many sales engineers who have not had an engineering education and training. When attending public lettings it is very noticeable that many representatives of the firms bidding either on material or labor are members of the American Society of Civil Engineers. The requirements for this are very well known. Engineers representing various materials are chosen on account of their actual experience as an engineer with these materials. They are not selected on account of their ability as salesmen, which is often very questionable.

As to credit given by engineering societies for the work of sales engineers, it varies as much as with the practicing engineer—some design, some supervise construction after the goods are sold, and a few do very little but sell. As to the name, if the profession desires that it be changed, little actual opposition would be met. Personally, I should not like to be counted out of the profession entirely, for I do as much engineering work now as I ever did. To the engineer who has entered the commercial world, certainly should be given some title properly cognizant of his training and standing as an engineer. The word "engineer" has certainly been mistreated, and if we sales engineers must protect it, I, for one, will co-operate, as will the firm by whom I am employed. My title was not suggested by the firm, but was my own choice. C. E. PAINTER,
Sales Engineer, D. C. Dunbar Co.
Salt Lake City, Utah, Jan. 9.

Brick Paving in the City of Panama

Sir—In 1906, the writer was in charge of the paving of the streets of the City of Panama subsequent to their upheaval by the introduction of water mains and sewers.

Trenching in the narrow streets had destroyed the old cobble pavements on a heretofore solid foundation of natural hard clay and the entire built-up section of the city comprising some 5½ miles of street was repaved with vitrified brick, using a concrete foundation except in the regions of lightest traffic. Pavements, varying from 15 ft. to 30 ft. in width, were given a fairly high crown on account of the heavy rainfall, and were laid between concrete curbs. The joints were filled with grout.

In all, about 65,000 sq.yd. were laid in the city in 1906 and 1907. On the completion of this work, the writer removed to other regions and did not again see Panama until recently, after a lapse of 15 years. It was a matter of considerable interest to note the present good condition of the original brick pavements which have had a long and severe service test.

Practically all of the original pavements were found in place except for a few changes due to street openings or widenings and the building of a tram-way in the main street.

It should be noted that these pavements were designed for a traffic of horse-drawn vehicles only. After their completion, the first automobile was brought to the Isthmus in the shape of a privately owned, French-built touring car. The use of motor vehicles for commercial purposes had not been thought of when the pavements were designed. Today, however, and for some years past, the city of Panama has had heavy motor truck traffic, including that to and from the nearby army posts.

On the heaviest traffic streets there was some wear of the brick noticeable, and some maintenance had been required. Elsewhere the original brick pavements showed little wear considering their age and the changed conditions.

Brick was originally selected because it was thought that it would prove satisfactory under the contrasting conditions of the torrential rains one half the year and the heat of the other half. It was also a consideration to obtain a material that could be quickly laid without a complicated plant or specially skilled labor. In 1906 labor was scarce and when the work started, the writer had less than half a dozen men who had ever seen a pavement laid. The bulk of the work was done by unskilled Jamaicans who soon acquired ability and speed.

That materials and workmanship were good and a suitable type selected is apparent from the service given for a period which is entirely adequate considering the changed conditions. HENRY WELLES DURHAM.
New York, Jan. 5, 1923.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

There has been introduced into the New York State Senate a bill calling for the appropriation of $5,000,000 for the construction of an administration building on state land west of the Capitol building, in Albany.

A number of research scholarships in highway engineering have been established at Iowa State College for the summer session of 1923. These are available to students who are qualified to assist in the regular research work of the Engineering Experiment Station.

Tuesday, February 13, has been set as the date for a joint legislative hearing in the New York legislature on the state fund bill of the Lockwood Housing Committee; the bill regulating the disposition of stock investments of insurance companies; the bill creating a trade and commerce commission and the measure regulating trade unions.

Proposed electrification of the Grand Trunk lines between Niagara Falls and Toronto and eastward of Toronto will be studied by a board of technical experts who will be appointed to inquire into its feasibility, according to an announcement by Sir Henry Thornton, president of the Canadian National Railways.

Three more generators have been ordered for the Chippawa-Queenston hydro-electric power development, the purchase having been approved by the Provincial Government. Four generators are now in operation and a fifth is being installed. The additional three will give the power house at Queenston a total capacity of between 400,000 and 480,000 hp.

The Senate on Jan. 25 passed a resolution by Senator McCormick, of Illinois, providing for the appointment of a senatorial commission to investigate the problem of a 9-ft. channel in the waterway from the Great Lakes to the Gulf of Mexico. The resolution specifies that three members of the committee are to be Republicans, and two Democrats.

Senator Alexander Simpson has introduced a bill in the New Jersey Legislature for a referendum election to repeal the $40,000,000 bond issue law adopted by the voters November last. The bill proposes that the question be submitted to the voters at the November election this year. Another bill will be offered by Senator Simpson in the event that the first is killed. The second will provide that funds for road construction shall not be expended except when specifically appropriated by the legislature.

A. G. C. Completes Successful Convention

Lost Time in Construction, War-Fraud Suits and Indictments Furnish Discussion—Dues System Revised

Engineering News-Record Staff Report

CONSIDERATION of methods whereby lost time in construction could be eliminated; reaffirmation, by resolution, of confidence in the form of contract under which war-time construction was prosecuted, and an appeal in the same resolution for the public to withhold judgment of war-fraud suits and indictments until trials had been disposed of; discussion of problems affecting particular divisions of the industry; and a decision to abolish the present dues system, were the high spots in the last days of the convention of the Associated General Contractors of America, held last week in Los Angeles. A preliminary report of convention proceedings was given in last week's issue in these columns. Abstracts of convention committee reports will be found on pages 260-262.

At Wednesday morning's session in presenting the report of the committee on methods. A. P. Greensfelder, chairman, emphasized the need for increasing the working season and urged each chapter to send in suggestions on the subject. Planning work well in advance and winter discounts would help, he said, as would also the study of methods of continuing work in wet and cold weather, such as the use of caterpillars when wheeled vehicles are no longer effective. He recommended that all members read the series of articles by C. S. Hill in *Engineering News-Record* on "Lost Time in Construction."

How Railroads May Aid

Railroads should be shown the advantage of establishing seasonal rates for construction materials during times of light traffic. This would help the railroads and would facilitate advance planning on construction. Reciprocal demurrage whereby shippers would be compensated for delayed deliveries would be quite as logical as penalizing the shipper for delay in unloading cars. If railroads set the date of delivery when accepting shipments and stated in the manifest the time allowed each division for handling the freight, responsibility for delay could readily be fixed. Because of the high cost of labor turnover the average foreman should not have unlimited authority for arbitrarily discharging workmen. Instead, necessary discipline should be maintained as far as possible by the alternatives of transfer and suspension.

Investment in power equipment is good economy, it was suggested, but each piece of machinery should be entered on the payroll by number, and its cost and earnings should be carefully studied to determine its usefulness. A sample A. G. C. manual was shown which consisted of a loose-leaf binder in which members could file data sheets on equipment, contracts, insurance, labor, etc., as sent out periodically by the association.

In an address on "The Skill Element in the A. G. C. Slogan," E. J. Mehren, Editor, *Engineering News-Record*, pointed out that knowledge of management, methods and the use of equipment constitute a large part of the contractor's stock in trade and require continual study. He supplemented Mr. Greenfelder's suggestions with three more, namely; (1) that local chapters

London Underground Extension Awarded to Foundation Co.

Contract for the extension of the London Underground Ry. from Hendon to Edgware has been awarded to the Foundation Co., New York City. The new line will be about 3 miles long and the contract involves £258,000.

The extension will serve Colindale, Burnt Oak and Edgware at each of which places stations are to be built. It is hoped that the work will be completed by the end of 1923.

New Jersey Bill Would Open Road Specifications

A bill has been introduced in the New Jersey legislature declaring for open specifications for competitive bidding in the expenditure of the $40,000,000 highway bond funds. The keynote of the bill, which was introduced by Senator Mathis, of South Jersey, is found in the fifth paragraph, part of which reads: "It shall be the duty of the board of public body in charge of the (road) work that specifications are so drawn that the competition is in every way fair and reasonable."

House Raises Appropriation for Rivers and Harbors

Washington Correspondence

Action by the House of Representatives increasing the appropriation for river and harbor expenditures by nearly $30,000,000 more than that recommended by the director of the budget has had its influence on the Senate where the prospects are that the $56,589,910, the amount voted by the House, will be approved.

The amount voted by the House was the total of the estimate submitted to the director of the budget by the chief of engineers. The appropriation is subdivided as follows: Principal seacoast harbors, $19,683,410, maintenance, $7,375,400; secondary harbors and coastwise channels, $7,860,900, maintenance, $1,509,600; lake harbors and channels, $1,726,000, maintenance, $1,450,800; principal rivers, $13,726,000, maintenance, $2,249,000; secondary rivers, $[illegible], maintenance, $[illegible] endeavor to compile, classify and report to headquarters elements of construction costs; (2) that data be compiled on the proper use of equipment giving particularly the functions and limitations of different types; and (3) that data on the management of labor be compiled to show how to handle labor to best advantage, how to hold it over during slack times, etc.

QUANTITY SURVEYS DISCUSSED

Except for a vigorous plea by Alfred Carlson, Seattle, for the proper protection and care of equipment while not in use, much of the discussion at this session referred to quantity surveys. The quantity survey plan to which sixteen Milwaukee contractors subscribe was explained by W. F. Tubesing, who believed that the plan benefits all and hampers none of those who use it. In Milwaukee the central bureau compiles and tabulates quantities on all masonry and concrete work, the intent being to protect members from the danger of error in estimating quantities. This does not obviate the need for each individual contractor to look over personally the work and determine the best layout and construction plan.

At Thursday morning's session of the building division F. J. Twaits, Los Angeles, read a paper on "Architects as General Contractors" in which he defined the function of the architect as showing the owner what to get while the contractor's function is to show him how to get it. Each is a business in itself and the architect who subdivides the work unto a great number of small contracts which he personally supervises virtually becomes a contractor.

The question of admitting to membership men who engage in both designing and contracting was discussed at length and although opposite views were expressed the concensus of opinion favored taking in such members and afterward proposing any necessary changes in policy. The man who has ability in both professions cannot be put out of business and the association would only be weakening itself by refusing him membership. Edward Haupt, Chicago, suggested that perhaps licensing laws would aid in keeping each profession within its proper field. Alfred Carlson, Seattle, pointed out that general contractors who sublet an entire job in small contracts and then fail to keep adequate personal supervision on the work provoke the architect into dividing jobs up into small contracts and supervising these himself to avoid paying a percentage to general contractors.

BIRMINGHAM QUANTITY SURVEY

Discussion on quantity surveys begun in the previous session was continued with lively interest, although not all were convinced that the plan was economical. J. G. Tidwell described the quantity survey plan used in Birmingham, Alabama. The plan has been in use there for a year, covers all items on each job, and has effectively prevented wide discrepancies in bids. Godfrey Edwards, Los Angeles, suggested that the quantity survey idea might be tried out by any chapter or by a group of members on one job before attempting its more general introduction. Mr. Twaits pointed out that the most could not be expected from quantity surveys unless contractors and the central bureau estimators used the same accounting forms and methods of listing unit quantities.

After vigorous expression of opinion disapproving the indictments and war-fraud suits, the following resolution was adopted by the **A. G. C.** in Los Angeles last week:

"Whereas, when war was declared in 1917 the unpreparedness of this country developed the necessity of constructing as a precedent to the training of our army and the manufacturing of munitions; and,

"Whereas, it is a fact that the fate of the world was in balance, depending upon the speed with which this country could develop its facilities in men and munitions; and,

"Whereas, as a consequence thereof it was recognized that the utmost speed in construction must be attained; and,

"Whereas, the surest measure of the wisdom of the procedure adopted by the War Department is that it accomplished the result, and the consideration at this time of other plans can only be conjectured; and,

"Whereas, the Department of Justice of the U. S. Government has secured indictments for conspiracy against seven former war officials in connection with construction and has sued 11 general contractors who built 11 of the original cantonments; and,

"Whereas, the bringing of these eleven suits and securing the indictments of the seven former government officials calls for a defence of the construction industry before the bar of public opinion by this body and a request for a suspension of judgment by the public until after the trial of these cases;

"Therefore, be it resolved, that we agree with and reaffirm the approval of the form of contract and procedure of war construction contracts made by the committee of technical experts headed respectively by A. N. Talbot, then president of the American Society of Civil Engineers, and by Francis Blossom, of the firm of Sanderson and Porter, quoting from the latter as follows: 'The board finds that the use of this form of contract as finally developed was well justified and contributed to the success of the emergency program; that by its use speed was obtained in war construction projects; and that it is probable that such work could not have been performed in the time without it or its equivalent;

"Be it further resolved that no act of an individual, no overzealous public official, no propaganda, can dim the pride and honor we have in the men who planned and built the work needed to win the war, and when again our safety and civilization are in danger we will honor and applaud men with the skill, ability and courage to get results in spite of rules, regulations and red tape;

"Be is further resolved that the Associated General Contractors of America in convention assembled in Los Angeles, Calif., demand the immediate trial of all these proceedings: that we look with suspicion at any delay; and that every member of our industry throughout the land should insist and demand through every avenue of influence that may be available to him that the Department of Justice be challenged to prove the charges it has made."

At Thursday afternoon's session the quantity survey discussion was concluded by a motion that the chair appoint a committee of three selected from the advocates of the plan to prepare and submit to the committee on methods details of a quantity survey plan such as seemed most likely to be generally useful to association members, this to be the foundation for later recommendation by the committee on methods. The chair appointed on this committee W. F. Tubesing, Milwaukee, Wis., J. G. Tidwell, Birmingham, Ala., and W. F. Creighton, Nashville, Tenn.

In his discussion on "How to Eliminate the Irresponsible Bidder," W. A. Simpson, Los Angeles, said many bonding companies investigate only the honesty of the financial standing of the contractor before writing his bond, although more failures are caused by lack of judgment and skill than by insufficient resources. Since the law frequently makes it necessary to award to the lowest bidder, one of the prerequisites to eliminating irresponsibles is to get bonding companies to raise the requirements put on contractors. Incidental to the discussion of bonds it was suggested that since owners require a bond from the contractor he in turn might well safeguard his own interests by requiring of the owner a bond guaranteeing payment within thirty days after satisfactory completion of the job.

IRRESPONSIBLE BIDDERS

J. C. Edwards, chairman of the building division, suggested that perhaps contractors themselves shared with bonding companies, architects and material men responsibility for the existence of irresponsible bidders by not showing the latter the dangers of improperly figuring costs. Contractors who are unsuccessful because they do not know how to figure costs need education on that score after which they have a chance to get out of the irresponsible class. It would also help in eliminating irresponsibles, it was suggested, if material men could be induced to be more careful about assuming responsibility for such operators.

Officers of the building division elected for 1923 were Col. J. R. Wiggins, Philadelphia, chairman, and W. F. Creighton, Nashville, vice-chairman.

In the first session of the highway division Walter Gillette, Los Angeles, discussed the construction of public works by day labor. Contending that contractors should endeavor to inform the public on the wastefulness of the practice, he believed that the public would put a stop to it if it had the facts. The newspapers need to be informed regarding the high costs of day labor work.

On the subject of contracts W. F. Creighton contrasted the satisfactory relationships in performing the work under the standard contract documents of the American Institute of Architects with the stress and difficulty in working under the usual forms of public works contracts. He urged that there be conferences with engineers and committees of engineering societies to the end that more equitable contracts, as those being worked out by the joint committees of the Associated General Contractors, be adopted.

In the annual report of the highway division H. H. Wilson, the chairman expressed the appreciation of the Asso-

(Continued on p. 277)

George W. Fuller Nominated for President Am. W. W. Assoc.

The nominating committee of the American Water Works Association has submitted the following ticket of officers for 1923-24: President, George W. Fuller, New York City; vice-president, Frank C. Jordan, Indianapolis; treasurer, William W. Brush, New York City; trustees, District No. 2, Charles R. Bettes, Far Rockaway, N. Y.; District No. 5, Edward E. Wall, St. Louis. Under the constitution additional nominations may be made by means of a petition of twenty-five members filed with the secretary up to noon, March 1. If there are no other nominations the officers named by the nominating committee will be declared elected without ballot. The election results will be announced at the 43rd annual convention of the association, which will be held at Detroit, May 21-25.

Knickerbocker Demurrer Denied

Denying the demurrer of the Knickerbocker Theater Co. to damage suits (see p. 226, Feb. 1) on account of the roof collapse of Jan. 28, 1922, the Supreme Court of the District of Columbia on Feb. 2 held that the proprietor of a place of amusement is charged with positive knowledge of its reasonable safety for its purpose.

Gas Plant Wrecked by Purifier Explosion

A gas explosion in the purifier house of the Springfield Gas Light Co., Springfield, Mass., on Feb. 1, wrecked the building and damaged much nearby property. Three men were killed. The cause of the accident has not been finally determined, but it is thought that a leak in one of the purifier boxes allowed gas to accumulate in the building, the explosive mixture finally becoming ignited in an undetermined way.

Tanana River Bridge Completed

Completion of the 700-ft. truss span of the Alaska R.R. across the Tanana River was announced on Jan. 25 by Col. Frederick Mears, chief engineer of the Alaskan Railroad Commission. This is the last important structure on the line. The Metropolis bridge across the Ohio River has the only simple truss span exceeding the Tanana.

Appointment of Single Tennessee Road Commissioner Contested

Two of the three highway commissioners in the state of Tennessee forced out under a reorganization bill passed by the state legislature whereby the state highway department of three members was replaced by a single commissioner of public roads and buildings, have filed an injunction seeking to restrain the single commissioner from taking office. J. G. Creveling, Jr., former county engineer of Davidson County, was recently appointed by Governor Peay as the commissioner of public roads and buildings. The three-man commission was comprised of one commissioner each from the three congressional districts in the state.

The injunction arguments will be given an early hearing before the State Supreme Court at Nashville.

Indianapolis Chamber Recommends Resurfacing Cost Plan

The Committee on Civic Affairs of the Indianapolis Chamber of Commerce, after several months' investigation of methods of financing the resurfacing of improved streets, has adopted a resolution favoring the payment of three-fourths of the cost of resurfacing from the general funds of the city, the other one-fourth to be paid by the owners of the properties. The Committee on Legislation will endeavor to have this resolution put into the Indiana law.

House Moves Toward Amendment to Curb Tax-Exempt Bonds

Washington Correspondence

With seven votes to spare, the House of Representatives on Jan. 23, rather unexpectedly, passed the joint resolution proposing an amendment to the constitution of the United States intended to prevent the issuance of tax-exempt securities. The belief is quite general on Capitol Hill that the approval of the joint resolution cannot be secured at this session of Congress in the Senate. This would have the effect of allowing the legislation to die with the session of Congress which ends March 4, thereby making it necessary for the House of Representatives to reconsider the measure at the next session. Even were the Senate to pass it before March 4, many are of the opinion that great difficulty will be experienced in securing the ratification of the amendment by two-thirds of the states.

Tri-State Development of Delaware River Proposed

A plan for the development of the Upper Delaware for water supply and power by the states of New Jersey, Pennsylvania and New York has been incorporated in a bill introduced in the New Jersey Legislature. The plan is proposed by Morris R. Sherrard, consulting engineer to the North Jersey District Water Supply Commission and to the Department of Streets and Public Improvements of Newark. Under the terms of the bill the Governor of New Jersey would appoint a commission of three members, to co-operate with representatives of New York and Pennsylvania in recommending a policy to be followed in the utilization of the waters of the Upper Delaware.

An appropriation of $25,000 for clerical and other necessary expenses of the New Jersey Commission is proposed but the commissioners would sreve without pay.

Reinforced-Concrete Bridge Over Potomac Opened To Traffic

The 2,700-foot Key bridge across the Potomac at Washington was thrown open to traffic on Jan. 17. The bridge was built by the Corps of Engineers of the Army under direct appropriation by Congress. The cost was $2,350,000.

The bridge is constructed of reinforced concrete. Its center is 85 ft. above mean low water. It is 70 ft. wide and carries a double-track electric railway. There are in addition two 16 ft. roadways and two sidewalks each eight feet wide.

The bridge is named for Francis Scott Key, who was born on the site of the District of Columbia approach of the bridge. It replaces the old Aqueduct Bridge, which has been in use for more than three quarters of a century.

Chicago Engineers Hold All-Day Civil Problem Meeting

Engineering problems in the water, sewage and electric utilities of Chicago were covered Feb. 1 in the series of papers presented at the mid-winter all-day convocation of the Western Society of Engineers. The three sessions were well attended, the dinner meeting drawing an audience of nearly 400 engineers to hear Samuel Insull, president of the Commonwealth Edison Co. compare the Chicago electric plants of 30 years ago with those of today and those in contemplation in the immediate future which will utilize steam at 600-lb. per square inch pressure and turbine generating units of 50,000 kw. capacity in the 500,000 kw. station on Crawford Ave.

Harrison P. Eddy, consulting engineer, Boston, Mass., described present-day methods of sewage treatment and outlined the procedure recommended by the Board of Experts reporting on the proposed $13,000,000 Northwest sewage treatment plant of the Sanitary District of Chicago. (See *Engineering News-Record*, page 324, Aug. 24, 1922.) Mr. Eddy was preceded by George C. D. Lenth, secretary of the Clay Products Association, who sketched historically the genesis of the present 40-year sewerage system in the loop district held back from improvement awaiting a solution of the subway problem. Langdon Pearse, sanitary engineer, Sanitary District of Chicago, outlined the present status of the district work.

The water utility problem was handled first by Dabney H. Maury, consulting engineer, who described recent developments at Denver, Colo., Norfolk, Va., and Tulsa, Okla. He stressed the danger of metering without previous proper rate adjustment.

Louis R. Howson's paper on "What Metering Would Do for the Chicago Waterworks" gave a startling and graphic account of the enormous present waste under which but 25 per cent of the consumers get water under satisfactory pressure. This argument and the fact that filtering can never be accomplished until wastes are curtailed are conceded to be about the only arguments Chicago aldermen will listen to. Myron B. Reynolds, engineer of design and operation, however, in his paper stated that the million dollar deficit only lately changed from a surplus will be the starting point for official action.

Clarence Goldsmith, assistant chief engineer, National Board of Fire Underwriters, discussed the waterworks system from the fire protection standpoint referring especially to the recommendations in the recent engineering report of the board abstracted in *Engineering News-Record*, Dec. 28, 1922, p. 1125.

Bridge Damaged by Mine Caving

Pier settlement has endangered the security of a highway bridge over Spring Creek, near Springfield, Ill. Caving of the ground due to local coal-mining operations caused a settlement of 8 to 12 in. of the main pier of the bridge in the space of a few days. One abutment has also settled. Falsework has been placed under the spans of the bridge and jacking is to be done to restore them to proper elevation when the settlement of the substructure stops.

State Water Conservation Measure Advised for Connecticut

A State Water Conservation Commission with broad powers of control over the taking of water for municipal supplies, both as regards quantity and quality, is recommended by the Commission to Investigate the Pollution of Streams created in 1921 by the Connecticut legislature. A notable recommendation of the commission's report is that statutory provision be made for the formation of sanitary districts to include the whole of one or more stream drainage areas. The commission expresses the hope that such a plan would result in co-operation between the various municipalities in each district and between these and private interests, and that it would facilitate the financing of the necessary projects for correcting such stream pollution as may exist. An appropriation of $50,000 for the work of the proposed State Conservation Commission in the first two years of its existence is proposed.

Included in the membership of the commission are David M. Saville, manager and chief engineer of the Hartford Water Works, who has been chairman of the commission; and Robert A. Cairns, city engineer of Waterbury.

The recommendations of the commission on pollution, if carried into effect, would provide that separate state agencies, such as the Agricultural Experiment Station, be used for the laboratory and research work of the proposed Water Conservation Commission; that the new commission confer with the State Board of Health in matters of water pollution where both public health and other questions pertaining to a given stream are concerned but that where health only is involved sole jurisdiction should be vested in the State Board of Health; that the proposed commission establish rules and regulations relating to the condition and use of the waters of the state; and that the state courts be given power of injunction to enforce the decisions and regulations of the Water Conservation Commission.

House Members Block Bill for New Washington Buildings

Washington Correspondence

Because the administration refused to sponsor an omnibus public buildings bill, members of the House are blocking efforts to secure appropriations for new government buildings in Washington.

Evidences of this attitude were seen in the fact that the House conferees declined to agree to an appropriation of $250,000 to start what the Senate intended should be a $2,500,000 archives building for government records in the capital. The Senate conferees receded after several days of futile argument and the item was stricken from the bill.

Stuart to Study N. Y. Port Problem for Trunk-Line Railroads

Francis Lee Stuart, consulting engineer, has been retained by a committee of executives of the trunk-line railroads serving New York to investigate and report on transportation conditions in the Port of New York insofar as they affect the railroads individually and collectively.

Robert M. Morton New California State Highway Engineer

Robert M. Morton, whose appointment as state highway engineer of California to succeed the recently resigned A. D. Fletcher was noted in the columns of this journal recently, has had varied experience as highway engineer. During the past two years he has been engaged with San Diego County as chief engineer of improvement involving the expenditure of almost $2,500,000. Prior to that time he was with Sacramento County as chief engineer engaged in the design and construction of a road system of 124 miles. For a short time prior to that he was superintendent of construction of the California Highway Commission assigned to make studies and reports on the selection of state highway routes through Sacramento, San Joaquin, Alameda and Contra Costa Counties.

Mr. Morton was graduated from Washington & Jefferson College in 1906. He was employed immediately thereafter by the Public Road Office of the U. S. Bureau of Agriculture, first as civil engineer student, then as assistant highway engineer. Various assignments placed him on object lesson road construction in states throughout the Middle West, South and Pacific Coast. In 1908 he was assigned to San Joaquin County, California, for the Department and made a study of local highway needs, assisted in construction of an object lesson road and then entered the employ of the San Joaquin County Highway Commission as chief engineer in August, 1909.

California Highway Commission Engineering Force Reduced

The newly appointed California State Highway Commission has announced that material reductions will be made in the number of employees in the engineering department. According to press reports, the reductions will amount to 20 per cent.

This is not to be taken as an indication of decrease in efficiency, it is stated, as the men to be released are chiefly the engineers and draftsmen working on proposed extensions of the highway system which the new commission does not expect to undertake now.

Wreckers Recover Copper Sunk in N. Y. Harbor Three Years Ago

One of the largest bucket digging dredges of the Merritt & Chapman Derrick and Wrecking Co., New York, is anchored in the main ship channel, between Governors and Ellis Islands, that city, salvaging copper bars which have been lying under 93 ft. of water for three years since a lighter was sunk by the transport Buford. The copper, which belongs to the government, is worth about $150,000. Divers searched the channel bed for two years before they could locate it.

The pigs are of two sizes, weighing 140 lb. and 250 lb. respectively. The first were brought up on Jan. 14. Since then over 400 have been recovered. After ingots are hoisted they are washed off at the depot of the wrecking company, then are sent by motor truck to the government warehouse.

It is expected that nearly all the lost copper will be recovered.

A. G. C. Holds Successful Annual Convention

(Concluded from p. 274)

ciated General Contractors at the successful conclusion of the conferences on contract provisions with the American Association of State Highway Officials. The Division by formal vote expressed its thanks to *Engineering News-Record* for the assistance it rendered through editorial discussion in getting results from this co-operative work. Many instances were cited of contractors being driven out of certain states by reason of inequitable contract provisions, South Dakota's case being particularly flagrant in this respect. There was much commendation of the Minnesota law requiring public officials to give publicity to the cost of work done by day labor. Failure to comply with the law is a misdemeanor.

Officers of the highway division elected for 1923 were: Chairman, L. L. Rogers, Los Angeles; vice-chairman, N. F. Helmers, St. Paul.

PUBLIC WORKS DIVISION

One of the interesting matters discussed at the meeting of the public works division was the obligation of the contractor in the interest of his client to urge upon the cement companies that they change their practice and sell wholesale lots to the contractor at the same price that they do to the dealer. It was disclosed that conferences with this end in view had been held with cement manufacturers both in the east and in the middle west. There was unanimous agreement that the present practice of allowing the dealer a differential in cases where he performed no service whatsoever was indefensible. It was the feeling that the practice would be changed if groups of contractors in every part of the country would bring their influence to bear upon the cement manufacturers.

Officers of the public works division elected for 1923 were: Chairman, Charles V. Burkhart, Chicago; vice-chairman, R. A. Schaffner, St. Paul; of the railroad division, chairman, A. S. Doney, Seattle; vice-chairman, Frank Stuart, Boston.

At the general session on Thursday morning John W. Cowper, Buffalo, chairman of the Committee on Contracts, stated that much progress had been made toward drafting a desirable contract form and that clauses releasing retained percentages would be included. Particular emphasis was placed on the fact that for the first time joint conferences have been held by engineers, architects, and contractors to co-operate in drafting better contract forms. Through the co-operation of the government interdepartmental board there is even good prospect of incorporating in Government contracts a clause providing for arbitration before a board of review. Discussion showed a very general belief that the problem of securing fair contracts is of the very greatest importance to the industry.

W. O. Winston, Minneapolis, explained in detail the action of the association last year in borrowing money to carry on work that would cost about $50,000 more than the year's receipts. He stated that, although this was done in accordance with the best judgment of the board, it has since been definitely decided that no more of the bonds would be sold and that money would not be borrowed again under any circumstances. General discussion showed the sentiment to be very strongly against spending in any year more than the actual receipts for that year and there was unanimous approval of the new budget program which limited the expenditure for the coming year to $125,000 or such part thereof as is to be received by the association as income for the year. In conjunction with this budget it was voted that the present system of dues should be abolished and instead members should pay according to the following classification: Chapter members who shall pay $30 per year, co-operative members who shall pay $250 per year, sustaining members who shall pay $500 per year, provided that each chapter shall have at least one co-operating membership for each ten members or major fraction thereof, individual members shall pay dues as sustaining or co-operating members. The executive committee was also authorized to reclassify the dues of the present individual members as in their judgment is in the best interest of those members and of the association.

Regarding the additional cost these dues would place on small chapters Frederick Cranford stated he believed plans could be worked out in each case that that would be satisfactory. Representatives from several comparatively small chapters believed their chapters would accept the new dues schedule.

President-elect Cowper stated that with the withdrawal of field secretaries incidental to the curtailment of expenses necessary this year special effort must be directed toward getting new members and that he planned to appoint James H. Ellison, Minneapolis, chairman of the membership committee, and would name all chapter chairmen as assistants.

William B. Joyce chairman of the Board of Directors, and George W. Allen, Pacific Coast Representative, National Surety Co., made addresses in which they pointed out changes necessary to improve the conditions under which bonding companies write bonds for contractors. Ninety per cent of the losses of this company in the contracting business are due to false financial statements submitted by the contractors.

PRESIDENT COWPER'S ADDRESS

On assuming his new duties as president, Mr. Cowper made a short address in which he emphasized the importance of establishing skill, integrity, and responsibility as the watchword of the association. He pointed out that the volume of building work would likely be restricted due to rising costs and indicated desirable modifications of immigration laws so as to admit immigrants who would fit well into our social system. He commended the formation of the American Construction Council and urged that among other things it combat the erroneous propaganda that public works should be done without the aid of those skilled experienced and regularly engaged in such work. He commended the broad scope of the council's proposed activity and concluding placed special emphasis upon the need for every agency of influence to assist in securing a proper public attitude toward our transportation system, particularly our railroads, because upon their prosperity and progress depends industrial and agricultural development.

Engineering Societies

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 13-15.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

The American Society of Safety Engineers and the Engineering Section of the National Safety Council will hold a joint meeting Feb. 16 in New York.

The Engineering Society of Wisconsin will hold its annual meeting at Madison, Wis., Feb. 22-24. Two joint sessions will be held with the Wisconsin Drainage Society. There will be also a joint meeting and banquet with the Madison Technical Club. Papers announced include "The Drainage of Highways" by E. A. Rossiter, Chicago, with discussion by A. R. Hirst, state highway engineer of Wisconsin; "Relations of Drainage and Sanitation," by L. K. Sherman, Chicago, and "Control of the Neenah Dam," by Geo. Randall, Oshkosh, Wis.

The North Dakota Society of Engineers and the North Dakota chapter of the American Association of Engineers will hold a joint annual meeting on Feb. 20 and 21. The first day will be spent at Mandan and the second at Bismarck.

The Indiana Sanitary and Water Supply Association will hold its annual meeting Feb. 14 and 15 at Indianapolis Round-table discussions on meters, operating troubles and water use by contractors, as well as papers on municipal water softening, centrifugal pumps, and the Bloomington (Ind.) situation are on the program.

The New England Water-Works Association will hold its annual meeting Feb. 13 at the Boston City Club.

Personal Notes

FRANZ AND BOND, architects and engineers of Holyoke, Mass., have dissolved in order that Philip Bond may give his entire attention to his duties as city engineer, to which office he has recently been appointed. He succeeds J. T. McCarthy. Fred H. Franz will continue the practice of architecture under the firm name of Franz and Bond.

JOHN E. PALMER CO., INC., of Boston, Mass., has recently been incorporated to engage in general engineering work. The president of the concern is Daniel S. Bell, of Boston; and the treasurer is John E. Palmer, Dorchester, Mass.

Raymond J. Curtis, for many years connected with the county highway department, has lately been appointed by the Board of Supervisors as county engineer of Herkimer County, N. Y. Mr. Curtis succeeds William H. Corey, of Salisbury Center, who has held the office for the past 14 years.

W. J. Kelly, county engineer of Trinity County at Trinity, Texas, has been appointed county highway engineer of Montgomery County. He is stationed at Conroe.

Alvin L. White, who has been resident engineer on state highway projects in Reeves and Jeff Davis Counties, Tex., has been appointed county engineer of Brewster County.

I. E. Houk, city engineer of Dayton, Ohio, has been elected president of the Dayton Chapter of the American Society of Civil Engineers. He succeeds Charles H. Paul. Charlton Putnam was elected vice-president and C. H. Eiffert, maintenance engineer of the Miami Conservancy District, secretary and treasurer.

Ross Alverson, Everett, Wash., has been elected county engineer of Snohomish County, succeeding F. G. Tegtmeier.

A. H. Dimock, consulting engineer, Seattle, until recently city engineer of that city, has been appointed to take charge of the investigation and survey of the water situation in Bellingham, Wash.

Charles H. Lee, consulting hydraulic engineer of San Francisco, Calif., has been appointed lecturer in civil engineering at the University of California and during the spring term will give a course in water-supply engineering. This course was formerly conducted by Prof. Chas. Gilman Hyde, who expects to spend the coming six months in Europe.

H. B. Miller, consulting engineer formerly manager of construction and director of supplies and sales for the U. S. Shipping Board, has been appointed assistant city engineer, Chicago, a position held by the late C. F. Healey. Mr. Miller was graduated in 1912 from the University of Pennsylvania, and for 5 years was assistant engineer with McClintic-Marshall Co. at Pittsburgh.

Col. Frederick Stuart Greene, who was Commissioner of Highways of the State of New York when Alfred E. Smith served his former term as governor, has been reappointed by Governor Smith as Commissioner of Highways, succeeding Herbert S. Sisson, the appointee to the position of ex-governor Miller. He entered consulting highway practice upon his resignation in 1921. Col. Greene has had broad professional experience, having early in his career been employed in railroad construction work, as well as in designing and building of terminal facilities. Previous to his entering highway engineering he was for several years with the American Manufacturing Co. of New York City as consulting engineer on transmission of power by rope.

William H. Connell of Germantown, Pennsylvania, has been appointed deputy state highway commissioner for Pennsylvania by Governor Pinchot. Mr. Connell for many years previous to 1912 was in public engineering work in New York City. From 1910 to 1912 he was deputy commissioner of public works of Bronx Borough. From 1912 to 1917 he was chief engineer of the Bureau of Highways and Street Cleaning in Philadelphia. Since then he has been engaged in private practice. For two years he was executive engineer for Day & Zimmerman of Philadelphia and from 1919 to very recently with the Philadelphia Rapid Transit Co.

William S. Davis, chief engineer of the Mangan & Risser Contracting Co., Lebanon, Pa., has been appointed city engineer of Lebanon, succeeding Paul Volcker, who has become secretary of the Lebanon chamber of commerce.

Harry E. Harris, Bridgeport, Conn., engineer specializing in manufacturing methods, will carry on under the name, Harry E. Harris, consulting engineer, the work formerly conducted by Hubbard, Harris & Howell, Inc., Bridgeport.

A. E. Christhilf, former highway engineer of Baltimore, Md., has been appointed chief engineer of that city; and his successor as highway engineer is Charles F. Goob, who has been chief engineer of the electrical commission of Baltimore.

Alan J. O'Brien, formerly New York representative of Blome Sinek Co., Chicago, has opened offices in Long Island City, N. Y., under the name of A. J. O'Brien Co., which will specialize in industrial design and construction.

E. B. Fithian has been appointed district engineer of the western district of the Missouri Pacific R.R. Co., with headquarters at Kansas City, Mo. He succeeds C. O. Congdon, resigned.

Eugene A. Balsley and Albert E. Fisk have opened a consulting office at 30 N. La Salle St., Chicago, under the firm name of Balsley & Fisk. Mr. Balsley has been with the American Bridge Co. for the past 20 years. He was graduated from the University of Wisconsin in 1902 and immediately entered the erecting department of the bridge company. In 1905 he was made assistant manager and two years later was transferred to the Milwaukee plant as manager, where he remained until 1916 when he was appointed assistant operating manager of the western division and manager of the forge division. This position he held until his resignation Jan. 1, to engage in private practice. Mr. Fisk's engineering experience has been obtained with the American Bridge Co., Mead-Morrison Manufacturing Co. and Freyn, Brassert & Co.

Robert E. Barrett, Holyoke, Mass., has been elected president of the Holyoke Water Power Co., which controls practically all the water power in the large manufacturing districts surrounding the city of Holyoke. Mr. Barrett has had long experience in hydroelectric and harbor design and construction in New England. After leaving Harvard University in 1905 he became connected with the work of the Charles River Basin Commission which he left in 1907 to become assistant engineer and designer of the Board of Water Supply on the Catskill Aqueduct. From 1910 to 1913 he was on construction work on that aqueduct, returning in 1913 to Boston to become designing engineer of the Directors of the Port of Boston. From June, 1915, to August, 1916, he was acting chief engineer of that organization. In 1916 he became associated with Fay, Spofford and Thorndike, consulting engineers of Boston, on the design and foundation of the new bridge crossing the Connecticut at Springfield, leaving that work in 1917 to become construction engineer of the Turner Falls Power & Electric Co. In February, 1918, he became general manager and chief engineer of the Connecticut River Conservation Co. and some time later became connected with the company of which he is now president.

George H. Biles, for the past year acting state highway commissioner of Pennsylvania, has resigned. He was in full charge of all activities in the state highway department from the death of the late commissioner, Lewis S. Sadler, until the appointment of the new commissioner January 16, 1923 (See *Engineering News-Record*, January 18, p. 137). Mr. Biles had been connected with Pennsylvania road work for the last fifteen years. He carried on first experiments for that state in bituminous surface treatment materials. In 1913 he organized the maintenance division of the Pennsylvania State Highway Department, with supervision over 10,000 miles of highway and employing over 12,000 men in the peak seasons work. In 1919 Mr. Biles conceived and executed plans for the complete re-organization of the Pennsylvania State Highway Department. This organization at present with its accounting system is said to be the most comprehensive of its sort. Mr. Biles is a licensed professional engineer and land surveyor, a member of the American Society of Civil Engineers, the American Society for Testing Materials, the American Road Builders' Association and the American Association of State Highway Officials.

Obituary

Harrison M. Randel, for eight years county surveyor at Greencastle, Ind., died recently at his home there, aged 84 years.

Gordon Emslie, civil engineer of Montreal, died in that city Jan. 23, aged 74 years. Mr. Emslie was for over 30 years connected with the Dominion Bridge Co. and for 8 years was on the board of engineers which had charge of the construction of the Quebec Bridge. He was a graduate of Ontario University.

Lieut.-Col. J. A. Hesketh, C.M.G., D.S.O., of the engineering staff of the Canadian Pacific Ry., died at Winnipeg, Jan. 26, aged 57 years. His overseas service was with the Lord Strathcona Horse and he was afterward attached to the engineering corps. He was born in England and was a graduate of the Royal Military College, Kingston, Ont.

William Lloyd, Sr., contractor and builder in Johnstown, Pa., from 1880 to 1903, died in that city Jan. 22, aged 87 years.

From the Manufacturer's Point of View

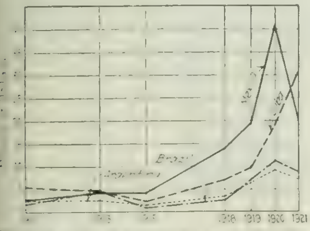
A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Analysis of Foreign Machinery Markets Shows Export Opportunity for U. S. Manufacturers

By W. H. Rastall
Chief, Industrial Machinery Division, U. S. Department of Commerce
Washington, D. C.

IN THE machinery trade 1923 promises to be a year of exceptional opportunity for the export manager, but in making his plans he should carefully analyze the whole field and devote his energies to the expanding markets as never before.

In 1910, the United States exported $51,489,598 worth of industrial machinery. In 1921, this had expanded to $246,436,364. Export business has become five times as important to the machinery producer as it was a decade ago, as the average shop exports nearly 20 per cent of its product, a ratio that is rising rapidly. Shops as far west as Wisconsin, that produce heavy machinery exclusively, have exported as much as 60 per cent of their total production. American engineering equipment is now going to practically every country in the world in rapidly increasing quantities.

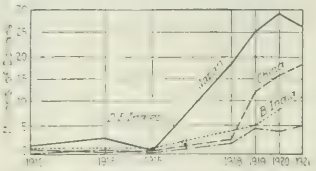


VALUE OF MACHINERY EXPORTS FROM U. S. TO LATIN AMERICA 1910-21

The merits of American machinery have long been recognized in foreign countries, but events since 1914 have given our equipment a definite prestige. Most of the countries of the world are disposed to buy high-class machinery in larger quantities than heretofore. Also, European manufacturers are finding it difficult to conduct their businesses under present conditions. All these circumstances create a situation that offers the American machinery manufacturer an unusually favorable export opportunity.

In order that sales effort may be expended most effectively, the accompanying table is presented showing the 30 most important foreign markets arranged in the order of their importance, as shown by the volume of American machinery absorbed in 1921, but including data for 1919, 1913, and 1910, to show the nature of the changes that have taken place. These data show clearly that Canada is our best foreign market, having ranked 2, 1, 1, 1, in 1921, 1919, 1913, and 1910, respectively. Mexico reached first place in 1921, but because of various disturbances ranked 1, 9, 4, 2, in this series of years. It will be noted that in 1921 there were 29 different countries that absorbed more than $1,000,000 worth of American machinery, a volume that justifies the sales manager in developing a carefully planned export campaign unless other factors intervene.

During recent months the situation in Europe has discouraged certain of our manufacturers from making an active push for export business, for in pre-war days our best machinery markets were in Europe. It will be noted, however, that in the first 20 countries mentioned in the table (on page 280) only 3 are in Europe, while the other 17 are largely free from the troubles resulting from the war. Nine of the first 15 countries have progressed to a point where the currency depreciation is less than 5 per cent. However, it is not the *rate* of exchange that makes business difficult but the *fluctuations* in exchange. In the above cases the fluctuations have all but disappeared, or at any rate the swings have become very narrow, and such changes as do develop are usually in a direction that promotes American export trade. Reconstruction has now reached a point where, for most countries, our position will continue to grow better.



VALUE OF MACHINERY EXPORTS FROM U. S. TO JAPAN, CHINA, BRITISH INDIA, AND DUTCH EAST INDIES, 1910-21

The machinery export manager should also recognize the development that has taken place in many of these markets during the last decade, as shown by the data in the table. For example, China took $260,431 worth of our machinery in 1913, but this had grown to $18,184,978 in 1921. Such development calls for radical readjustment of sales plans. British India expanded from $628,063 in 1913 to $10,772,891 in 1921; Japan from $1,741,402 in 1910 to $20,941,408 in 1921; Mexico, Cuba, Brazil, Argentina, Peru, Chile, Philippines, Netherland East Indies, etc., have shown remarkable expansion, as is indicated by the accompanying charts. All this information indicates clearly that there are splendid opportunities for the sale of American

(Continued on p. 280)

High-Grade Materials Urged for Concrete Mixtures

National Sand and Gravel Association Plans Educational Campaign—Hoover Discusses Priorities

Washington Correspondence

A NATIONAL campaign intended to point out the advantages of using high-grade materials only in concrete mixtures is to be undertaken by the National Sand and Gravel Association. The proposal was brought out by the board of directors during the annual meeting of the association in Washington January 24-26, and was approved unanimously on the floor of the convention. While the principal effort will be to convince contractors that it is poor economy to use low-grade sand or other materials in mixing concrete, a publicity campaign will be undertaken to acquaint the public with the fact that the value of an investment in concrete depends to no small extent on the grade of the aggregates used in connection with the cement.

Edwin W. James, of the U. S. Bureau of Public Roads, pointed out to the gathering that every effort is made on federal-aid roads to insure the use of high quality material by contractors. Within the last few months, he said, the bureau has assigned a specialist on qualities of road materials to each of the district offices.

Against Priority Orders

Much of the discussion at the sessions revolved around the Interstate Commerce Commission's priority orders. There was a great round of applause when Secretary Hoover told the convention that he does not approve of priority orders. He declared that the open-top car situation in the winter months could be relieved very materially if the railroads would haul and store their own fuel during the months when there are surpluses of open-top cars. There was abundant testimony from the floor of the abuse of the priority orders, and actual records were taken by many sand and gravel companies to show that cars stood for weeks or months on the sidings at coal mines.

E. H. Degroot, of the Interstate Commerce Commission, talked of the transportation situation from the commission's standpoint. He called attention to the fact that relief had been afforded to the extent of thousands of cars when sand and gravel producers called their specific energies to the attention of the commission.

New Officers

Alexander W. Dann, of the Keystone Sand & Supply Co. of Pittsburgh, was reelected president of the organization. E. Guy Sutton, of Danville, Ill., was elected vice-president; John Prince, of Kansas City, was reelected treasurer, and T. R. Barrows, executive secretary. E. C. Ross, of Parkersburg, W. Va., U. L. Smith, of Memphis, R. C. Fletcher, of Des Moines, and Hugh Haddow, Jr., of Millville, N. J., with the foregoing officers will comprise the new executive committee.

Representative Casper, of the Interstate and Foreign Commerce Committee of the House of Representatives, another of the speakers, was severe in his criticism of the Railroad Labor Board.

Foreign Market for Machinery

(Concluded from p. 276)

machinery abroad and that it is not wise to pay too much attention to reports regarding Europe where the markets are contracting. It is far better to employ constructive sales effort in the markets that are expanding. The following statement may be useful:

Canada.—This has long been our best market for industrial machinery, and this market should show good results in 1923 as Canada is probably the most prosperous country in the world, and its exchange problems have disappeared. Plans have been prepared for important water-power plants, paper mills, grain elevators, highway construction, and a large number of other operations, and it would appear that these will require much American machinery.

United Kingdom.—Exchange is now at a discount of less than 5 per cent and improving rapidly. On July 31, 1921, it stood at 375.25, a discount of about 22.8 per cent, so that there has been very creditable recovery. Many of the factories in England are in need of new labor-saving machinery, as the old equipment has not been adjusted to the present high-labor costs. Machinery of the types required must be purchased in the United States as it has not yet been developed elsewhere. Also, it is felt in the United Kingdom that 1923 is to witness a boom in British trade. It would not be surprising if American machinery business showed great progress in England this year.

France.—The franc was valued at 20.22 cents on July 30, 1914, 7.61 cents July 31, 1920 and 7.02 cents Dec. 1, 1922. Although conditions are unsettled many very important engineering projects are to be developed and appropriate equipment will be required. This market may not show much expansion in 1923.

Australia.—This country, as a market, ranked 12, 16, 9, 8 in 1921, 1919, 1913 and 1910 respectively. The exchange rate is much the same as for the United Kingdom. Readjustment has now advanced to a point where the commonwealth can take up constructive problems, interrupted during the war, and work that is several years behind should now be brought down to date. A large number of projects are contemplated. New Zealand is in a somewhat similar position and there is a strong desire to industrialize both countries. In doing this they should use a great deal of American machinery.

South Africa.—Has ranked 17, 19, 13, 12. A very large amount of American mining machinery is used there. Also, there is a growing demand for other classes of machinery. This territory gives promise of rapid development and American equipment is very popular there.

Spain.—Has ranked 19, 18, 16, 25. The peseta was worth 19.6 cents July 30, 1914, 15.52 cents July 31, 1920 and 15.36 cents December 1, 1922. This market offers attractive prospects, but one gathers the impression that many of our manufacturers should improve their methods of handling Spanish business.

Egypt.—Has ranked 23, 13, 31, 29, and exchange is no longer a serious consideration there. One gathers the impression that American machinery has never been properly represented in the Nile Valley and that constructive methods would be well repaid.

Netherlands.—Has ranked 24, 22, 17, 17. The guilder was worth 40.75 cents July 30, 1914, 34.5 cents July 31, 1920 and 39.52 cents December 1, 1922, a negligible discount. Very closely associated are the markets of the Netherlands East Indies that ranked 13, 17, 25, 27, expanding from $84,448 in 1910 to $5,061,080 in 1921. This group will probably show a handsome expansion in response to proper sales effort.

COMPARATIVE VALUE OF THE FOREIGN MARKETS FOR AMERICAN MACHINERY

Country	1921 Rank	1921 Value	1919 Rank	1919 Value	1913 Rank	1913 Value	1910 Rank	1910 Value
Mexico	1	$30,784,076	9	$9,623,381	4	$4,998,262	2	$5,038,786
Canada	2	28,474,868	1	56,872,104	1	32,573,274	1	14,129,298
Cuba	3	21,307,814	5	19,618,436	6	4,125,049	5	2,404,592
Japan	4	20,941,408	4	25,021,786	[illegible]	3,314,435	10	1,741,402
China	5	18,184,978	7	12,149,039	28	260,431	15	641,732
United Kingdom	6	18,019,508	3	38,522,254	2	10,435,835	3	4,594,241
France	7	14,364,119	2	38,856,748	7	3,622,486	7	1,994,728
British India	8	10,772,891	15	4,822,136	22	628,063	19	516,438
Brazil	9	8,737,477	10	6,696,225	5	4,835,621	9	1,809,389
Argentina	10	8,007,785	11	6,407,357	10	2,428,017	6	2,168,565
Philippine Islands	11	5,529,555	8	10,007,110	11	1,489,836	18	532,361
Australia	12	5,510,167	16	4,604,588	9	2,999,321	8	1,877,985
Netherlands E. Indies	13	5,061,080	17	4,546,249	25	424,314	27	84,448
Peru	14	3,770,184	20	3,045,582	19	755,004	21	255,666
Chile	15	3,561,510	12	5,652,134	14	1,085,599	14	703,270
Dominican Republic	16	3,252,954	24	1,069,168	18	884,377	22	254,995
British S. Africa	17	2,907,183	19	3,208,622	13	1,177,207	12	1,177,324
Colombia	18	2,729,690	25	752,320	21	632,868	24	229,598
Spain	19	2,505,039	18	4,005,721	16	929,450	25	228,459
New Zealand	20	2,144,897	23	1,078,195	23	508,644	20	305,487
Sweden	21	1,957,928	21	2,210,253	24	497,260	23	254,652
Belgium	22	1,836,167	14	5,147,196	12	1,340,345	13	711,388
Egypt	23	1,733,625	13	5,173,893	31	69,753	29	46,011
Netherlands	24	1,600,471	22	1,854,492	17	925,361	17	593,925
Venezuela	25	1,422,439	29	571,365	26	388,100	26	110,680
Trinidad and Tobago	26	1,385,920	30	287,777	30	109,293	31	.....
Rumania	27	1,311,582	28	639,037	27	296,303	30	23,880
Honduras	28	1,249,762	31	248,934	29	120,529	28	63,991
Italy	29	1,054,653	6	12,250,311	15	931,383	16	604,794
Panama	30	982,941	26	761,668	20	722,946	11	1,325,523
Germany	31	628,893	27	655,300	3	5,259,454	4	3,177,648

The above returns include only industrial machinery. In 1921, no other country absorbed as much as a million dollars' worth of American machinery. Certain countries not here shown may have absorbed more equipment than Honduras in 1919, Egypt in 1913, etc.

To Exhibit Equipment at Jersey Highway Convention

A highway industries exhibit of materials and equipment will be a feature of the third annual New Jersey State Highway Convention, to be held at the Stacy-Trent Hotel, Trenton, Feb. 14-17. A number of technical papers and discussions also are being planned.

Lack of space this week has made necessary the omission of the discussion on "Better Equipment Maintenance and Repair Parts Service," which has been appearing in recent issues.

The discussion will be resumed next week by comment from the Jeffrey Manufacturing Co., Columbus, Ohio, maker of conveying and crushing machinery.—EDITOR.

Business Notes

FRED H. CHESTNUT has resigned from the White Co., where he held the position of transportation engineer for the Pacific Coast district with headquarters in San Francisco, and has become vice-president of the Anderson-Endebrock, Inc., Pacific Coast distributors of Trailmobiles.

WILLIAM P. WAUGH, consulting engineer for the H. H. Robertson Co., Pittsburgh, manufacturer of roofing and building products, and widely known through his development of skylights and the solution of ventilation problems for industrial plants and public buildings, died at his home at Sewickley, Pa., Jan. 15. He was born in Hedrick, Iowa, and attended Iowa State College. His early work was in the railway field, where he was associated with John F. Stevens. Mr. Waugh was employed as secretary to Mr. Stevens until 1888, when he went to Los Angeles and Santa Barbara, Calif., on independent surveys for a number of firms. Later he was employed on the construction of the St. Louis water-works tunnel under the Mississippi River and on construction work for the Chicago drainage canal.

Mr. Waugh next joined the James G. Wilson Manufacturing Co., St. Louis, going to New York later as sales manager in the New York district, where he remained for 12 years and became interested in the need for better skylight construction. For two years he was connected with Irving F. Orr, of the Clason Architectural Metal Works in Providence, R. I., in the development of what was then known as the Waugh type of skylight. While with this company he built the skylights now in use on the Boston Museum of Fine Arts.

Mr. Waugh then joined the H. H. Robertson Co., with which he remained until his death. During this period his skylights were developed to their present state. Some of his most notable installations are those on the Cadillac, Packard and Dodge motor company plants in Detroit, the Indianapolis Union Station, and the Centennial Memorial Building at Springfield, Illinois. During this period he also developed a double glazed skylight that is widely used on paper mills and in textile plants where drippage must be constantly guarded against.

Equipment and Materials

Rubber-Tired Transfer Trailer for Paving Mixer

For quick transportation of paving mixers and other heavy construction equipment a four-wheeled rubber-tired trailer has been built by the Foote Concrete Machinery Co., Chicago. Units of the type illustrated in the accompanying photograph have been supplied to the White Paving Co., Chicago, and H. G. Goelitz Co., municipal contractors, Oak Park, Ill., both of whom report substantial savings in time in moving from one job to another and reduced wear and tear on equipment. The trailer is designed to be operated at motor truck speeds of from 12 to 15 miles per hour.

The trailer has a capacity of 13 tons, and an underslung frame, the top of which is only 2 ft. above the ground so that a crawler-mounted paver can run up onto the platform on inclined runways under its own power, the loading operation taking only 5 min.

The platform is of 4-in. oak, 93 in. wide and 156 in. long and is supported by three 8-in. I-beams reinforced with 6-in. channels. The wheels are equipped with solid rubber tires 40 x 8 in. on the front and 40 x 12 in., on the rear, and tractive resistance is lowered by the use of Hyatt roller bearings. The shipping weight of the trailer is about 8,000 lb.

Light Gasoline Roller for Subgrade and Maintenance Work

For rolling subgrades of concrete roads and for maintenance work when equipped with scarifying and planing blade attachments, the Austin-Western Road Machinery Co., Chicago, has introduced a 3-ton, three-wheel motor roller designated as the "Pup." The machine has been designed to meet the requirements of the Illinois State Highway Department for a 3-ton power roller for subgrade work. It is claimed by the manufacturers to be the first three-wheeled power roller weighing less than 7 tons to be placed upon the market. The power equipment is that of the Fordson tractor except that the high speed has been blocked out as too fast for roller operation. Two lower speeds of 1½ and 2¾ miles per hour are available.

The rear wheels have an 18-in. and the front wheel a 31-in. face, resulting in compressions per linear inch respectively of 114.4 and 60.7 lb. The rolling width is 5 ft. and the lap between front and rear rolls 3½ in.

On maintenance work the roller serves as a tractor. In that case the front end is equipped with a leveling blade, the weight of the roller being applied to the blade to prevent its riding over hummocks. Folding wings are attached to each end of the blade, increasing its width from 5 to 8 ft.

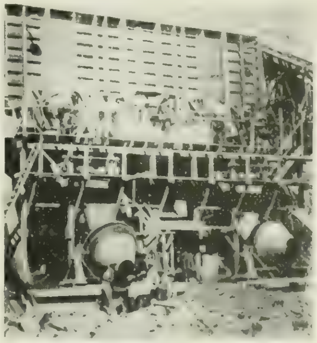
Trench Hoe Attachment for Locomotive Crane

A new interchangeable attachment, in the form of a "trench hoe," for its crawler-mounted locomotive crane is announced by the Northwest Engineering Co., Chicago. The device, exhibited for the first time at the Good Roads Show in Chicago last month, consists of a boom, dipper arm, and a dipper which digs toward the machine instead of away from it as is the case with a steam shovel dipper. The attachment is designed especially for trench excavation and will dig to depths of 14 or 20 ft., depending on the length of the dipper stick. Dippers are furnished in four widths, 27, 35, 40, and 48 in.

Among the advantages claimed for this ditcher attachment is that the machine operates on solid ground and does not have to straddle the trench as does a steam shovel, thus doing away with mats. It is asserted, also, that there is no loss of digging power at great depths as with a steam shovel equipped with extra long dipper stick. It is pointed out also that the ditcher attachment may be used successfully in handling blasted rock. In ordinary earth the manufacturers quote from 400 to 600 cu.yd. as the volume of material that the machine will handle in a 10-hour day.

American Concrete Mixers on South African Dam

American construction equipment is speeding the completion of the Hartebeestpoort dam in South Africa, a project, including canals, on which a labor force of 3,000 is at work. Concrete is mixed in a central plant where two 28-S mixers made by the T. L. Smith Co., Milwaukee, are used.



Two methods are employed for the delivery of concrete to the job. In the first the mix, after being dumped into 1-yd. steel trucks, is trammed to a point of delivery into an inclined wooden chute. In the other the concrete is handled by a cableway rigged to carry two truck bodies at a time. In addition to the concrete plant just mentioned, there is a third American machine, a 10-S Smith mixer, for miscellaneous work.

Easton Car & Construction Co., Easton, Pa., has issued an illustrated folder describing its roll-over bodies for Ford and other trucks on road construction. One of the bodies is equipped with watertight cement compartment.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Production and Materials Stocks in Nine Cities

Steel and Lumber Output Increasing—Cement and Brick Slower —Mill Deliveries Held Up by Rail Embargoes

Steel—Mill operations continue to increase, with further expansion expected during current quarter. Operations at about 80 to 85 per cent of capacity. Orders now on books would accommodate full capacity output but for labor shortage and transportation difficulties. Annual ingot production rate of 42,000,000 to 45,000,000 tons expected to be reached before end of next month.

Lumber—Weekly gains in production, shipments and orders may be noted in the following comparisons:

Week Ending	No. of Ft. Cut	No. of Ft. Shipped	No. of Ft. Ordered
Dec. 30, 1922	120,551,907	180,695,550	173,411,023
Jan. 6, 1923	162,219,452	200,245,297	181,805,237
Jan. 13, 1923	187,673,033	246,606,718	291,377,943
Jan. 20, 1923	202,843,438	251,908,414	328,159,215

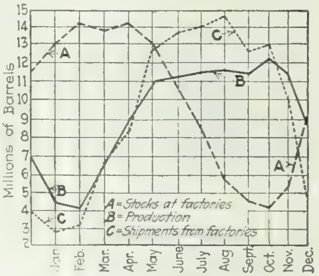
The National Lumber Trade Barometer, Feb. 2, shows production at 10 per cent below; shipments 8 per cent and orders about 26 per cent above, normal. One month ago the output was 50 per cent; shipments 23 per cent and orders 24 per cent below normal. A year ago production stood at 15 per cent; shipments 30 per cent and orders 22 per cent below normal.

Cement—Production and shipments of finished portland cement at mills, have shown seasonal declines since October, 1922. Beginning at the same time, reserve stocks of cement at factories began to increase, until the quantity on hand at present about equals the rate of output, namely 9,000,000 bbl.

San Francisco—Ample supplies of railway materials, metal lath, reinforcing bars, triangle mesh, hollow tile, lumber and cut nails. Large stocks of road oils, asphalt, common brick, structural steel, galvanized sheets and manila rope. Plenty of sewer pipe and fair quantities of lime, black and blue annealed steel sheets, available. Stocks low, however, on structural rivets, cement and wire nails.

Denver—About 3,000,000 brick available. Stocks of other materials, particularly lumber, being maintained at normal levels.

Minneapolis—Dealers stocks of brick, tile, cement and lime, well kept up; materials available at short notice. Lumber stocks normal for season and adequate to demand which is necessarily low at this time of the year. Estimated 100,000,000 ft. in Twin City yards, including wholesale reserves.



FLUCTUATIONS IN FINISHED PORTLAND CEMENT

Detroit—Enough sewer pipe in yards to satisfy immediate demands. Sufficient cement stocks, in nearby mills; increased slightly. Prompt lime deliveries from Michigan and Ohio kilns. Enough brick in local yards. Large deliveries of hollow tile take several days; enough on hand in city to meet demands. Lumber stocks somewhat decreased, only moderate quantities in yards. Small supply of asphalt in storage but deliveries prompt. Sand and gravel shipments in carload lots hampered by breezing weather.

New Orleans—Lumber stocks normal. Mills not yet caught up with orders previously received, which they had been unable to fill, owing to car shortage. Freight service definitely improved.

Atlanta—Plenty of common brick, pine lumber and asphalt. Deliveries take from four to six days on hollow tile and from six to eight, on sewer pipe. About five carloads of structural steel on sidings; twenty-five to thirty, of lime and twenty cars of cement.

New York—Rail embargoes seriously affecting shipments of building materials. Dealers' stocks sufficient under present seasonal conditions, but the usual increase in demand for freight cars in the early spring will undoubtedly cause delayed mill deliveries and thereby impoverish dealers' reserves. Hudson River brick shipments blocked by ice. Threatened shortage of expanded metal lath.

Philadelphia—Shortage of sewerpipe. Brick supply consumed as fast as produced. Sand, gravel and crushed stone movements not impeded by weather conditions. Lumber yards short on nearly all sizes; buying for actual requirements only and not for reserve.

Boston—All materials plentiful except fir and hemlock lumber.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Lumber, Minneapolis, 100,000,000 ft.); time required for delivery of carload lots to city job, example: (hollow tile, Atlanta, 4 @ 6 days); and stocks on hand in general terms, example: (sewer pipe, Philadelphia, shortage.)

	San Francisco	Denver	Minneapolis	Detroit	New Orleans	Atlanta	New York	Philadelphia	Boston
Sewer pipe.......	Plenty	Del. 24 hr., local plant	Sufficient	Satisfying immediate demands	Fairly well supplied	Del. take 6 @ 8 days	Mill del. slow	Shortage	Plenty
Cement..........	Small reserve	Normal	Large quantities	Nearby mill stocks sufficient	Sufficient	20 cars	Enough for present requirements	But slightly recovered from recent depletion	Well supplied
Lime............	Fair supply	Plenty	Ample	Prompt del. from Mich. and Ohio kilns.	Enough	25 @ 30 cars	No shortage	About 30 cars	Sufficient
Common brick....	Large quantities on hand	3,000,000	Available at short notice	Enough in local yards	Large supplies	Plenty	Hudson River del blocked by ice	Demand greater than supply	Enough
Hollow tile.......	Fair supply	Stocks in normal condition	Sufficient	Large del. take several days	About enough	Del. take 4 @ 6 days	Nearby plants; water deliveries	Stocks low	Ample reserves
Lumber..........	Heavy stocks	Normal level maintained	100,000,000 ft.	Moderate; somewhat decreased	Normal; car service improved	Plenty pine	Del. take 6 @ 8 weeks from mill	Sufficient for actual requirements only.	Plenty pine and spruce
Asphalt..........	Extensive native reserves	About 10 cars	Enough	Small supply in storage	No market	Plenty	Heavy reserves in N. J.	Well stocked supply center	No shortage
Structural steel...	Plenty bars and shapes; low on rivets	Warehouse stocks sufficient	Meeting all demands	No shortage	Sufficient for present	5 cars, approximately	Slow mill shipments	Harder to get quick del. on shapes	Mill del. slow

Figures on Which to Base a Construction Forecast

Can you give me any figures on which to base a forecast of the volume of construction that may be expected in the early part of 1923?—SUBSCRIBER.

First of all, past performances must be studied. Of these the *E. N.-R.* Construction Volume Index Number deserves particular consideration, as it shows the rate at which contracts were awarded in the months of the last three years compared with the 1913 rate of 100. It will be seen from the following table that the number has been well above 100 since March, 1921:

E. N. R. CONSTRUCTION VOLUME INDEX NUMBER
1913 and 1920–23
(1913 = 100)

	1923	1922	1921	1920
January	126	91	41	146*
February		100	43	114
March		202*	88*	107
April		150	86	142*
May		179	90	107
June		187*	117*	74
July		118	90	85*
August		154*	94	65
September		129	114*	85*
October		127	109	73
November		122*	101	51
December		111	118*	58*

* Taken from five issues of *Engineering News-Record* during month.

Of course, these are figures of contracts actually awarded, and the builder is interested in indications of the volume of proposed work not yet out for estimate. But it will be observed that the volume index was above 100 for every month in 1922, except the first two. This means that the volume of new work developing must also have been greater than "normal."

The table which follows presents figures on large general projects of all kinds arising in each of the last four years, as reported by Construction News. It gives the number of jobs proposed, the number on which bids were invited and the number of contracts awarded. Of course, many of these were the same job at successive stages:

	Contracts Awarded	Bids Desired	Proposed Work
1922	8,140	7,118	11,280
1921	7,047	6,831	11,699
1920	9,249	6,028	11,709
1919	6,993	4,789	13,861

The above figures do not include residential building or small construction.

Following are some figures on value of building permits furnished by R. G. Dun & Co.:

	1922	1921
New York	$603,742,425	$444,782,820
Boston	55,616,604	23,610,841
Philadelphia	125,414,480	
United States	2,514,435,467	(52% under 1922)

Number of large building projects compared with the total number of large projects, reported in Construction News, are shown for both the "Eastern District" and the whole of the United States and Canada. The Eastern District comprises the whole of New York State, northern New Jersey south to Princeton Junction, and Connecticut north to Stamford:

1922	U. S. and Canada	Eastern District
Total projects	28,370	3,635
Buildings and industrials	11,425	1,659

Of these 28 per cent are contracts awarded; about 35 per cent bids desired; 7 per cent bids received; 30 per cent proposed.

Bids Wanted on Large Jobs of a Single Week

In last week's issue bids were asked on forty-three building projects averaging $367,000, a total of $15,775,000. The engineer's estimate on every one of these buildings amounted to $150,000 or over.

In addition, bids were asked on a dozen industrial projects aggregating $2,000,000.

Total number of large jobs of all kinds, now out for bids, is as follows:

	Number	Bids Wanted
Water-works	32	Feb. 10 @ Mar. 7
Sewers	12	Feb. 12 @ Mar. 12
Waste disposal	4	Feb. 13 @ Mar. 1
Bridges	14	Feb. 13 @ Sept. 1
Dams	3	Feb. 20 @ Feb. 28
Excavation and Dredging	5	Feb. 13 @ Mar. 1
Streets and roads	44	Feb. 12 @ Apr. 23
Industrial work	4	Feb. 13 @ Feb. 24
Buildings	57	Feb. 12 @ Apr. 1
Federal Gov't. Work	23	Feb. 12 @ May 10
Miscellaneous	21	Feb. 12 @ Feb. 26
Total	155	Feb. 10 @ Sept. 1

In the "Miscellaneous" columns, alone, of the Feb. 1 issue, bids were invited on thirty-two jobs. The various wants amounted to $25,000 worth of tools, 20,000 bags of cement, 50,000 granite blocks, 600 tons asphaltic cement, 2,500,000 gal. of road oil, 35,000 ft. of pipe and culverts, 613,000 ft. of lumber, and 570,000 lb. of reinforcing steel. These items will amount to more than a quarter of million.

Some Unit Bids of the Week

Kansas—2-in. galvanized pipe, 43c. per ft.; 4-in. c.i. pipe, 95c.; 6-in. c.i., $1.30.

North Carolina—Paving 5,000 sq.yd. with sheet asphalt, $2.78 per sq.yd.; with bitulithic, $2.48.

Florida—5,405 lin.ft. concrete gutter, 60c. per lin.ft.; 60,000 sq.ft. concrete sidewalks, 19¾c.

Michigan—76,612 sq.yd. gravel surface, 80c.

New Jersey—40,000 gal. tar patching material, 19c.

Missouri—6,000 tons roofing gravel, $1.65@$1.80.

Important Foreign Construction Projects Reported

Progress on a number of important public works in foreign countries has been reported to the United States Department of Commerce during the week of Feb. 3, as follows:

China.—Approximate cost estimates have been prepared and suggestions made for financing the international bridge at Tientsin. Nothing definite has yet been decided upon except the site. Either a bascule or rolling lift type is favored, Consul General Stuart J. Fuller, Tientsin, China, reports.

Australia.—Announcement has been made by the Premier of New South Wales, according to a report from Consul R. Wormuth, that the policy of the previous governments in granting a preference to local manufacturers of 10 per cent on tenders for public work will be recognized and followed by him on materials and contracts for the North Shore Bridge across Sydney Harbor.

The Melbourne City Council has purchased an asphalt mixing plant from the Geiger Co. of California, U. S. A., at a cost of 9,500 pounds sterling. This is for road purposes and to overcome the dust problem in the city.

Colombia.—Consul S. H. Piles, Bogota, reports that authorization has been given the government by a law passed December 14, 1922, to contract loans up to $100,000,000 for the construction of railways, port works, and for waterway improvement. Loans under this law must have the sanction of the National Loan Board which has supervision also of the expenditure of the money.

Rumania.—Construction is to begin this spring of a railroad 70 kilometers in length connecting the towns of Ilva-Mare and Vatra Dornei. Other railroad extensions and certain gage-widening work are also planned for 1923, according to a report from Consul Ely E. Palmer, Bucharest.

Finland. — Petitions proposing the construction of new railroads have been considered by the Finnish Committee on Communications. During the next five years 100,000,000 Finnish marks (present value about 2.5c.) will be included in the annual budget, this sum having already been appropriated for 1923, says Consul Leslie A. Davis, Helsingfors.

Siam. — Recommendations for the erection of a garbage incinerator and a series of crematories have been made to the government of Siam by the official health adviser. Plants of the most modern types are being considered, Trade Commissioner John A. Fowler reports.

Brazil.—The C. A. D. Bayley Co. of Atlanta, Ga., have concluded contracts in connection with a loan of $2,000,000 to the State of Cerea, Brazil, covering water and sewerage systems for Fortaleza, its capital.

Canada.—The Canadian National Ry. has awarded to Foley, Welch & Hervey a contract for the construction of the "Longlac cut-off," a 29-mile link from Longlac on the main line between Toronto and Winnipeg to Nakina. The construction of this line will reduce the distance between Toronto and Winnipeg by 103 miles and save several hours running time.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 69 to 81, are the following projects:

Office building, Chicago, Ill., to Starrett Bros., $8,000,000.

Bank and office, Philadelphia, Pa., to Thompson-Starrett Co., New York City, $3,000,000.

High school, New York, N. Y., to J. S. Brady & Co., $2,311,380.

Hotel, Cleveland, O., to Crowell and Little Construction Co., $2,000,000.

Railroad, Kentucky, for Illinois Central R.R., from Central City to Dawson Springs, to A. Guthrie & Co., St. Paul, Minn., $1,500,000.

College, Mountain View, Calif., to J. L. McLaughlin, San Francisco, $1,250,000.

Capitol annex and memorial, Nashville, Tenn., to A. J. Krebs & Co., Atlanta, Ga., $1,240,000.

Heavy Locomotive Orders Placed by Railroads

Aside from gains made in locomotive repairs during December, eleven railroads placed orders with the American Locomotive Co. for 133 engines of various types. During the last week of 1922, new business placed with the Locomotive Company amounted to $6,600,000.

Shipments of locomotives in December, as compiled by the Department of Commerce from reports of principal manufacturers, were the largest since January, 1921, and amounted to 210, as against 89 in December, 1921. Total shipments for the year 1922 reached 1,274, of which 218 were for export; representing a drop of nearly 6 per cent from the preceding year. Unfilled orders on Dec. 21, amounted to 1,592 locomotives, a slight decline from the previous month.

Business Failures Decrease

All sections of the United States showed decreases in the number of failures reported to R. G. Dun & Co. for the week ending Feb. 3, and the total is 437, as against 511 during the preceding week and 629 a year ago.

The number of defaults with liabilities of more than $5,000 in each instance is lower, being 255 as compared with 298 in the previous week, but both numbers represent the same proportion of their respective totals, being 58.3 per cent. In the corresponding week of last year, similar insolvencies aggregated 391, or 62.1 per cent of the total.

Canadian failures number 84, while for the week preceding they were 82 and a year ago 52. Defaults involving more than $5,000 in each case are 36 in number, as against 41 in the previous week and 23 in the corresponding period last year.

Next week — résumé of recent public bond sales, showing rate, yield, price and by whom handled.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of February 1; the next, on March 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	+$3.29	$3.95	$4.40	+$3.05	+$3.30	+$3.95	$3.25	+$3.80	$3.50
Structural rivets, 100 lb	3.85	4.60	5.25	3.75	4.00	+4.95	4.75	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb	+3.19	3.85	3.15	+2.95	+3.20	3.62½	3.30	+3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	+51%	53%	45%	59½%	+55-5%	+38%	39.2@51.8%	45%	22.50
Cast-iron pipe, 6 in. and over, ton	+57.30	+57.80	+57.00	52.20	+56.20	+65.60	+56.00	+56.00	55.00
Concreting Material:									
Cement without bags, bbl	2.60@2.70	+2.75	2.25	2.05	2.29	2.85	2.71	2.90	2.15
Gravel, ¾ in., cu.yd	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd	1.00	—1.24	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd	1.75	2.00	+2.00	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	+61.00	—35.00	50.00	+56.50	42.75	+54.00	—36.00	+29.00	90.00
Lime, finishing, hydrated, ton	16.80@17.10	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	+3.00@3.25	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	+11.00	11.00	11.00	—17@19	12.00	15.50	13.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0859	.115	....	.0836	.065	....	.11	—.105
Hollow partition tile 4x12x12, per block	.1230	.0859	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal	+.96	1.03	1.07	+1.02	1.04	+1.13	1.04	.86	1.02
Common Labor:									
Common labor, union, hour	.60	.35	.30@.50	......	....	.50@.55	.56¼	.50@.60	......
Common labor, non-union, hour	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.50	....	—.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¾c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.82). Bag charge is 80c. per bbl Discount of 10c. per bbl for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $22.50; 6-in., $108.

Changes Since Last Week

Discounts on wrought steel pipe reduced two points or Pittsburgh basing card of Feb. 3, 1923; change reflected in warehouse quotations in New York, Minneapolis, Denver and other important centers. Steel structurals up 15c. in New York and Minneapolis and 10c. per 100 lb. in Denver and Seattle warehouses, following stiffer prices at mill. All new business on steel structurals at $2.10 per 100 lb. f.o.b. mill, or higher. Large tonnage orders on books of leading producers sufficient to keep mills busy for next three or four months. Semi-finished steel also tending higher.

Cast-iron pipe advanced $1 in Minneapolis, Dallas, Denver and Chicago; and $2 per ton in New York, San Francisco and Seattle, during last two weeks. The market for this material is strong and very active, and in view of advancing pig-iron prices, further rises are expected.

Lumber prices are displaying unusual firmness, with price advances in several important cities. During the last two weeks, pine timbers have gone up $2 in New York and $4.50 per M. ft. in Chicago; Douglas fir rose $2.50 in Denver and $4 per M. ft. in Seattle.

Common brick reported $1 per M. higher in Atlanta, with slight decline in Minneapolis. New York price firm at $20 per M., alongside dock. Although no new brick are being received from the Hudson River district, because of ice, there are about eighteen bargeloads of covered brick in winter storage.

The linseed oil market, keeping pace with white and red lead, is advancing generally. New York quotes rise of 3c. per gal., effective Feb. 3. Chicago reports advance of 4c. and Denver 3c. per gal. during week. White and red lead rose ⅜c. per lb. in month.

A Consolidation of Engineering News and Engineering Record
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E. J. MEHREN
Editor

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No Isthmian Canal Now

IF any engineer is counting on getting a job helping to build the new Isthmian canal that Washington is discussing in cabinet and press he had better find a fairly long stop-gap engagement to take care of the next dozen or so years. Statesmen have to look a long ways ahead, much longer than engineers. And the current canal agitation lies more in the field of diplomacy and statecraft than in that of engineering. The Panama Canal, as was pointed out in these columns some months ago, is good for another thirty years provided certain precautions are taken to insure an additional water supply and even then its capacity can be increased by parallel locks at a tenth of the cost of a new route. With the half dozen national projects crying for execution with federal funds, projects which will both create wealth and protect life and property, this is no time to contemplate the billion dollars that a new Isthmian canal might well cost.

Activated-Sludge Tendencies

ACTIVATION by paddles or some other mechanical device rather than by compressed-air diffusion will doubtless be given more attention in American activated-sludge projects hereafter than it has in the past. This conclusion rests on the observations and opinions recorded in Mr. Fuller's concluding impressions of sewage-works in England, concerned wholly with activated-sludge plants and studies in that country and on the strong expressions in favor of mechanical agitation contained in the second of two articles on the activated-sludge process by C. Lee Peck soon to appear in this journal. That England is much further in the lead of America as regards practical work in activation by mechanical means than in pre-treatment of sewage before activation may be inferred from Mr. Fuller's remarks on this subject. The growing use of pre-treatment in both countries is a new illustration of the seemingly inevitable division of labor in sewage treatment wherever effluent of high character is the aim. In the matter of sludge dewatering at activated-sludge plants it would appear from Mr. Fuller's impressions that far less has been done, or for that matter even attempted, in the United States than in England. On dewatering and sludge utilization the forthcoming article by Mr. Peck will afford information and stimulus.

Public Economy

THERE is satisfaction in reading a story of how a bridge more than 600 ft. long was replaced after its washout by a temporary wooden bridge at a cost of $16,000, which expenditure will serve for ten or fifteen years; the operation is described on p. 302 of this issue. In another part of the country last summer a similar piece of temporary bridging consumed the rather startling sum of about $300,000. Though there were compliating items, such as a draw span, and different proporions and load capacities, that affect the comparison, it is nevertheless true that a taxpayer—a "common citizen"—will find it hard to understand. One good reason for the low cost of the South Dakota bridge may be found in the fact that money was scarce: if anything at all was to be built, it had to be built as cheaply as possible. Money can be made to go far if it must be husbanded, as many engineers know from their own experience. In the case of the other bridge there was no such pressure, for money was plentifully available. Whatever may be the reason for the difference in cost of the two bridges in question, it is fairly sure that when the engineering department of any community spends money wastefully or lavishly it will arouse dissatisfaction and feelings of distrust in the public, while the thrifty use of public money will earn approval and strengthen the public confidence.

Breaking the Budget

IT HAS always been clear that the federal budget would be successful only insofar as it was supported by Congress. The minute Congress begins to appropriate more than the maximum allowable amounts the budget makers decide upon that minute the morale of the budget begins to break down and the return to the free-for-all appropriation system is foreshadowed. As was to be expected, the first attack on this year's budget comes with the rivers and harbors bill, commonly known as the pork-barrel. Senators and representatives alike were unable to resist the local demands which increased a budget estimate of $27,000,000 to a total of $56,000,000. In explanation it is claimed that the larger amount is merely that recommended by the Army engineers and that it is necessary to insure the proper carriage of water-borne freight. Both claims have shallow foundations. The Army engineers merely list expenditures that can well be made—regardless of how much money the government has to spend. As to water transportation, only the main harbors and one or two of the large rivers are necessary to satisfy the demands of commerce. They are cared for by the smaller sum; the rest goes merely to prospective benefits which may or may not be realized, and which in times like these of national financial stress are, to say the least, expensive experiments.

A Short Step on a Long Road

PASSAGE by the House of the British debt refunding bill with a spirit that bids us anticipate similar action by the Senate may be viewed either from the standpoint of the principals to the transaction or from that of the rest of the world. With respect to the former the event is of far-reaching importance. Acceptance of this settlement by the Senate and its final approval by the President will mark the funding of the largest international debt ever contracted. To the United States it will mean a setback to the agitation for the cancellation—in part, at least—of the European debts—and will establish a standard by which to adjust the obligations of other nations. For Great Britain it will halt the accrual of interest charges at the present high rates and effect a new deal that has been accepted as fair by both parties. It seems easy, however, to overestimate the effect of the settlement on the rest of the world. To be sure, it is the first step toward a readjustment of the war-debt tangle, but it is an obvious and a discounted step. No one ever has doubted that Great Britain would measure up to her proud standard of a "debt-paying nation." And to be sure also, the settlement may be taken to clarify the attitude of the United States toward the rest of the European debts. But in the light of France's position that she can consider modification of the German reparations only in proportion as her own obligations may be forgiven, it is difficult to discern much promise in this development. For until consideration of the reparations problem has been dragged down from the murk of political prejudice, sheer guesswork and arbitrary opinion to a basis of ascertained fact and reasoned judgment, there is small hope of general progress toward economic peace and stability in Europe.

A Necessary Quality

MOST precepts to insure success in life are variations of the basic principles of conduct set up in age-old texts. The Bible is full of them, Bacon and Ben Franklin amplified them and today they appear in modern dress in the inspirational magazines out of the mouths of those who by their position may appear as instructors of youth. Once in a while, though, a new thought appears. One such was gleaned last week from a talk to some McGraw-Hill men by E. M. Herr, the president of the Westinghouse Electric and Mfg. Co. Referring to an old chief, Mr. Herr said that he possessed in a remarkable degree the most necessary quality for a good executive; he was able to give an order so clearly that the subordinate could not possibly misunderstand what was wanted. The subordinate might not be able to do what was expected but he would know quite unmistakably what that thing was. Some years ago Elbert Hubbard immortalized one who had carried a message to Garcia by contrasting him with the average inefficient who can never properly execute an order. Mr. Herr's thought implies that this incapacity may not always be the fault of the subordinate. An obligation for clear statement—which presupposes clear thinking—rests on the superior. The engineer may take this rule to heart, for even in his more elementary capacities he has to give orders. If he would have them properly executed let him study to make them unmistakably clear.

River Sanitation Districts

THE Connecticut proposal to cope with stream pollution by a combination of state and district control is logically sound. Such method by itself has precedents. It is the combination, at least such an extensive one as seems to be contemplated, that is novel. What happens without central control is sufficiently illustrated by Connecticut itself, where stream pollution has gone so far as to be a serious problem. What state control can do is shown by a number of our states, but for the most part they have been vested with but little power to hold industrial wastes in check, and these are perhaps the most serious problems in Connecticut. District agencies, with jurisdiction over one or more entire stream drainage areas, have functioned successfully in the United States, England and Germany for years past. Here, in Germany, and to some extent in England, these river sanitation boards have been created for the construction and operation of works designed to remedy stream pollution nuisances; but England affords notable examples of river conservancy boards whose function is to control pollution by pressure on municipalities and industries rather than by building joint disposal works. Such control is almost if not quite unknown in the United States. Two weeks ago it was commended for American consideration by George W. Fuller in the first of his series of impressions of British sewage-works now running in our columns. The report of the Connecticut Commission to Investigate the Pollution of Streams, noted last week, is so sketchy as to leave uncertain the exact relation between the proposed Water Conservation Commission and the drainage district boards, as well as how the latter are to be created and financed and their exact function and powers. Enough is said, however, to make it clear that the general plan deserves careful study in Connecticut and elsewhere as also the elaboration of details suited to local needs which should take into account political as well as physical conditions.

Technical Direction of Highways in Danger

MORE changes in state highway department heads are being made this year than in any year since the disturbed period of war times. New York, Pennsylvania, New Jersey and California, all major road building states, will start the construction season of 1923 with new directing officials. Except in Pennsylvania, where the deaths of the former commissioner and chief engineer made necessary new incumbents of these offices, all the changes are the outcome of the election results of last November. They are acts prompted primarily by political expediency even though the men appointed and the administration reorganizations predicted by their appointment offer no compelling cause for criticism. This is a disquieting circumstance.

Regarding highway improvement as a continuing business of great magnitude, and it must be so regarded or we shall commit a vital error of foresight, changes of directing officers and of official policies of demonstrated efficiency, expect for the soundest engineering and business reasons, is courting danger to highway development as a state and national enterprise. It has been somewhat notable in public works engineering history that the technical heads of public roads work have been comparatively permanent. A higher appreciation of responsibility and a greater pride in vocation have resulted and are being demonstrated by research and practice that are putting highway engineering and highway transport in America on a higher plane than they occupy in any other country. The road using public cannot afford to have this development placed in danger.

A situation exists which is dangerous. It does not arise wholly from the disposition of partisan politics to make public roads work subservient. The mood of the people is critical of centralized engineering direction of highway improvement. Shifts of directing heads of departments with all the loose talk of inefficiency and graft that is the invariable political smoke screen confirms the people in their notion that the modern practice of centralized engineering direction is nowise more efficient and honest than old time non-technical county or township direction, and they are wondering if it will not cost them much more. A score of state departments this winter are confronting this attack in their legislatures and by some it will not be easily withstood.

All these happenings indicate clearly the necessity that devolves upon state and federal highway departments and on national associations of industries collateral to highway improvement, of selling in season and out the vital fact of the technical nature of the highway problem. The first lesson is that highway development is a continuing business. The problem of road construction is followed by the equally large problem of road maintenance and this by the greater and more intricate problem of highway transport. Each problem, moreover, is first and last essentially technical. These facts must be got to the consciousness of the road building and road using public and this is a task which the highway engineer and the highway transport engineer might well place above all the many tasks which devolve upon them.

A Measure of Service

IN THE long run the success of the engineering profession depends upon the trust which the community places in engineers even more than upon the competence of engineers themselves. To hold that trust is of first importance. From this requirement flow the commandments of professional honor and the principles of engineering ethics. In particular, it gives us the true statement of the engineer's responsibility in the execution of his work. It establishes that whose want is often seriously felt: a measure of adequate engineering performance.

In these days of change in the conditions of engineering organization, the question of what obligation of performance is involved in a given engineering undertaking presents itself more and more often as a troublesome problem. Because engineering services are not subject to description and specification, they remain undefined, and the terms of the contract existing between the engineer and his employer are subject to the engineer's own interpretation alone. The execution of the contract is left without supervision, and there is no check on when its performance is complete and adequate. Professional self-respect and conscience furnish the only control. But if competition brings bargaining for engineering services, and if price tends to become a deciding factor, it becomes desirable to have a more certain guide than that of conscience, and to appeal to some tangible measure of adequate performance. That measure is furnished by the obligation of carrying out each item of engineering work in such a way as to perform to the full those obligations which the community, in its own (not the engineer's) conception of the profession's responsibility, imposes.

The engineer who falls short in performance strikes a blow at the strength and good repute of every one of his professional brethren, greatest as well as least. The world depends on the engineering profession to do its constructive work, and it judges engineers as a class according to the excellence with which this work s done. It takes no account of whether payment was disproportionately small or whether monetary expedincy counseled a narrow view, but looks only to the asting result. If it finds the result inadequate or alse, it inflicts the penalty of loss of trust upon that lass which it holds responsible.

And the world, we must bear in mind, has a long memory for some things. Though the shortcomings of a plan or a structure may not appear until years or generations after it was conceived, yet blame and ridicule are turned against the profession whose members did the work. Even today we bear the burden of errors and delinquencies committed by earlier engineering generations.

Professional honor and ethical principle, we have said, are shaped by the necessity of holding the community's faith and trust. This obligation may appear intangible. It can be translated into more definite terms, however, when it is applied to specific engineering activities. The best professional standards exemplified in the practices of engineers today are such as satisfy the community obligation most completely, we believe. Ultimately such standards will be written down to form a basic declaration of what constitutes full engineering performance.

City Management and Manners

EVERYONE keenly appreciates that municipal thrift is sorely needed, all over the country. In consequence any determined effort toward economy is sure to enlist general support and approval. What has been going on in Cleveland during the past year—the administration's drive for reduction in city expenditures to get out of the red ink—is commendable and has won merited praise. But the Cleveland movement now seems to be taking a sinister turn, threatening to destroy all that has been achieved in the direction of economy, by disruption of the city's working organization through ill-advised and ill-mannered conduct on the part of the mayor. It now affords a warning example of how city government may be wrecked rather than a model of how it can be reformed.

Some of the events of the developing Cleveland situation are reported from local correspondence in the news pages of this issue. They exhibit a lack of appreciation of technical needs and functions in city administration, which, however deplorable it may be, is a not unnatural outgrowth of ordinary ignorance about engineering matters. Up to the present no permanent harm has been done the city by this lack of appreciation, and it is not necessarily a critical element of the situation. But when superadded to ignorance, the methods of a drill-sergeant are brought into play by the mayor in dealing with his fellow-officials and aids, municipal government is bound to go to pieces. The resignation of the utilities director, A. B. Roberts—who by the way is an engineer, recommended for office by the local engineering society, and has been a strong point of hope on the part of those who looked for real improvement in the city's government—represents the start of this disintegration.

Government is a business, in short, and good government demands methods comparable to those of good business requirements. Just as a business cannot prosper that is not built on the basis of decent conduct between man and man, so government under the same conditions cannot succeed. This elementary principle, illustrated anew in Cleveland, is the warning lesson of Mayor Kohler's police-chief government. However badly we may need municipal reform and waste-elimination, we cannot hope to attain it by disregarding ordinary business decencies. Roughneck manners will not reform city management.

Chicago Building Huge Public Stadium on Lake Front

Concrete Structure with Benched and Terraced Grandstands and Large Halls for Athletics, Parades and Exhibitions—Beam and Girder Frame in 48-Ft. Lengths

A PUBLIC STADIUM of reinforced-concrete construction, with an arena having the unusual length of 1,014 ft. and with side structures 860 ft. long which not only form grandstands but also provide large halls for exhibitions and indoor sports, is being built in the new portion of Grant Park, Chicago, by the South Park Commission, as part of the extensive improvements along the lake front. Its total cost will be about $4,500,000. The stadium has the very unusual feature of providing for large parades, pageants, military manoeuvers, concerts and outdoor winter sports in addition to the usual athletic sports. In order to provide for evening use an extensive system of general and decorative electric lighting is included in the project.

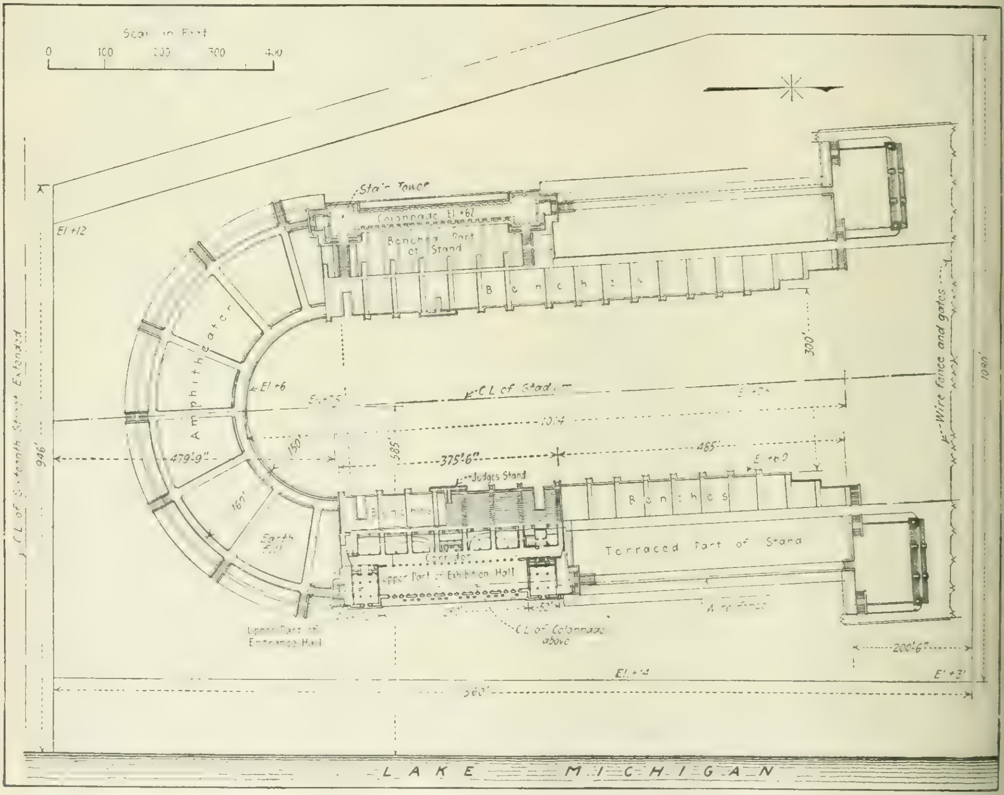

FIG. 1—PUBLIC STADIUM IN GRANT PARK, CHICAGO, COMBINATION EARTH FILL AND CONCRETE FRAME

In plan the stadium is U-shaped, with an amphitheater at one end, although five of the six competitive designs were based on a closed oval plan. As shown by the general plan, Fig. 1, the sides are parallel and not of the horseshoe arrangement used in the Ohio University stadium described in *Engineering News-Record*, Oct. 19, 1922, p. 640. For 375 ft. from the amphitheater the side structures will have tiers of benches extending to the full height. For the remaining 485 ft. there will be a lower tier of benches backed by a series of terraces, the purpose of this terraced arrangement being to provide for temporary tiers of additional seats when required.

These two types of cross-section are shown in Fig. 2. At present the masonry work of the amphitheater and the terraces will be omitted. Earth embankments will be built on their sites, with surfaces sloped and turfed or held in a vertical face by timber retaining walls where the slopes would encroach upon the present buildings.

Governing factors in the design were specific conditions as to minimum length and main elevations, as well as the dimensions of the site. Limitations of height made it impracticable to consider the use of double-deck stands and also controlled the pitch or slope of the single-deck structures, so that this pitch is not as great as might have been desirable for the most advantageous lines of sight. These height limits also made it necessary to use the maximum available length in order to obtain the required seating capacity.

The 300-ft. width of the arena is governed by the sight lines and by the athletic requirements. It is made up of a standard 160-ft. football field, having on each side a 20-ft. safety zone for the players, a 30-ft. running track one-third of a mile long and a space of 20 ft. between the track and the front wall of the stand. It was not practicable to provide space for a baseball field, but football was considered the sport of most importance, with track athletics ranking second. In the complete scheme the benches of the two side structures and the amphitheater will provide seating capacity for 60,000 persons and temporary seating for 40,000 can be arranged on the future terraces. In general dimensions the stadium will have an extreme length of 1,400 ft., a width of 700 ft. including the side structures, and an area of thirty-five acres of which seven acres will form the arena.

Foundations—The site is made land, reclaimed by filling along the lake shore, the fill having a minimum depth of about 22 ft. Below this is blue clay and hardpan. Wood piles 60 and 65 ft. long, driven into the hardpan, will carry the buildings, since the loads are not large enough to warrant the expense of sinking concrete piers to rock at a depth of 80 to 90 ft. A bearing capacity of 15 tons per pile is assumed. Combined footings are used where the loads are light and the column spacing is small. Special foundations for light loads are avoided in some cases by carrying these loads into the framing. For example, the judges' stands are supported by cantilevers from the main framing. The earth embankments used temporarily at certain portions, as noted above, are expected to reduce the cost of future permanent work, since these embankments will become sufficiently stable and compact to permit the concrete structures to be built directly upon them. This plan will avoid the heavy uture expense of driving piles through the embankments to solid material and making deep excavation or footings and foundations.

Buildings and Structural Design—The two side buildings for the grandstands will form inclosed structures f approximately triangular cross-section, each surmounted at its highest point by a colonnade. Numerous ide entrances will give access to the main exhibition hall, El. 15, at the opposite side of which are stairs and curved ramps leading up to a circulation corridor at El. 28.5. In the main towers at each end will be other ramps and stairways which lead from the 15-ft. level to the corridor. From this corridor straight ramps at frequent intervals will lead into the grandstand. The grades of ramps range from 1.75 to 2 in. per foot.

Reinforced concrete was selected for the framing, floors and benches, as the loads and spans present no particular difficulty, while structural steel would have to be completely fireproofed to meet the requirements of the city building ordinance. Artificial stone will be used for the exterior finish and decorative work. It will be mainly in precast slabs and blocks erected like cut stone masonry, but at certain points it will be cast in place and then carved or worked in the same way as stone.

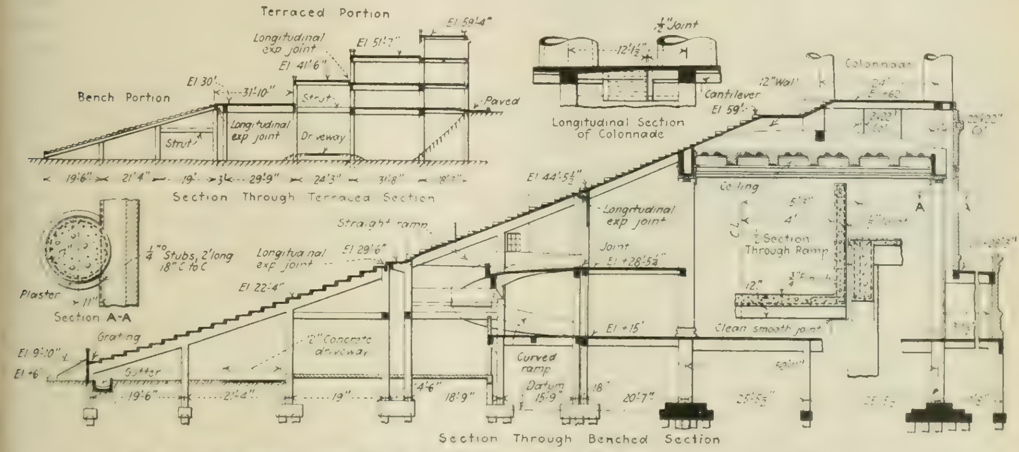

FIG. 2—SECTIONS THROUGH BENCH AND TERRACE PARTS OF CHICAGO LAKESIDE STADIUM

Poured concrete walls will be 6 in. and 8 in. thick, reinforced both ways and in both faces by $\frac{3}{8}$-in. bars of 18-in. spacing. Precast blocks for the wall facing will weigh 56 and 66 lb. per square foot for 8 in. and 12-in. thickness. Curtain walls supported on the framing will complete the inclosure. It was planned at first that the ornamental columns of the colonnade would be poured in place, but instead they are being precast in sections 5 ft. high, with a minimum thick-

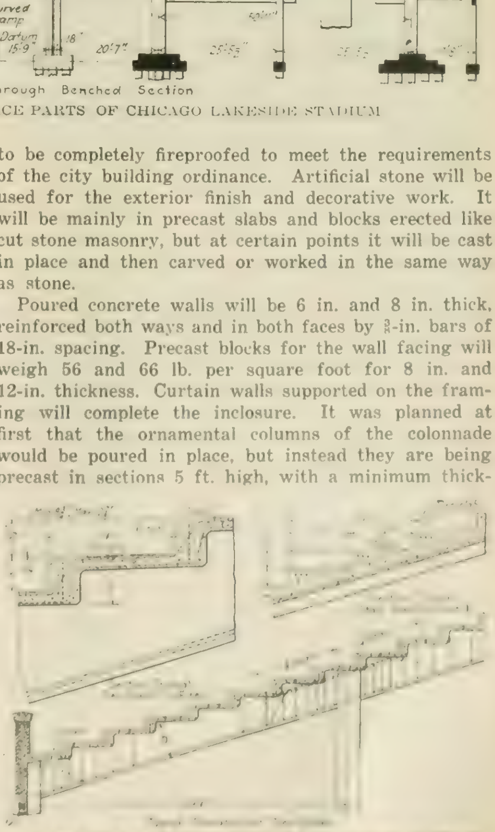

FIG. 3—STEPS AND THE GIRDERS IN [illegible] SECTION

ness of 5 in. for the shell. A concrete slab roof with asphalt roofing will cover the colonnade and that portion which is visible will be finished with ornamental clay tile.

The minimum section for main columns is 16x16 in. For long unsupported lengths between floors the columns are braced by tie-beams or struts at intervals of approximately twelve times the column diameter. No diagonal bracing is introduced, since ample stiffness in both transverse and longitudinal directions is provided by the bench construction and the walls.

FIG. 5—BEGINNING GRANT PARK STADIUM, CHICAGO

Floors and Beams—Floors are of the beam and slab type, with fireproofing 2 in. thick on beams and 1 in. on slabs and tier framing. Slabs up to 4½ in. thick have continuous bar reinforcement, with alternate bars raised over the supports. In slabs of greater thickness and in beams and girders, alternate bars are bent up at the fifth point and extended to the quarter-point in the adjoining span. Beam depth is limited to one-twelfth the span to prevent excessive deflection. Where wire mesh is not used as slab reinforcement, temperature steel is provided by ⅜-in. bars of 18-in. spacing at right angles to the main reinforcement. Typical girders and beams for the benched portions of the grandstands are shown in Fig. 3.

Live-loads as follows were used in the design: For ramps, bridges, aisles and stairs, 150 lb. per square foot; for benches or seat tiers, 100 lb.; for framed interior driveways, a motor truck with 6-ton maximum axle load. These loads were reduced 50 per cent for columns. The live-load per lineal foot of bench 30 in. wide is 250 lb. No allowance is made for impact.

Bench Construction—Elevations prescribed by the South Park Commission for the top and an intermediate point of the structure limited the cross-section and controlled the rise of benches, as already explained. The uniform width of tread is 30 in. (see Fig. 3), with a rise increasing from a minimum of 8¾ in. to a maximum of 12⅞ in. to suit the required sight line clearances. A design for precast tier members or stepped girders was found impracticable because of the difficulty of erecting the large and heavy members, the difficulty of making forms sufficiently accurate for a close fit, the probability of leakage and the lack of economy in the design.

The slab is 3 in. thick, with mesh reinforcement weighing 22 lb. per 100 square feet. Joists or risers are 6 to 8 in. wide and 11 to 15½ in. deep, with one straight bar and one bent bar in each joist. The width of joists is governed by the shear.

Wood seats are provided on all tiers, the risers being too low for convenient seats. Fir planks, 2x12 in., form the seats and are supported on creosoted oak blocks secured to anchor bolts in the concrete. To shed water from the tiers the cascade drainage system is used, with the slabs and tiers pitched toward the arena. In the lowest tier is an iron grating over a concrete gutter. (See Fig. 2.) A slope of ¾ in. in 30 in. for each bench provides for a quick runoff and eliminates seepage. The concrete of the seat tiers is to be finished with a wood float and no top dressing will be applied.

Expansion Joints—As a preliminary to the design an examination was made of several existing structures. It is stated that this showed numerous evidences of injury due to expansion and contraction movements, not only in the way of cracks but also critical failures in the framing which have involved considerable expense for repairs and maintenance. Sliding joints usually had failed to work, with the result of broken ends of beams and brackets. Mastic filler had been squeezed out in hot weather and failed to return when cooler weather caused the joints to open. In other cases the rigidity of the filling or the accidental presence of pebbles in the joint caused the edges of the concrete to spall. A concrete stadium built as a monolith was found to have several cracks serving as expansion joints. On the basis of this investigation it was decided to omit all joint filling and to reduce sliding joints to a minimum, using them only where the loads are light.

An approximate variation of 9 in. in the 1,400-ft. length of structure is provided for by transverse joints ½ to ⅜ in. wide, placed about 48 ft. apart. There are also two longitudinal joints somewhat further apart. In the stands the transverse joints are placed at the sides of stairways in order to be inconspicuous. The general layout of joints in the grandstands and details of some of the joints are shown in Fig. 4. Gutters are placed generally under all expansion joints in benches, decks and roofs in order to prevent the nuisance of dripping water. These gutters were omitted where the detail of concrete at the joint was such as to prevent entrance of water. Since no filler is used the joints may be easily inspected and cleaned.

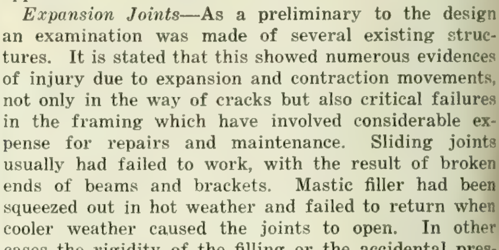

FIG. 4—EXPANSION JOINTS, PLANS AND DETAILS

To carry the transverse joints from foundation to roof without causing unsightly appearances required considerable ingenuity on the part of both the structural and architectural designers, especially as these joints occur through halls, coffered ceilings and high walls. Architectural considerations made it impracticable to carry expansion joints on a straight line, offsets being introduced to bring them to places where they might be concealed. In beamed ceilings the joints follow the edges of beams, requiring either a suspended ceiling or cantilever construction from an adjacent beam. In partitions a clean vertical joint is made and is covered with a thin strip of zinc. On exterior walls the joints are carried down along reveals or pilasters where possible. On flat surfaces they follow the vertical and horizontal joints. In the roof, the joints will have metal strips under the asphalt covering, to prevent leakage. The curved ramps are designed to stand free from the structure proper, resting on brackets and beams provided with lead bearing plates.

Where sliding joints were unavoidable the reactions were made as light as possible and freedom of movement will be assisted by the use of two ½-in. lead plates separated by a sheet of paper soaked in lard oil. Cantilever construction was used at these joints where possible, together with split columns and double beams forming independent rigid frames.

Utilization of Interior Space—The value of the large volume of inclosed space beneath the stands was so apparent, especially in view of the unusually varied purposes of the structure, that the plans were prepared with special attention to utilizing this space effectively. Three great halls with an unobstructed width of 50 ft. and an additional space of 25 ft. on one side are provided, two under the grandstands being about 260 ft. long, while the third under the future amphitheater will make an aggregate length of about 1,000 ft. These halls will serve for exhibitions and similar purposes.

Under the lower part of each stand is a 12-ft. concrete driveway nearly ¾ mile long, with 11 ft. headroom and this is flanked on each side by unpaved vacant space which will be available for organizing parades or preparing decorative floats. Under the terraced section of the stands there will be an additional 16-ft. driveway (Fig. 2). In addition, extensive provision is made for smaller halls, locker rooms, baths, hospitals, toilet rooms and public comfort stations.

Electric Lighting—Since this stadium has the unusual feature of providing for night displays both outdoors and indoors, a comprehensive electric system will be required. This is to include 500 kw. for general lighting, 500 kw. for flood lighting, 250 kw. for stage lighting and 260 kw. for power. Duplicate cables carrying 12,000-volt three-phase current will lead into a main transformer vault with 2,300-watt distribution thence to six smaller vaults. Flood lighting as planned for the arena, 1,014x300 ft., is believed to be the largest installation of its kind. For this purpose there will be 336 lamps of 1,500 volts, or 1.65 watts per square foot. Some of the projectors will be mounted on the frieze of the colonnade and others on twenty-two removable posts with ten projectors to each post.

Designers and Builders—Competitive designs were submitted by six Chicago architectural firms, by request of the South Park Commission. The award was made to Holabird & Roche, who thus became the architects of the work by the terms of the competition. The structural design was prepared under the direction of T. J. Burt, consulting engineer for the firm. Information for this article has been taken in part from a series of papers presented to the Western Society of Engineers by Mr. Burt and by A. M. Korsmo, J. E. Sansberry and F. A. Byrne, as his assistants. The contract for foundations and superstructure has been let to the Blome-Sinek Co., Chicago. It is expected to have the main part of the stadium completed by the fall of 1924, but the amphitheater and certain other features will be left until such time as the South Park Commission has funds available. The cost of work under contract is $2,500,000 and the total cost of the entire project is estimated at $4,500,000.

Gasoline Rail Car of New Design on California Railway

A GASOLINE rail car having several new and distinctive features has recently been delivered to the Hetch-Hetchy Ry. at Groveland, Calif. The car complete weighs about 10,400 lb. and makes 8 miles per gallon of gasoline. It seats thirty passengers and may be built for either narrow or broad-gage railroads.

On the Hetch-Hetchy road it negotiates a 5 per cent grade 12 miles long with numerous 30-deg. curves at a speed of about 27 miles per hour. By placing the motor to the rear of the driving wheels all revolving parts in front of the rear axle have been eliminated. This permits a very low-hung car and eliminates motor noises, smoke, and gasoline odor. It makes possible also a greater passenger seating capacity without lengthening the wheel base of the car. Vibration has been eliminated and traction increased by suspending the motor on coil springs directly over the rear axle on one end of a sub-frame.

NEW GASOLINE RAIL CAR

The subframe makes one-half of the complete truck, as it has a swivel bolster built in the main frame so that it will turn at curves, thereby eliminating flange wear and relieving side thrust. The car has been invented and patented by A. R. Meister and was built by the A. Meister Sons Co. of Sacramento, Calif., at a cost which is given at $8,500.

New Zealand's Extensive Power Plans

The proposed hydro-electric development in New Zealand involves an expenditure of $60,000,000 and is to be spread over a period of ten years, states Consul General David F. Wilber, Wellington, in a report to the United States Chamber of Commerce. Besides lines already under construction there will be large main works at Lake Waikaremoana, and lines from Lake Coleridge will be extended into Otago and North Canterbury and from Mangahao will reach to Wanganui and Napier. There will be smaller developments in the South Island.

Award Made in Toronto Street Railway Valuation

Settlement of Payment for Taking Over System Decided at Sum More Favorable to City Than Company

By P. W. Greene
Toronto, Ont.

On Jan. 31 of this year, the award of the board of three arbitrators appointed to determine the amount to be paid by the city of Toronto for the property of the Toronto Railway Co., which the city took over on Sept. 1, 1921, was announced. The city acquired this property upon the expiration of the thirty-year franchise on the above-mentioned date, and the system has since been operated by a municipal commission known as the Toronto Transportation Commission, which has already spent many millions upon the rehabilitation of the property.

The board set a valuation of $11,188,500 upon the railway, and ruled further that the city should pay interest upon this amount from September, 1921, to the date of the award, at the rate of 5 per cent, which amounts to an additional $792,500, bringing the total cost to the city up to $11,981,000. As shown later this is nearer the city's contention of value than that of the company.

The report was not unanimous, Sir Adam Beck, the city's representative, dissenting. He stated he could not concur with his colleagues as to the general method of valuation adopted, the necessity for the city taking over certain disputed properties and the extent of the allowance for obsolescence. He did not, however, submit any alternative figure.

Roughly speaking, the property consisted of 139 miles of single track, with the necessary trolley wire, overhead and underground distribution system; 830 passenger cars; five carbarns; three storage batteries; a steam plant, not in operation but for which the company claimed "stand-by" value; car building and repair shops; five substations and certain real estate which the city objected to taking over.

In presenting its case to the board, the company contended strongly for a valuation of the above property based on reconstruction cost new less an allowance for depreciation, using average prices for a three-year construction period, ending Sept. 1, 1921. The city opposed this method on the grounds that it included the years of 1919-20, when prices were abnormally high, and contended that it would be grossly unfair were it compelled to pay for the railway at those extremely inflated prices, and on its part, submitted a valuation on what it termed the "trend basis." This valuation was also based on reproduction cost new less depreciation, using however prices as they would have been in 1921, assuming there had been no war and that the normal trend of pre-war prices had continued undisturbed through the war years to 1921.

Both sides also submitted alternative figures using prices as of the date of taking over, that is September, 1921, but in each case contended that the methods mentioned above were what they considered to be the equitable methods.

Price Basis Adopted—The board actually adopted this 1921 price basis, stating that the three-year period as advocated by the railway company would in this case have thrown an unfair burden upon the city, due to the abnormal prices of 1920. At the same time, referring to the "trend basis" as advanced by the city, in the words of the award they stated—"We are unable to give weight to this contention, which in effect, disregards entirely current prices and rates of wages. Value (as set forth in the agreement) means value in lawful money of Canada at the time the valuation is made, not lawful money of Canada as of an imaginary period. We are unable to find anything in agreement or in judicial decisions sustaining this view."

While this matter of the basis of valuation to be adopted was undoubtedly the most important point of principle which the arbitrators were called upon to decide, the wording of the original agreement between the company and city was the source of some other very contentious points. It stated that the board appointed to decide the value "were to consider and award only value of said several particulars (property, plant, equipment, etc.) to the city at the time of the arbitration, having regard to a railway of the best kind and system then in operation and applicable to said city," and further, that, "rights, privileges, profits, dividends, etc., were not to be considered, but the arbitrators were to consider only the actual value of the actual and tangible property necessary to the operation of the railway." The phrases "best kind and system" and "necessary to the operation" resulted in lengthy legal arguments, and introduced the questions of obsolescence, and the necessity or otherwise of the city taking over certain parts of the property which they wished to reject on the grounds that they were "unnecessary for the operation of the railway" or were obsolete, not coming up to the requirements of a railway "of the best kind and system then in operation."

The principal items in dispute in this connection were the three storage batteries, and the old steam plant. Numerous expert witnesses were brought in, and a mass of evidence was submitted, to prove the necessity or the reverse, of these two sections of the property. The board decided that the city should take over the storage batteries at a valuation of $338,500, the company having asked in the neighborhood of $800,000. With regard to the steam plant, the award specifies that the city shall take it over, but sets a scrap value upon it, stating as the reason that the city has already willingly taken over the half of the building containing certain electrical equipment, and they could not, therefore, reasonably reject the remaining half of it.

The board also ruled that the city did not have to take the original three-story head office building; some disputed sections of real estate, certain cars which the city claimed were obsolete, and the majority of the stores and patterns.

General Overheads—One of the most interesting points arose in connection with the general overheads to be allowed. The arbitrators recognized only two items—engineering and superintendence, for which they allowed $375,000 and interest during construction, $525,000, making a total of $900,000 for general overheads. The company had claimed in all, approximately $3,300,000 under this heading, which included in the neighborhood of $1,530,000 for cost of placing property in operation; $680,000 for miscellaneous general overheads, such as taxes, insurance, legal expenses, and such like, and $165,000 for contingencies and omissions, but the board allowed nothing for these. While they admitted that such allowances are frequently taken into account, they considered them as "intangibles" and, therefore, not capable of being included within the meaning of the words "actual and tangible property."

Nor did they, on the same grounds, allow anything for cost of raising the capital, the company's figure for which was $2,500,000 to $3,000,000.

Award Itemized—In setting out the award, the board was careful to state, in addition to the actual amounts to be paid, the figures it arrived at for the main subdivisions of the property on both the "three-year average" basis and the "trend basis," having in mind, evidently, the possibility of an appeal; in which case these figures might prove of great value and save endless duplication of work should its decision as to the proper basis be not upheld. Further, values were set for disputed properties which the board itself ruled as unnecessary to be taken over. Reasons were given for all conclusions arrived at by the board, and numerous legal precedents were quoted. Each of the main items of the property was dealt with separately, and detailed schedules were attached covering all the real and personal property, undisputed and disputed; so that the award was an extremely clear and comprehensive document, leaving apparently nothing not covered. It stated also that obsolescence had been considered where they thought reasonable. The main figures of interest are:

Amount of actual award based on 1921 prices..	$11,188,500
Valuation by railway company on 1921 basis...	21,000,000 approx.
Valuation by city on 1921 basis..............	7,000,000 approx.
Valuation by railway company on 3-yr. basis..	22,000,000 approx.
Valuation by city on 3-yr. basis..............	5,000,000 approx.

Personnel—It should be noted that the railway company's three chief witnesses, mentioned below, each submitted complete appraisals, covering an inventory agreed upon with the city's engineers, the chief differences being in the prices used in parts of the property and allowances for overheads. These three appraisals all ranged about the figure $21,000,000 of the above table, which includes all disputed property as well as undisputed.

At the time of writing no definite announcement has been made, but it is generally believed that both sides will appeal to the Privy Council in London.

Among the prominent engineers engaged were Hagenah & Ericson, of Chicago; A. L. Drum, of Chicago, and M. E. Cooley, from Ann Arbor, Michigan, for the company. Jackson & Moreland, of Boston, were in charge of the case for the city, and were assisted by Prof. A. S. Richey, of Worcester, Mass., who valued the rolling stock. Numerous other prominent engineers were called in to deal with special features of the property.

The Board of Arbitrators consisted of Hume Cronyn, of London, Ont., chairman; Sir Thomas White, ex-Minister of Finance, at Ottawa, representing the railway company, and Sir Adam Beck, of the Ontario Hydro Electric Power Commission, for the city.

W. N. Tilley, of Toronto, was chief counsel for the city, and N. W. Rowell, for the company. Pierce Butler, now justice of the United States Supreme Court, also acted as railway counsel.

In view of this distinguished array of arbitrators, engineers and counsel, the extent and detail of the evidence submitted, and duration of the proceedings (the court actually sat on 156 days; 48 witnesses were called, and nearly 800 exhibits were filed), this case will be considered as one of the most interesting of the kind on record.

Refined Tar for Coating Cast-Iron Pipe and Fittings

By S. R. Church
Technical Adviser, The Barrett Co., New York City

Extracts from a paper read before the New England Water Works Association

TEN years ago I first gave some attention to the question whether or not there ought to be a specification for a refined tar product for coating cast-iron pipe and fittings, I found that at practically all the foundries crude coal tar was being used. The method of coating varied somewhat but was usually developed by experience and not marked by close control. I came to the conclusion that the coating could probably be improved by: (1) Closer temperature control of both castings and bath; (2) Adoption of some method for testing the consistency of the coating from time to time and keeping it uniform; (3) Specifications for the coating that would insure reasonably uniform consistency and freedom for excess water. It did not seem to me at that time that the last named requirement was of greater importance than the other two.

No doubt coating technique has been improved during the last ten years; most industries are making progress. I know that your association has been giving attention to the problem and that tentative specifications for pitch for pipe coating are under consideration.

You may ask: Is pitch a better material for coating pipe than crude coal tar? If so what should be the melting point of the pitch? What is the meaning or significance of "free carbon" in tars and pitches? Should the origin of the tar be specified—that is, gas works, coke oven, etc.?

The tars first used for coating pipe were horizontal gas-works coal tars. In the early days of gas making fire clay retorts were used and the first important change in the character of coal tar occurred when fire clay was replaced by silica retorts. With the latter, higher heats were employed and tar was produced of very high viscosity and high free carbon content.

The newer types of tar—coke oven, vertical retort and water-gas—are thinner and of lower free carbon content than the horizontal gas-works tars. Undoubtedly the best coating is not obtained when very thin tar is used. Crude water-gas tar or crude vertical-retort tar makes a very poor coating, lacking body. To obtain a coating having the consistency and covering power of a medium gas-works coal tar, most of the tars now available must be modified by distillation, or reduced to the proper consistency. Either coal-tar or water-gas tar may be reduced to any desired consistency but it is doubtful whether water-gas tar should be used for pipe coating as its resistance to chemical attack and its life under conditions of service have not been well established.

What happens when a hot casting is dipped in tar? The object of the process is to obtain a thin but complete coating that will dry in a short time, adhere strongly to the pipe, be resistant to abrasion and finally protect the metal from corrosion. If crude tar is used the heat is sufficient to drive off enough of the more volatile oils so that the remaining film or coating is pitch. If pitch is used to start with, either higher temperatures must be employed or a thicker coating will result. I do not believe there is any merit in a thicker coating per se; on the other hand a very thin tar may produce a coating so thin as to be non-protective and unduly brittle. I am inclined to the opinion that what is needed is a refined distilled tar with reasonable limits as to viscosity and free carbon. The viscosity limits should be specified at an elevated temperature, say 100 deg. C., approaching that of the bath.

What does free carbon signify? The term is a misnomer. Free carbon means matter insoluble on hot extraction with benzol. It is not "free carbon," but a mixture of difficultly soluble and insoluble compounds of high carbon content, but containing some hydrogen. Tar is a product of destructive distillation which means that the vapors distilled out of the coal are partially decomposed and the result is a mixture of hydro-carbons with some oxygen and nitrogen compounds which were not present as such in the coal but are formed in the retort. "Free carbon" is an index of the amount of decomposition that occurs. Tar obtained from coal under conditions suitable for decomposition—for example, under high vacuum with rapid removal from the retort—would be entirely different from our commercial tar. It would contain a lot of paraffin compounds and phenols and would be thin and oily, with a very low pitch content.

"Free carbon" in the specification is simply a means of providing for tars that have been produced at neither too low nor too high heats. Lack of it indicates a thin tar of inferior covering capacity; too much, a thick material difficult to handle and settling out in the treating vessel or bath.

Apart from specifying that the tar should be obtained from the carbonization of bituminous coal, I do not believe that its origin need be specified if the proper limits for consistency and free carbon are arrived at. Uniformity is what is wanted and it is the tar distiller's job to produce that uniformity by selecting and combining his tars, and processing the mixture to obtain the desired product. The tar producer cannot insure this, and while tar from one source may run very uniform for a long time it may and in fact often does change profoundly without any warning as the requirements of coke and gas vary. It has been the history of material specifications that as we approach perfection the requirements for the finished product become more important than the question of where the raw material originated.

How to Develop Cost Curves for Building Estimates

Equation of Cost Curve for Given Type of Building Derived from Analysis of Estimated Costs of Three Buildings

By O. G. Wilbur
Building Pilot Engineer, The Baltimore & Ohio System, Baltimore, Md.

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BUILDING unit cost curves can be very satisfactorily used in appraisal work, at a much reduced cost when a number of buildings of similar design and construction are involved. This method of appraisal affords an opportunity to compile data which might be applied as a "rule of thumb method" in appraising property where reasonably accurate results are required.

Studies of costs of various building materials and rates of wages for the various trades in the principal cities indicate that within certain zones but little variation in costs exists, so that by developing cost curves covering the various general types of construction, using unit costs representative of a certain territory, those curves might be applied anywhere within that territory and reasonable results obtained.

To develop a building cost curve applicable to the superstructure of a specific type of building, two or preferably three representative buildings are selected whose exterior and interior construction are comparable, widths and heights varying somewhat and lengths varying to a considerable extent. If three buildings are used, one should be selected whose dimensions are nearly an average between the smaller and larger ones. Prepare an estimate for each of the three buildings to determine the total cost of each and plat the total costs in a graph using the total volumes of the buildings as the abscissas and the total costs as the ordinates. Through these three points pass a flat curve. This curve is the "total cost curve." The "unit cost curve" is developed from the "total cost curve" by selecting various volumes and their respective total costs from the "total cost curve" and reducing each to a cost per cubic foot of volume; these values are then platted by using the volumes as ordinates and the costs per cubic foot of volume as abscissas. A smooth curve passed through these points is the "unit cost curve" for this type of building, for any volume within the limits of the curve. Some engineers have endeavored to develop the "unit cost curve" on the assumption that the curve is a parabolic curve, but its equation is not the equation of a parabola.

A study of shop buildings and various other classes of railroad buildings indicates that within each classification, the buildings increase materially in length as the volume increases, but the variation in width and height is small. Due to the variation in width and height, it is impossible to derive an equation that is theoretically correct unless it takes into account the three factors of length, width and height with constants and variables for each. An equation, however, can be derived for a curve which for all practical purposes will represent an average "unit cost curve" for buildings.

To develop the equation of the cost curve, consider for example, the following two frame buildings used as passenger stations; their general type of construction being similar:

	Width, Ft.	Length, Ft.	Height, Ft.	Vol Cu.Ft.	Est. Cost	Unit Cost
Building A	20	60	17.5	21,478	$2,302.30	10.7c
Building B.	14	28	14.5	5,860	1,443.41	24.6c.

The volume of building A is 3.664 times as large as that of building B. If the widths and heights of these two buildings were identical the length of A would consequently be 3.664 times the length of B. If this were true and all the materials in building A were increased in proportion to the volumes of A, and B, then building A would replace building B in its entirety 3.664 times. This would increase the cost in the same proportion and consequently the unit cost of A would be the same as that of B. The total cost of A under these conditions would be $5,283.59, an increase of $2,981.29 more than the actual estimated cost. In constructing A, although the volume is more than triple that of B, certain units remain constant in both buildings, as for example the ends, bay window, chimney and various minor items. These items then, in this particular example were included but once in the construction of building A and therefore omitted 2.664 times. The cost of these omitted items is $2,981.29 as developed above which if reduced to one unit, gives a total cost for the two ends, bay window, chimney and other constant items of $1,119.10, which is the "constant total cost of constant units." Deducting the "constant total cost of constant units" from the total estimated cost of building B and dividing the remainder by the volume of the building we have the "constant unit cost of variable units." The following equation is then self-evident using symbols as designated.

Let x = total unit cost; y = total volume; K = constant total cost of constant units; a = constant unit cost of variable units; C = total cost of building.

Then $$C = ay + K \qquad (1)$$

and $$x = a + \frac{K}{y} \qquad (2)$$

Equation (1) is the equation of the "total cost curve" if the widths and heights of the buildings are constant, but since there is a variation in these dimensions the equation of the "total cost curve" is theoretically, of the general form $C = ay^n + K$. (3)

This is explained by the fact that the cost of a building approaches a minimum as the building approaches the shape of a cube. Therefore as widths and heights slightly vary, the power of y in the equation will vary. If the widths and heights practically remain constant for all buildings in a type, y^n in equation (3) will approach y and the equation of the "total cost curve" will take the form of equation (1) which is the equation of a straight line. Taking into account the variation in the width and height, the "total cost curve" is a flat circular curve instead of a straight line.

If the "total cost curve" is developed graphically by passing a flat curve through three platted points representing total estimated costs of three buildings and a "unit cost curve" is developed therefrom, this curve will nearly coincide with one developed from equation (2). Theoretically the "unit cost curve" graphically developed from the "total cost curve" will give more nearly correct results than the equation, and the use of the graphical method is therefore recommended.

Example of Development—Assume the determination of a "building unit cost curve" for frame passenger stations of volumes from 500 cu. ft. to 9,000 cu. ft. The following buildings are selected as typical:

	Dimensions					
	Width, Ft.	Height, Ft.	Length, Ft.	Volume, Cu.Ft.	Total Cost	Unit Cost
(A)	10 3 x	10 25 x	12	1,267	$284 89	0 225
(B)...........	12.0 x	11 75 x	16	2,264	351.04	0 1563
(C)	16 0 x	14.0 x	22	4,928	533 07	0.1082

$$\frac{\text{Vol. (C) 4,928 cu ft.}}{\text{Vol. (A) 1,267 cu.ft.}} = 3.889 \text{ the ratio of volumes}$$

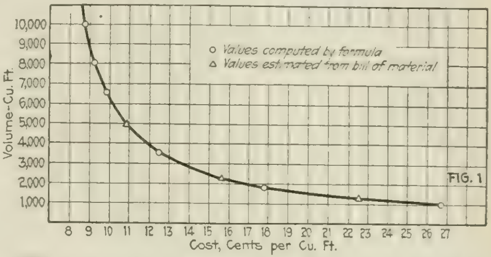
Had it been necessary to reproduce all materials in building (A) 3.889 times in order to construct building (C) because of the volume of building (C) being 3.889 times as large as building (A), the unit costs would have been the same and the total cost of building (C) would have been 4,928 cu.ft. x 0.225 = $1,108.80, the total multiple cost, using unit cost of building (A). Deducting $533.07, the total actual cost using unit cost of building (C), we have $575.73 as the estimated cost of constant units not required in building (C). Dividing $575.73 by 2.889, we get $199.28, the constant total cost of constant units designated as K. Deducting from $284.89 the total cost of building (A), $199.28, the constant total cost of constant units, we have $85.61, the constant total cost of variable units. Now, $85.61 ÷ 1.267 = $0.0675 constant unit cost of variable units which has been designated as a.

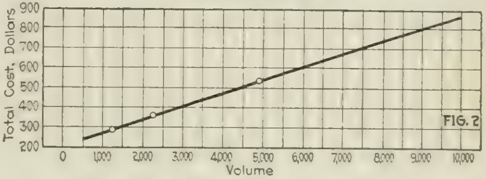
Substituting these values for K and a in the equation $x = a + \frac{K}{y}$ and the values for y as indicated in the following tabulation, the corresponding values for x are derived.

Volume	Unit Cost
1 000	0 2668
1,800	0 1782
3,500	0 1245
6.500	0 0982
8 000	0 0924
10,000	0 0874

The above values for x and y and the values developed from the estimates for the three buildings used as examples are platted in Fig. 1 and a smooth curve passed through the points. This curve is the "unit cost curve" for any size building similar in construction to the three selected.

Fig. 2 represents the "total cost curve" developed by passing a smooth flat curve through the three points platted and relatively representing the three typical buildings. Fig. 3 represents a "unit cost curve" developed graphically from the "total cost curve," Fig. 2, by assuming various volumes and computing the respective units cost from the "total cost curve." The points indicated within a triangle represent values derived by using equation (2). It will be noted, that for large volumes the difference in cost between the graphical method and the analytical method is approximately one tenth of a cent per cubic foot or about one per cent; for volumes near the center of the curve, the unit costs developed by both methods are identical and for the small volumes there is a difference of two tenths of a cent per cubic foot or less than one per cent.





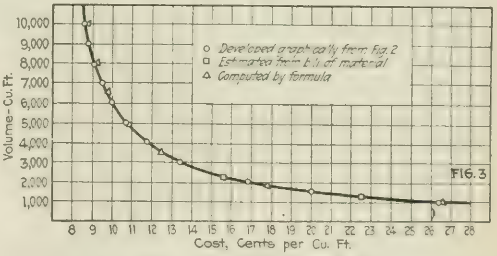


FIG. 1—UNIT COST CURVE

This curve, derived from the estimated costs shown by the points in the triangles, indicates the relation between cubical contents and cost per cubic foot.

FIG. 2—TOTAL COST CURVE

A smooth curve passed through the total costs of three typical buildings of different volumes

FIG. 3—COMPARISON OF UNIT COST CURVES

Relation between estimated unit costs derived graphically from Fig. 2 and computed as in Fig. 1.

The foregoing comparison bears out the discussion that "unit cost curves" developed by both methods are practically identical and for all practical purposes, equation (2) is the equation of the "unit cost curve."

Topographic Surveys in 1922

During the fiscal year ended June 30, 1922, the topographic branch of the U. S. Geological Survey surveyed more than 12,000 square miles of new area, exclusive of Alaska, and resurveyed approximately 1,500 square miles.

Experience with Metal Forms for a Flat-Slab Floor

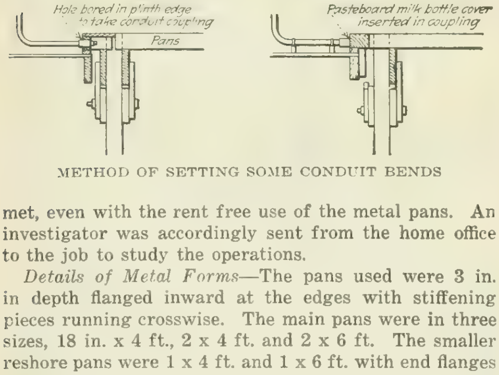
System for Using Old Metal Forms Worked Out on Job and Saves Money, But Wood Forms Advocated for Most Jobs

BY DAN PATCH

Aberthaw Construction Co., Boston, Mass.

IN the matter of total cost and of safety and convenience in construction, the use of wood forms for flat slab construction would seem at the present to have in its favor a considerable margin over metal forms. The experience of the writer's company during the past summer in the use of metal forms, would lead, however, to the conclusion that the margin might eventually be made much narrower.

One of the disadvantages of standardization of design and method is the difficulty which arises when an organization, trained to the minute on its own kind of work, hits something new. The very momentum of standardization may then become a handicap. The company the writer works with is proficient in typical flat slab form construction. It has just been carrying through a contract, however, for an owner who had on the site, rented for a previous operation, a full equipment of steel pan forms, and a partial equipment of supporting members. From the time the erection of this system of forms started the field reports showed costs so far above those of standards that it was evident that something must be done if estimates were to be met, even with the rent free use of the metal pans. An investigator was accordingly sent from the home office to the job to study the operations.


Hole bored in plinth edge to take conduit coupling
Pans
Pasteboard milk bottle cover inserted in coupling

METHOD OF SETTING SOME CONDUIT BENDS

Details of Metal Forms—The pans used were 3 in. in depth flanged inward at the edges with stiffening pieces running crosswise. The main pans were in three sizes, 18 in. x 4 ft., 2 x 4 ft. and 2 x 6 ft. The smaller reshore pans were 1 x 4 ft. and 1 x 6 ft. with end flanges omitted so that posts under their ends could bear them securely against the slab, while the main pans were supported on the flanged edges by joists set on shoulders bolted to the posts. These shoulders were tapered to a standard taper and hard wood wedges of the same thickness and taper were inserted under the joists and used for adjusting the joists into the proper relation to the post tops.

The joists and wedges were kept in place laterally by 2 x 4 in. arms which pivoted on the shoulder bolts and could be swung down for purposes of stripping. The two 2-in. joists plus the 4-in. post made an out to out of 8 in. which had the design been made to fit the pans, would have given ample landing for the pan edges. As it was, the plinth sizes were such that a post spacing was necessitated which gave only the 2 in. joist width as a landing for certain rows of pans.

Routine of Erection—The operations as observed by the investigator were as follows: Set up and brace plinth towers, set and center plinth tops, mark off post lines on paving or slab below, set up posts with pair of wedges under each and brace with ledger boards, put up joists, throw up arms and place hard wood wedges on shoulders, lay pans on joists, saw off post tops which interfere with pan flanges, grade up from under floor, arrange pans, final grade from top of pans, drive up loose and nail all shoulder wedges, fit wood filling pieces and panels, scrape and oil pans.

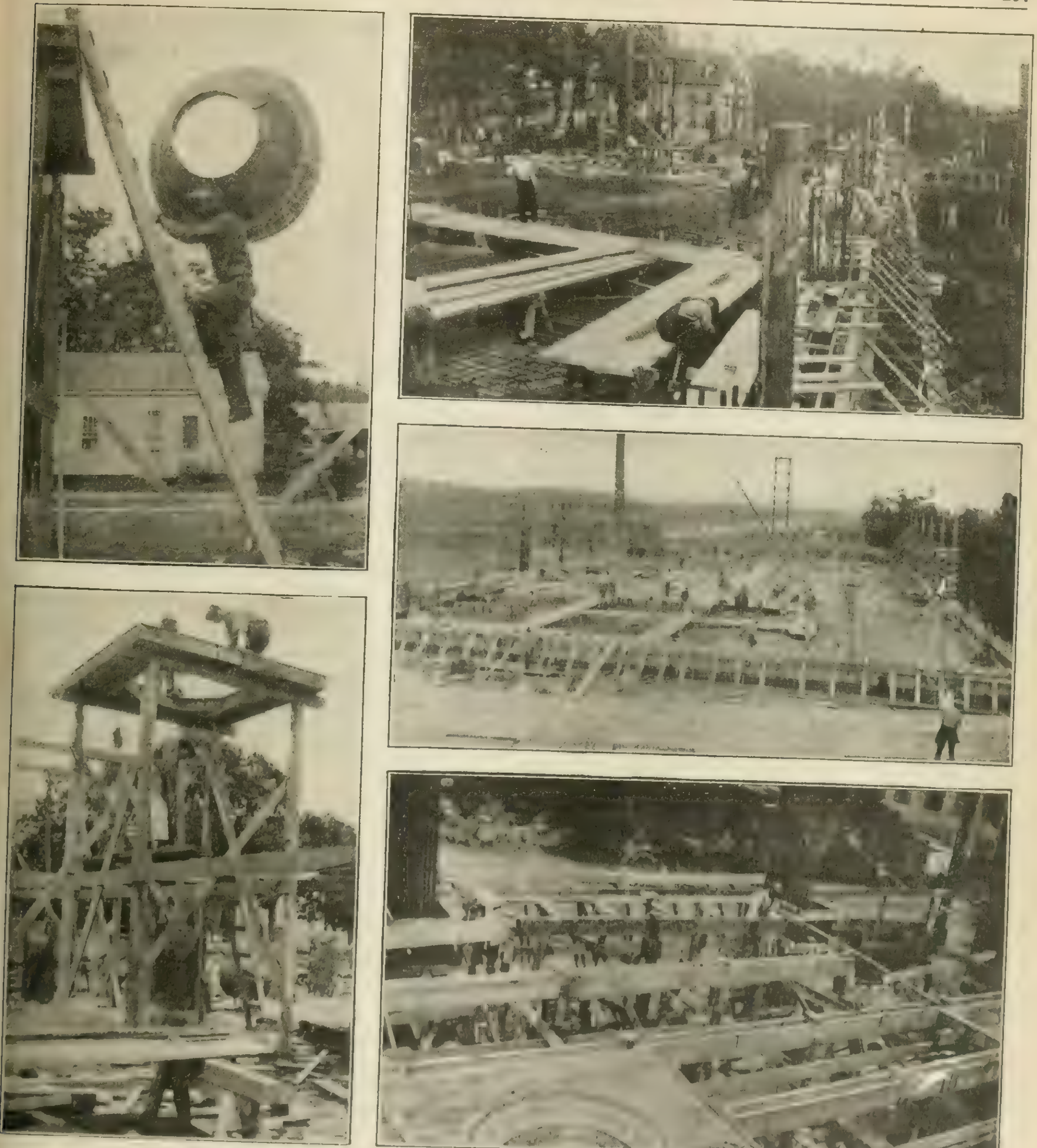
Time studies were made to determine what proportion each operation was of the total and to indicate where the greatest possible field for cost reducing study might lie. Some of the difficulties encountered and methods of eliminating will be enumerated.

It was found that one of the costly operations was the wood filling in, necessary because the building had not been designed in multiples of pan dimensions. This would seem to be an argument for the closest kind of co-operation between designing engineers and construction companies and the very probable reason for lower cost buildings by construction companies who build to designs made by their own engineering departments. These filling in pieces and panels were seen to be unsymmetrical, this symmetry being also responsible for the use of extra posts and joists near certain of the plinths.

The investigator accordingly laid out a complete form assembly to a scale of ½ in. = 1 ft. with a color key to show supporting structure, pan landings and filling. The same assembly carried the design of the wall beam bottoms and supporting jacks to suit the floor pans. It is always better to eliminate unnecessary operations before making any attempt to speed up work. This assembly not only eliminated many moves on the part of the carpenters and move men, but saved a considerable amount of lumber. The carpenters had been putting in place two 2 x 8 in. joists at each side of the plinths. The one of these adjacent to the plinth had no pan landing on it and bore only a filling piece which made the plinth edge. In the assembly drawn up by the investigator the joists adjacent to the plinth were omitted and four cleats were nailed to the plinth top frame, which was stripped and moved with these tops, to bear the plinth fillers. This saved a considerable amount of labor and lumber.

The operation of sawing post tops was seen to be unnecessary after the first set up if the locations of the short tops could be marked on the plan and distinguishing bands marked on the posts for these locations. There was a slight variation in the length of joists for certain locations. Carpenters invariably had to measure up or try and reject. A complete marking scheme was developed and the move men taught the location of each piece by mark. This allowed carpenters to do real work instead of sorting and saved the inevitable waste due to carpenters cutting the longer timbers rather than locate the shorter ones.

Some Improved Methods—As mentioned previously, certain of the rows of pans could, on account of the design, have only the 2-in. joist width as a landing and as there was no method of tying the pans to give continuous strength, it was quite easy, when working from the bottom up, to have joists now and then out of line enough so that the pans when laid and lined up would find no support whatever for one of their ends. This necessitated either casting off the ledgers and re-



ERECTING METAL PAN FORMS FOR A FLAT-SLAB CONCRETE FLOOR

Upper, left—Carrying column heads to be set. Lower, left—Erecting the plinths to support the pans. Upper, right—Wall beams at right. Middle, right—Floor about ready to concrete. Lower, right—Erecting the main joists.

aligning the posts and joists or the spiking on of 2 x 4 in. continuous cleats to the joists. To eliminate this correctional work which cost considerable and to assure symmetrical filling pieces at plinths, spacing battens were made and all posts were set up with the tops correctly spaced. With a high story height, even if set up with a spirit level the posts set to a bottom spacing will be out of line at the top. The spread of the plinth tower posts was just enough different from the adjacent lines of centering posts, so that it was difficult to run the ledger boards in a continuous line across the building. The spread was changed and the difficulty was eliminated.

As the forms were being erected when the investigator went to the job the filling pieces at the plinths were so wide that timbers boarded over were used. With the new layout it was possible to use a single 3 x 4 in. piece at each plinth edge across the building except the two middle edges, where filling pieces were eliminated entirely by using two 4-ft. pans instead of one 6-ft. pan for the middle bay. In order to use the **3 x 4** in. solid filler a change was made in the method of setting some conduit bends as shown in the drawing. This change made easier stripping and re-use of filling pieces.

Saving Time and Money—The time studies had shown that there was much time lost due to bringing pans onto the floor before the supporting structure was ready ahead of them. By keeping the pans off the working floor until a place was ready to lay them, a second handling was saved.

The operation of grading the floor had appeared to be one of excessive cost. This was partly due to the fact that there were two points of adjustment between the floor below and the pans above, one between the joist and shoulder and one between the bottom of the post and the floor. The cost was reduced by proper adjustment of joist tops and post tops at the start, and nailing in the wedges. Grading cost was further reduced late in the job by a scheme of one of the job engineers which was undoubtedly of value and should become one of the regular operations. The posts as originally set up were often not within one to two inches of the proper grade. This made it necessary to cast the ledgers adrift in order to grade and then renail after grading. To obviate this a straight edge was set on blocks at either end so adjusted that when they rested on the plinth panels the straight edge was at the grade of the post tops. This allowed the posts to be set so closely to grade before the ledgers were first nailed that the final grading could be done without detaching them.

That the study made of this job had a distinct financial value would be indicated by the following cost figures. About 15 per cent of the job had been done when the study methods were adopted.

	Average Cost per Square				
	First 15 Per Cent	Last 85 Per Cent	Difference 85 Per Cent	Quantity 85 Per Cent	Labor Saving
Floor slab.....	12.84	7.81	5.03	1098	$5,530
Wall beams....	26.19	19.39	6.80	148	1,006
					$6,536

No estimate has been made of the material saved. There was an additional labor saving on the wall beams due to a change in squad bosses which amounted to $273.

Costs—The costs per square for the last week's work were $6.70 and $15.35 respectively, which would lead the writer to believe that the investigator may not have squeezed all the water out, and that the average of $7.81 might be lowered on another job. From such information as has come through to him, however, he would venture the following conclusions:

1. That for New England, at least, wood panels still give a more economical system of forms for concrete construction. The steel pans save very little lumber in the supporting system and the labor saved due to not having to make up panels is partly lost by the labor necessary to mill and assemble the special posts with shoulders and arms.

2. In hot weather the steel pan floor is more difficult for the men to work on.

3. Lack of continuity and difficulty of tying in wall beams, floor stops and other members makes steel pans less attractive.

4. Inserts, "Hy chairs," and sleeves are more difficult to set on steel pans.

5. While steel pans may outlast wood panels, after a few uses much labor has to be expended on them in order to get good concrete surfaces.

6. This type of steel pans, after any considerable use, give the ceiling a wavy appearance due to deflection between flanges and ribs.

City Zoning Adopted by 110 Cities

TO THE close of 1922 zoning had been adopted by 110 municipalities in the United States. Additions to the table published in *Engineering News-Record*, Sept. 28, 1922, p. 519, in the article by Mary T. Voorhees, of the Division of Building and Housing, United States Department of Commerce, to bring the record to the close of 1922, are as follows, according to Miss Voorhees:

ADDITIONS TO ZONING ORDINANCE CITIES

"Comp." indicates comprehensive. "Use" means use district only. The last column gives the dates of adoption.

CALIFORNIA		
Fresno....	Use	
So. Pasadena......	Comp.	1922
ILLINOIS		
Berwyn..........	......	....
Highland Park....		
Maywood..		
Riverside.		
Wilmette....	Comp.	1922
INDIANA		
Indianapolis......	Comp.	1922
MASSACHUSETTS		
Lowell..........	Use	1922
Newton..........	Comp.	1922
Springfield........	Use	1921
MINNESOTA		
Minneapolis..	Height	1920
NEW JERSEY		
Cranford.........	Comp	1922
Elizabeth.........	Comp.	1922
Fort Lee.......	Comp.	1921
Hillside..........	Comp.	1922
Kearney	Comp.	1922
Madison	Comp.	1922
Orange...........	Comp.	1922
Passaic	Comp.	1922
West Hoboken....	Comp.	1922
NEW YORK		
Binghamton......	Comp.	1922
Brightwaters......	Comp.	1922
Buffalo..........	Use	1922
Endicott.........	Comp.	1922
Jamestown..		
Mount Vernon.....	Comp.	1922
OHIO		
Bay Village.......	Comp.	1922
Euclid Village.....	Comp.	1922
Grandview Heights	Comp.	1922
Idlewood.........	Comp.	1922
Mansfield........	Use	1920
TENNESSEE		
Memphis...	Comp.	1922

About 40 per cent of the 110 cities adopted zoning in 1922. Of the 110, 74 have complete zoning, including use, height, and area restrictions; 27 regulate use only; 1 each regulate use and height, use and area and height alone, and further extent of the regulation is not reported. In the original table, Newark, N. J., should have been listed as having adopted zoning in 1919 instead of 1920, the ordinance having been passed late in December, effective Jan. 3, 1920.

Four Missouri River Crossings to Be Built by Missouri State

Hitherto only three highway bridges have crossed the Missouri River within the State of Missouri: at Kansas City, Jefferson City, and St. Charles, all of them toll bridges. They are far too widely separated for the needed interconnection of the highway systems on the two sides of the river. Accordingly, four new crossings are being built by the state highway commission, under Federal Aid. They are located at Boonville, Glasgow, Waverly, and Lexington. All are high-level bridges, requiring no movable spans. The Boonville bridge will have 2,665 ft. of steel bridge, 447 ft. of reinforced-concrete trestle, earth-fill approaches and a roadway 18 ft. 8 in. wide and will cost $527,000. The Glasgow bridge, with four river spans, totaling 1,224 ft. and 684 ft. of approach spans, will have a roadway width of 21 ft. and will cost $566,000. The Waverly bridge, with five river spans aggregating 1,610 ft. and 345 ft. of approach spans, will have a 20-ft. roadway and will cost $585,000. The Lexington bridge, largest of the group and with the greatest depth to rock (100 ft.) will have a 20-ft. roadway, will cost $1,169,000, and will comprise 3,071 ft. of steel superstructure. J. A. L. Waddell is consulting engineer for the Lexington bridge, F. W. Adgate for the Glasgow, and Harrington, Howard & Ash for the other two. Their construction is under the direction of B. H. Piepmeier, chief engineer of the state highway commission.

The Present Status of Sewage Treatment in England—III

Impressions Based on Visits to Various Works and on Interviews with British Specialists in January, 1923, Presented with a View to Current American Problems

By George W. Fuller
Consulting Engineer, New York City

From his observations at eight British installations, Mr. Fuller concludes that the activated-sludge process has come to stay, although much is yet to be learned regarding it. Preliminary treatment in England exceeds that in the United States. As a rule, nitrification is not being sought or obtained. The present competition between air diffusion and mechanical agitation is described and the patent situation outlined. As a rule, disposal of the excess sludge has not yet been faced as a separate problem, since the sludge usually goes in with other sludge for disposal. Activated-sludge installation costs seem to be lower at some works than revamping old works of other types. Operating costs range from £2 to £2 10s. per million imperial gallons for 1-m.g.d. installations with power cost 7d. per kw.-hr., an average of $9 per million United States with current at 1.4c. per kw.-hr. The two earlier articles appeared Feb. 1 and 8, pp. 206 and 252.—Editor.

Outlook for the Activated-Sludge Process

On ENGLISH evidence alone this method has come to stay, with a certainty that more and better data concerning it will be available year after year. I saw eight installations, built or building, for its use on a sizeable scale, although in each instance only a part of the total sewage flow was treated. While these may be termed demonstration plants, yet it is worthy of note that the Ministry of Health has sanctioned a loan for building works for treating by this method the entire sewage flow of Reading, from plans of Midgely Taylor, one of the foremost sanitary engineers. Further, designs are being prepared by Haworth for the entire flow at Stockport. Caink at Worcester is similarly engaged on units for treating all local sewage. Sizable plants are under way or projected at Sheffield, Hanley, Birmingham and in the Bury district. Numerous investigations on a small scale are being conducted, particularly at London and Bradford.

Soundness of Method—The scientific basis on which this biological process is founded is undoubtedly sound, regardless of the limitations which its practical application may encounter. It stands up against trade wastes surprisingly well. I heard of only two instances where difficulties had been noted: gas-house wastes or tar at Manchester and an inhibiting effect on bacteria reported by the chemist at Leeds as caused by local trade wastes at times. I was interested to note that Garfield finds that by applying in a 30,000-gal. tank about 3 cu.ft. of air per gallon for an average period of 40 to 48 hours he can activate the Bradford sewage so that grease is removed by oxidation at the rate of about two tons per million gallons. (Unless otherwise stated tons of 2,240 lb. and imperial gallons are used throughout this article.) This intense selective action of the bacteria causes the temperature of the sewage to rise from about 60 to 80 deg. F. and converts the sewage into quite an effective coagulant.

Status of the Art—There is a vast difference between theory and practice concerning this method. No matter how sound the scientific basis, its usefulness depends on the skill shown in the art of its application. Basic data obtained on a sizable scale are now coming steadily forward, but it will be a long time before we know as much about this method as we do about some other lines of engineering, where practice has become stabilized, if not standardized. On the other hand, there is no reason why this method cannot be adopted, if desired, at most localities provided the margins of capacity are not made too small or provided there is not a disposition to look too closely into costs, either actual or relative. A leading question, ordinarily, will be a decision between this method and sprinkler beds, and for this the answer will no doubt vary in accordance with a number of local factors. Perhaps this question may be settled now at some localities without much investigation; but I doubt it, as a general proposition.

Preliminary Treatment—Before aeration the English sewages are clarified to a much greater extent than in America. The detritus tanks at Tunstall hold 1/100 d.w.f.; at Manchester from 40 to 60 minutes flow; and at Bury and Birmingham the aerated sewage has first been thoroughly sedimented. At Worcester a flow of about 750,000 gal. daily is pumped at the end of a tunnel from a suction well 20 ft. in diameter and 84 ft. deep, with the suction pipes extending about midway into the sewage, the depth of which ranges from 50 to 60 ft. Ardern favors tanks holding 1½ hours for dry-weather flow, which gives ½ hour at 3 × d.w.f. Haworth at Sheffield has used tanks holding about one hour's dry-weather flow, but for Stockport where the sewage contains much trade waste, he will have tanks holding 15 hours' dry-weather flow, and five hours' of wet-weather flow. Makepeace is providing at Hanley detritus tanks holding two hours' dry-weather flow. Thus it is seen that the clarified English sewage more nearly compares with American sewages before aeration than one might suppose.

Nitrification—At none of the plants visited was nitrification of the effluent sought or obtained, except at Tunstall, although the Worcester data are not at hand at the moment. This is attributed to the influence of trade wastes, as nitrification is said to appear during holidays. The settled effluent is clear and stable. Non-putrescibility seems to be due partly to oxygenation but principally to the successful removal of colloidal organic matter. I surmise that the separation of colloids from the more concentrated English sewages may come about rather more readily than in the case of the weaker American sewages. Perhaps the influence of iron salts is a greater factor than generally realized. However, the coagulating capacity of the returned activated sludge seems in some cases to be more of a factor than is generally regarded as the case in America.

Comparison of Data—American engineers have been somewhat puzzled to know why with the air diffusion plants there has been used in England for concentrated sewages rather less air per volume of sewage than with the weaker American sewages. Without discussing details, mention may be made of several elements.

1. English sewages are better clarified.
2. American plants are operated to produce more nitrification, partly with the view to getting sludge which more completely contains the colloids and partly in the hopes of promoting ease of dewatering.
3. Metal salts are seemingly more of a factor in England.
4. The sewages at Milwaukee and Houston are not particularly weak from the English viewpoint, and the test plant at Cleveland, with a weak sewage containing iron, showed quite good results with perhaps one-half of the quantity of air ordinarily used in America.

Differences in methods of analyses make it difficult to compare laboratory data in very precise terms. The influence of concentration upon the ease of separation of colloids needs elucidation. At some American plants there is quite likely a waste of air in preventing deposition in the aerating tank of solids from the less clarified and less comminuted American sewages. With such depositions come deaeration and the need of overcoming its effect on the main body of sewage aerated.

Competitive Arrangements—There is more or less competition between "air diffusion" and "mechanical circulation" arrangements. Of the latter there are two types, one developed by Bolton at Bury and the other by Haworth at Sheffield. The Bolton device provides surface agitation and aeration in a tank by revolving buckets on an agitating cone or apron attached to a shaft, with the buckets fed by an uptake pipe leading sewage from the bottom of the tank, which has a hopper bottom. The discharges from the buckets splash the surface with resulting waves and a circulatory movement of the entire contents of the tank. At Sheffield, Haworth uses paddle wheels to produce surface aeration and circulation of the contents of a series of channels about ¾ mile in extent at a velocity of about 1.5 ft. per second. These respective details are well described in recent issues of the London *Surveyor*. The diffusion plates and other associated arrangements are subject to patents secured by Jones and Attwood who did a good deal in earlier years to develop the art of applying this process and who recently assigned their patents to Activated Sludge, Limited, 14 Howick Place, Victoria St., London, S. W. I. The Bury device has been patented by Bolton and its selling agents are Ames Crosta Sanitary Engineering Co., Ltd., 12 Victoria St., Nottingham. The Sheffield arrangements have not been patented by Haworth who is serving as consulting engineer for several English cities and also for the Sewage Disposal Division of the National Department of Public Works in Holland. There is considerable competition between these different arrangements, with more or less discussion and controversy over their respective merits. In fact, I am reminded of the more or less similar discussions which I noted during a visit to England in 1900 as between contact beds and percolating filters.

It is said that about 30 brake horsepower is continuously required to provide aeration for treating 1 m.g.d., by either air diffusion or the Sheffield paddle wheels, while about one-half this power is sufficient for the Bury device. Some of the mechanical appliances are crude, as is usually the case with early beginnings, while others seem to be on a fair working basis. The difficulty in comparing these arrangements does not seem to me to relate so much to estimating the power required to actuate certain devices as it does to equating work done in treating different sewages for different periods in tanks of different types. Directly comparable data on a working scale are not available. I understand that Watson has made comparative tests on a small scale at Minworth and that he will soon begin an installation on a large scale. At London tests were carried out last year at Crossness with air diffusers and beginning in January of this year tests are understood also to include each type of mechanical circulation.

Combined Aeration and Sedimentation Tank—The only tank of this type was found at Bury. It is not believed to serve well the fluctuating flows in cases where the entire city sewage is treated, rather than at a fairly uniform flow as in test devices. Bolton is not using it in his new design for the neighboring town of Prestolee. More sedimentation seems desirable.

Flexibility of Arrangements—There is a good deal of difference between test devices and those needed in actual operating practice. In this respect I believe the English engineers are studying their designs most carefully in order to have the large plants meet the practical needs which vary so much from time to time. It is apparent that margins of capacity are being greatly increased and that devices are being studied to give as much flexibility of performance as is practicable.

Size of Aerating Tanks—The capacity of the aerating tanks in terms of dry-weather flow is about 8 hours at Manchester; 12 hours for the new Hanley works designed by Makepeace and for the Prestolee project being designed by Bolton; 15 to 18 hours at Sheffield; and 18 to 24 hours for the new works being designed for Stockport by Haworth. Watson will use 1 hour for the influent to his Minworth filters. The above sizes are generally larger than formerly were needed, but it is the intent of several of the designers to put through 3 × d.w.f. during storms. In this respect greater flexibility is claimed for the activated-sludge method than for sprinkler beds. But this does not mean much without detailed comparative study of loadings and costs.

Details of Aerating Tanks—Caink has operated a 750,000-gal. plant for seven years, during which time I understand that he has taken out and repaired 52 of the 350 diffuser plates. The cost of this per million gallons cannot be great but it suggests perhaps the desirability of standby tanks, should several tanks need repair at once, although I understand the clogging ordinarily comes on gradually. "Rusting" of the plates does not seem to be a serious factor (as at Houston) although the plates are set in cast-iron frames and fed by galvanized-iron drop pipes. Plate clogging has been noted at Manchester and Tunstall but is said not to be serious. New designs at the Withington sewage-works at Manchester and at Hanley provide one longitudinal row of plates in each bay. The ratio of plate to floor area at Hanley is 1:16, as is also true at the second Withington plant now being built as a duplicate of the Davyhulme plant which went in service in March, 1921. At both of these Manchester plants the line of diffusers is at one side of the flat floor of the bay, while at Hanley the diffusers are in the center from which the floor slopes upward on either side. The circulatory movement of the sewage and sludge seems to be effective in providing a bottom velocity of about 1.5 ft. per second and in preventing bottom deposits. The saw-tooth floors with diffuser plates placed transversely in the bays seem to be abandoned in new designs. At the Hanley works the bays are subdivided by several double transverse walls, of which the first extends from the bottom to the established flow line and over which the sewage passes, meeting the second wall which extends from above the flow line nearly to the tank bottom.

Volume of Sludge—I judge that the volume of sludge in the aerating tanks, after settling 1 hour, would range from 15 to 25 per cent at several of the plants. But I was interested to note two exceptions, one above and one below the "normal." Watson has used, I understand, at his filter influent plant only 5 to 15 per cent of solids by volume in his aerating tanks. On the other hand, Makepeace has used at Tunstall a volume of solids reaching as high as 60 per cent after settling three hours. This reduces the apparent period of aeration in the tank but he is inclined to think that it explains why he gets so good nitrification and helps in handling more flow at times of storms than would otherwise be the case. His present program is to return all sludge to the inlet of his aerating tanks and about once a week send the excess to the detritus tank.

Air Used—I found that at Worcester and Tunstall the air amounted to about 1 cu.ft. per Imperial gallon [0.833 cu.ft. per U. S. gal.], while at both Manchester works the average figures were given as about 1.4 cu.ft. Compressors are usually operated at about normal capacity and the quantity of air is really a function of varying rates of sewage flow through the aerating tanks. Thus at Davyhulme I found the registers to indicate only a little over 0.5 cu.ft. per gallon, due to a high rate of sewage flow at 11:30 in the morning.

Humus Tanks—Tanks of the Dortmund type are used with the intent of getting a sedimentation period of about two hours, at maximum rate, and a velocity of not over 8 ft. per hour. In terms of dry-weather flow the capacities are usually four to six hours, depending on whether the wet-weather flow will be 2 or 3 × d.w.f. A one-hour period at Worcester proves too small.

Sludge Handling—The excess sludge at most English plants of the activated-sludge type is mixed with other sludge produced at the works, and so the issue per se has been faced in only a limited way. Makepeace considers that he has a reasonable solution of the problem by pressing a mixture of the activated sludge and of plain sedimentation sludge obtained by the use of relatively large detritus tanks. At least that is his actual program at Tunstall and his projected program for Hanley. Pumping liquid sludge onto cultivated land within a radius of a few miles was mentioned by several, in order to make use of its fertilizing properties. The latter are quite favorably reported on from the Rothamsted Experimental Station, where tests have recently been made with expenses met by the Ministry of Agriculture. For two years Haworth has applied the activated sludge coming from the Sheffield plant dealing with the sewage of about 20,000 persons, and containing about 99 per cent water, on about two acres of land of a texture only moderately porous. The secret of success seems to be to give the surface a slope of perhaps 0.5 per cent, so that the clear water can run ahead of the solids which close the voids of the surface. The area has been spaded with care. Several have mentioned this method as quite satisfactory if the area equals 4 sq.ft. per person served. Caink has also applied the sludge from the Worcester plant to an area of about 2.5 acres for about 20,000 persons. I visited this plant after a long period of heavy rains and found that it was generally covered with sludge, of which only a small portion was spadable. This area seemed more porous than that at Sheffield but it has been much longer in use, and it will shortly be much enlarged. Caink says he has had no complaints from odors. He regards it more as a lagooning than a sludge drying area. However, he gets the sludge to a 70-80 per cent water content, permitting him to sell it for 10s. per ton at the works, or 20s. if he delivers it to the railroad station. At Manchester, Sheffield and some other places studies have been made on dewatering the sludge by vacuum filters and dryers, but I doubt if available English data approach in extent those obtained at Milwaukee, Chicago and Houston. The English have done enough to realize the difficulty of dewatering activated sludge which may behave quite differently depending upon varying composition both chemically and biologically.

Efficiency and Cost—There is no doubt about the capability of this process to turn out a stable, clear effluent, without air nuisances in the neighborhood. Its installation cost is attractive to the English as it is less, apparently, at some places than that of revamping existing works. Operating costs vary. They are stated as ranging at some places from £2 to £2 10s. per million gallons for a 1,000,000-gal. installation with power costing 7d. per kilowatt-hour.

Patent Situation—It appears that Jones & Attwood and their successors, Activated Sludge, Limited, have spent considerable money for the development of this process, including the early construction of several plants, such as the one at Worcester, under guarantee as to performance. Steps for recouping early losses and the continuing upkeep of offices with a technical staff at Westminster are not easy to negotiate, no matter how equitable they are. To add such overhead items to factory costs, as is done by the makers of pumps, boilers and other lines of equipment in extensive use, probably has it drawbacks because of the relatively small sums of money involved in these particular products. Furthermore, the owners of patents associated with the air diffusion devices and method now face competition from two types of mechanical circulation appliances, of which one is patented and the other not. Such a situation stimulates interest and discussion but over-promotion easily leads to exploitation which is usually disastrous to all concerned. Competition within reasonable limits is helpful and I doubt if experienced engineers begrudge reasonable overhead expenses to promoters and sellers of patented arrangements. The program as to the status of patents on the activated-sludge method does not seem to have become fully matured, and development will be watched with keen interest. This is particularly true of American engineers who have followed during the past twenty-five years the course of such patented arrangements as the Cameron septic tank, the Imhoff tank, the mechanical or rapid sand water filters, to say nothing of more recent proprietary devices for sewage treatment.

Force-Account Bridge Building in South Dakota

State Highway Department Crews Build Wood and Steel Spans—Wood Truss Design—Solid Plank Floor for Old Spans

HIGHWAY BRIDGE construction on a force-account system by the state highway commission has become necessary in South Dakota in several cases where the work was in undeveloped country and remote from railroad communication and therefore failed to interest contractors, especially when plenty of more attractive work was available elsewhere. As organized by J. E. Kirkham, bridge engineer of the commission, the bridge department has had a field force consisting of one to three crews, each crew consisting of five to ten men under a foreman. Mr. Kirkham looked after the training of these crews and supervised the work, assisted during a part of the time by two construction engineers. These crews have built steel and timber truss spans and concrete viaducts and culverts.

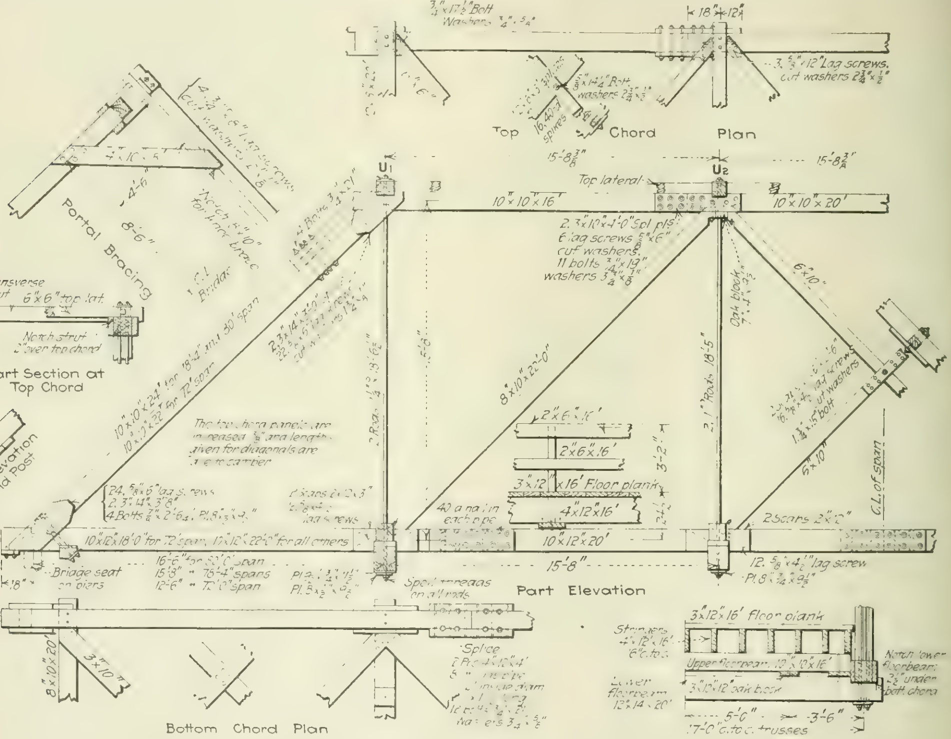

3/4"×17 1/2" Bolt Washers 3/4"·5/8"
18" 12"
3, 5/8"×12" Lag screws, cut washers 2 3/4"×1/2"
5/8"×14 1/4" Bolt, washers 2 3/4"×1/2"
16, 40-d spikes
Top Chord Plan
15'-8 3/8"
U1
U2
Top lateral
10"×10"×16'
10"×10"×20'
2, 3"×10"×4'-0" Spl. pls.
6 lag screws 5/8"×6" cut washers
11 bolts 3/4"×19" washers 3 3/4"×1/8"
4, 3/4"×8" lag screws cut washers
4'-6"
8'-6"
Portal Bracing
Notch 4"×10" for knee brace
C.L. Bridge
4 Bolts 3/4"×21"
8×8" transverse Strut
6"×6" top lat.
Notch strut 2" over top chord
Part Section at Top Chord
End Elevation of End Post
10"×10"×24' for 18'-4" and 30' span
10"×10"×22' for 72' span
The top chord panels are increased 3/8" and lengths given for diagonals are due to camber
8"×10"×22'-0"
Oak block
2, 1" Rods 18'-5"
6"×10"
1 3/4"×15" bolt
6"×10"
C.L. of span
2"×6"×16'
2"×6"×16'
3'-2"
3"×12"×16' Floor plank
4"×12"×16'
40 d nail in each pc.
10"×12"×20'
2 Scabs 2"×2"
24, 5/8"×6" lag screws
2, 3"×14"×3'8"
4 Bolts 7/8"×2'-6"; Pl. 8"×3/4"
10"×12"×18'-0" for 72' span, 12"×12"×22'-0" for all others
16'-6" for 80'-0" span
15'-8" " 78'-4" spans
12'-6" " 72'-0" span
15'-8"
Bridge seat on piers
18"
Spec. threads on all rods
12, 5/8"×4 1/2" lag screw
Pl. 8"×3/4"×9 1/2"
Part Elevation
8"×10"×20'
3"×10"
Splice
Bottom Chord Plan
3"×12"×16' floor plank
Stringers 4"×12"×16' 16" c. to c.
Upper floorbeam, 10"×10"×16'
Lower floorbeam 12"×14"×20'
3"×12"×12" oak block
Notch lower floorbeam 2 1/2" under bott. chord
5'-0"
3'-6"
17'-0" c. to c. trusses
Half Cross-Section of Floor

FIG. 1 TIMBER TRUSSES OF CHEYENNE RIVER BRIDGE

Cheyenne River Timber Truss Bridge—Reconstruction of the 640-ft. bridge over the Cheyenne River near Hot Springs in 1921 was an emergency force-account measure necessitated by the washing away of the old steel structure. A new steel bridge would have cost about $85,000, but no such amount was available for the purpose. A wooden bridge with five Howe truss spans of 70 to 94 ft. in length, built of native Black Hills pine, was designed by Mr. Kirkham and erected by his department at a cost of about $16,000, including 250 ft. of pile trestle. This bridge, which is shown in Fig. 1, is designed to carry a 10-ton tractor. It is estimated to last about fifteen years. The stress allowed on the timber was 1,000 lb. per square inch in tension and $1000 - 20l/d$ in compression, where l equals the length of the member in inches and d the least diameter in inches. In order to avoid danger from floods, the height of the old stone piers was increased by timber cribs to put the spans 4 ft. above high water.

Special features in the truss design of this bridge, Fig. 2, are the double floor beams and the oak bearing blocks instead of castings to support the ends of the web members. The oak blocks were used to save time and expense and are expected to last the full life of the bridge. Single timbers of the size required for floorbeams were not obtainable, the largest sticks being 12 x 14 in. Each floorbeam, therefore, is composed of a bottom piece 12 x 14 in. of full length and an upper piece 10 x 10 in. extending only between the trusses. With the 10 x 10-in. beam supported by blocks 46 in. from the trusses, the bending moment in the combined beam was reduced to an allowable amount. When the material had been delivered on the ground, the bridge was completed in about ninety working days. Considerable time was lost and also about $2,000 expended in replacing falsework carried away by the sudden breaking up of the ice in the latter part of January.

In the construction of this bridge Mr. Kirkham was very much handicapped at the start by being unable to find men experienced in the construction of wood truss bridges. As a result he had to pick up local men and teach them to do the work, aided by his two assistant field engineers, C. J. Laughlin and M. X. Wisda. The framing was done at the site and templets were used throughout on account of inexperienced men being employed. Owing to the timber being green, the trusses were constructed with somewhat excessive camber and the vertical rods were tightened twice after the bridge was completed. The camber in the trusses was maintained in this manner. The greater part of the truss erection was done with the aid of a gasoline hoist.

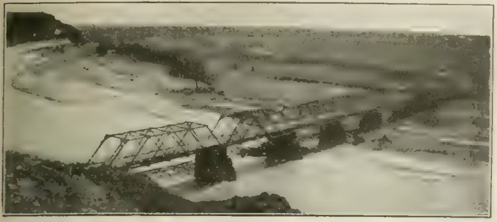


FIG. 2—TIMBER HIGHWAY BRIDGE, CHEYENNE RIVER

Other Force-Account Bridges—The first bridge constructed on the force-account system was the White River bridge at Kadoka, which consists of two 150-ft. riveted steel spans on concrete foundations. The total cost, including one concrete pier and two abutments and the two steel spans complete, was about $29,000, which was about $12,000 less than the work was estimated to cost by contract. At the start Mr. Kirkham, bridge engineer, had only one experienced man, this being his field engineer, C. J. Laughlin, who had had considerable experience as a rigger and as a general concrete construction superintendent. It was necessary to employ local men and train them to do the work. Some of the men employed were experienced in pile-driving and mixing concrete but none had had experience in raising steel or riveting. They soon developed into a good crew, however, and the work was satisfactorily completed.

This same crew was moved from the White River bridge to a bridge over the Belle Fourche river, nineteen miles north of Underwood. This structure consisted of two 140-ft. riveted steel spans on concrete foundations. It was built for about $28,000, a saving of about $11,000 below a contractor's bid of $39,000. At this time the crew was enlarged to about fifteen men. By the addition of a few more men, two crews were installed, one completing the Belle Fourche River bridge and the other constructing a 65-ft. pony truss a few miles north of the Underwood bridge. These last two bridges were constructed for Meade county, and the men and the cost of material were paid directly by the county. All the work was under the general supervision of Mr. Kirkham.

The next structure built by the main crew was a 150-ft. steel through truss span over the Little Missouri River at Camp Creek, about 70 miles from the railroad. This structure, shown in Fig. 3, has concrete piers and 130 ft. of timber trestle approach. Work could not be started until the end of December, owing to the late delivery of material and the long haul, but Mr. Kirkham states that good concrete piers were built in spite of the temperature being as low as 21 deg. below zero.

The gravel, sand and water were heated and the concrete was placed in the forms at a temperature of about 90 deg. The piers were housed with canvas and timber and heat was applied under the inclosure for about ten days. The entire work was completed in less than sixty days at a cost of $14,600. This work was directly under the supervision of M. X. Wisda, field engineer.

Tar-Wood Flooring—Maintenance of plank floors on old steel bridges is a large item in the bridge maintenance expense, which is paid by the counties. Mr. Kirkham points out that the cost of maintaining ordinary plank floors is much greater than is usually realized. For instance, a rancher or a farmer may notify the county engineer or county officials that a plank is broken, rendering the bridge floor dangerous, on a bridge perhaps fifteen miles from town. If repairs are not made, the county is liable to very heavy damage cost if an accident occurs. As a rule, therefore, it is necessary for two men to take a truck and two planks and drive out to the bridge, make the repairs and return. Many bridges are said to be completely refloored in a few years in this manner at a cost of about $10 per foot.

To reduce this maintenance expense Mr. Kirkham has designed what he terms a "tar-wood" floor consisting of 2 x 4-in. planks dipped in boiling coal tar, placed on edge across the roadway and nailed together. This solid 4-in. floor is covered with a layer of either tar and sand or tarvia and sand, about ½ in. thick. Its weight is only about 17 lb. per square foot, including the top coating, so that old light steel bridges will carry this floor when they will not carry a concrete floor. This new floor is said to be really lighter than a double layer of plank.

Crude coal-tar for dipping the planks can be purchased for 8 to 10c. per gallon, and ordinary workmen can do the work. The county crews can dip the planks during winter and pile them up in the county yards ready for building floors whenever re-flooring is required. Mr. Kirkham believes that a floor of this construction subject to ordinary country traffic will last for twenty years. Creosoted lumber flooring is much more expensive. Since the continuity of the "tar-wood" floor distributes the loads well over the floor system it is found to increase the rigidity of the structure as a whole. This construction is somewhat similar to the flooring used on some of the Chicago viaducts, as described in *Engineering News-Record*, Nov. 13, 1919, p. 866, but the Chicago design has alternate planks of different depths in order to form a grooved surface.

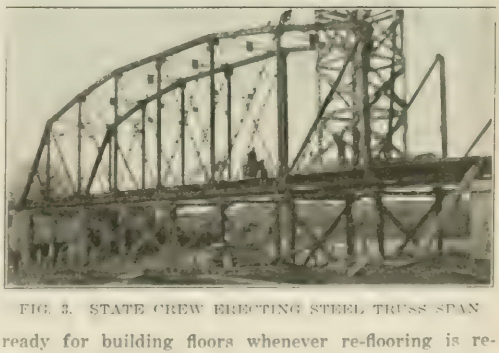


FIG. 3. STATE CREW ERECTING STEEL TRUSS SPAN

Finished Road Grades Produced by Tractor Outfits

Tractor-Hauled Blade Grader Work So Highly Perfected in Northern Wisconsin that Finished Road Grade Is Produced at a Cost of $300 to $700 a Mile

By J. R. McLean
Division Engineer, Wisconsin Highway Commission,
Superior, Wis.

COMPLETED road grade, without hand finishing and meeting Federal Aid acceptance requirements, is being regularly produced in Wisconsin with tractor-hauled blade graders. It should be emphasized that the grade is fully completed with sloped ditches and roadbed trimmed ready for finishing the subgrade. This result is being accomplished at a cost of from $300 to $700 a mile.

All road builders are familiar with the work of the horse-drawn blade grader generally a 6-ft. machine. The next step was the substitution of the steam or gas tractor for the horse. With more power available it was but a short time before there was a demand for a larger grader as the 6-ft. type would not stand the work; 8-ft. blades were then used and the size of tractors increased. With the increase in the size of the grader there was a noticeable improvement in the work and a decrease in the cost. Tractors and graders were gradually increased in size year after year and as a result we have grading outfits today that can grade from one-half to one mile of 26-ft. road per day at a cost very little in excess of the work done in the days of the horse-drawn grader.

ROAD GRADE FORMED AND FINISHED WITH TRACTOR HAULED BLADE GRADERS

Equipment for Tractor Grading—The equipment for this work should include a large tractor, preferably a 15-ton caterpillar and not less than a 10-ton or a 40-60 tractor of the best possible design. The caterpillar is the best as it has better traction on the average job regardless of soil or weather conditions. It will work in any soil that the grader will handle whenever the earth is dry enough to grade and with a good operator will go anywhere required on even the worst grading job. It has ample power at a low rate of speed to handle a large grader with a full load, which means that it will not tear the grader to pieces as it would if traveling fast. The slow speed gives the operator plenty of time to handle the grader, which is very important if one is going to produce a good job. There are no exposed gears to collect dirt and dust as on the four-wheel type and, with proper care, there is very little mechanical trouble.

A 10-ft. blade is the smallest size that should be considered; a 12-ft. is better. It will move more dirt and move it farther towards the center and being of greater weight it is able to do much heavier work. This means the elimination of much hand labor both in clearing and grubbing and in picking rock. The cross-section generally used on our gang maintenance work has a ditch about 2 ft. in depth, 30 in. wide at the bottom with 1½ to 1 slope on the outside and nearly 2 to 1 on the inside. A 10-ft. blade when set at the proper cutting angle is not long enough to move the dirt out of the ditch and up onto the shoulder. This means that the 10-ft. blade must make an extra round to place the dirt upon the roadbed.

When grading the lighter soils it is nearly impossible to put the grader part way over on the shoulder of the road to move in this dirt and at the same time keep a straight shoulder line as there is a constant tendency for the grader to slip towards the ditch, especially if loaded. A 12-ft. blade will move the dirt from the ditch clear to the top of the shoulder, where it can easily be handled by the grader on the next round.

The grader should be equipped with a bank sloper so designed that it may be adjusted for the proper slope and strong enough to stand the strain. A number of the slopers on the market are totally unfit for use as they are either too light for this kind of work or cannot be adjusted.

A 40-ft. steel cable should be used to attach the grader to the tractor. By using a long cable the grader may be kept running in a straight line with very little attention, regardless of the path taken by the tractor.

During the past year some counties have used two graders and tractors on the same job, thus speeding up the work and at the same time decreasing the overhead. This provides a smooth road for traffic at all times, which is very important if working on a trunk line. Other equipment will be required to supplement the grader, especially if there is any dirt on the job which must be moved either ahead or back, which is generally the case in choppy, hilly country. If the hauls are long, wheelers will be required; if not, four-horse fresnos. In this work a plow team can be dispensed with and the wheelers or fresnos will pick up the loose dirt turned into the road by the grader, hauling it to the low places. A few small tools for cutting brush and hauling rock will be found necessary, but no finishing tools, as all this work should be done with the large outfit.

A complete camp outfit consisting of bunk and cook car, mounted on wheels, should be included in every grader outfit and if possible a tank wagon for gas.

12-FT. GRADER WITH BANK SLOPER FINISHING A DITCH

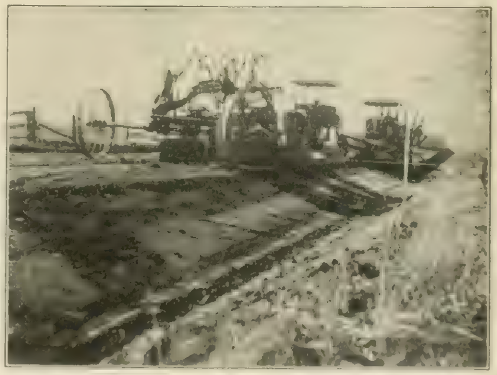
All equipment is portable and when moving day comes the grader and camp outfit can easily be towed to the next job with the tractor, and the wheelers, fresnos and small tools taken care of with the teams. Moving costs with this kind of an outfit are very light as one can pick up and get under way on a moment's notice.

Methods and Organization—Instead of the usual slope stakes, plain stakes are used to mark the ditch line. These will be set every station at a constant distance from the center line to enable the grader man to cut a straight ditch line. Stakes should be high enough to be plainly visible above the weeds and small brush as it is quite necessary to have at least two or three stakes in sight at all times. After the road limits are staked out, all stumps and rubbish are removed, using the tractor to pull the stumps and trees. Trees up to 15 in. in diameter can be pulled with a caterpillar tractor without grubbing. The first round is made keeping just inside of the stakes and cutting only deep enough to get below the tough, rooty sod. This material is carried in on the next round and spread out between the shoulders. The grader then returns to the ditch, cutting as deeply as possible, thus getting loose material with which to cover up all sods brought up before. On the second round in the ditch the grader man should pay particular attention to drainage, taking care to see that his ditch will drain at practically all points and taking out any little kinks left from the first round. No definite rule can be given for setting the grader blade. It should, however, be adjusted so that the dirt will slip back along the blade with a very slight forward motion, otherwise there will be a tendency to carry too much dirt in front of the machine. This will mean a hard riding road.

A proper organization for the tractor grading outfit should include above all a first-class grader man, a tractor operator, a straw boss to run the team outfit, wheeler holders, dump men for the wheeler gang and a few laborers. The grader man must absolutely know the cross-section which is wanted; that is, he must have a mental picture of the road desired before he starts work and he must be able to recognize the required cross-section when he sees it. He must also have a good eye for grading to eliminate all sags and waves as the work progresses by having the team outfit fill in the low spots.

The tractor man must keep his machine running without delay. This means that he must be prepared to put in over-time as it costs too much to stop the outfit during working hours. He must also pay some attention to what is going on behind him. Indifference on his part will often cause the grader man needless trouble, even to the extent of making an extra round with the outfit to remedy some kink or to get under a rock which he had to pass up on the previous round on account of the speed, not daring to hit it at a high rate of speed. In other words, the tractor operator should watch the grader man constantly.

The man in charge of the teams should be a man who understands moving dirt and with an eye for the work so that he can follow the grader man's instructions without trouble. The number of teams used in this work will of course vary, depending upon the topography of the country and the grade line desired. The idea is to put on teams enough to cut down the high spots as fast as the grader brings in the dirt. The more teams the better the grade line. No plowing is done as all dirt to be handled has been loosened by the grader. On the shorter hauls the fresnos do this work very rapidly. Four or five large fresnos will accomplish wonders in improving the grade line and as they require no snatch team and only one man to hold them, they provide a very flexible outfit which can be worked in a gang or separately as the occasion may demand. No dump man is required as the straw boss and grader man will attend to placing the dirt. As the grader makes the rounds, more material is brought up and that hauled ahead smoothed off. All rocks and roots loosened by the grader are taken care of by the team outfit. When the soil is very rocky it is a good plan to have extra laborers to keep all rock picked out as fast as they are deposited on the roadway. Rock from 2 to 3 ft. in diameter can be rolled out by the grader and then hauled off by the teams.



TWO-TRACTOR OUTFIT GRADING 24,000 FT. IN 19 DAYS

After the grader has made two rounds in the ditch and placed the material on the roadway, a sloper is put on. With a grade so designed that it can counteract the side pull of the sloper, it is a very simple matter to trim the bank up to 4 ft. in height as the wheels on one side of the grader are running in the ditch which should be straight and quite uniform as to grade by this time. All dirt trimmed off by the sloper is picked up by the blade and moved towards the shoulder. The second round in the ditch with the sloper should finish the banks. However, in constructing a wide ditch section the sloper should be left in place to help with the finishing. In this work the grader works from the bank towards the roadway, shaping and smoothing up the ditch as the work progresses.

After the ditches are cut, the traveled way is smoothed up. This is a very important part of the work and should not be slighted. All waves must be taken out and the entire roadbed brought to a uniform cross-section. This work does not take long, but at that is too often neglected and what would have been a good job is only a fair one because of the poor finishing. A good man will keep his ditches straight and down to grade, his shoulders straight and roadbed uniform. He knows that he cannot finish the job in one round so only cuts what dirt the blade will handle, keeps the blade set at an angle which gives the greatest lateral and yet free motion to the dirt; keeps the machine in repair, well oiled and greased and above all the road in shape for traffic to get over without trouble. In order to build a 26 ft. roadway through even flat country, at least twelve rounds must be made and with inexperienced workmen even more. Before the grader outfit has made its last round, the team outfit should have completed its work in order that the grader will have a chance to shape up the work.

Cost of Tractor Grading—The cost of this kind of work will naturally vary according to soil conditions, topography, class of help, etc. In this section the cost per mile is from $300 to $700, including lost time on account of weather and moving. The time required to complete a mile of road varies from two to six days. Either a 10- or a 15-ton caterpillar will use from 30 to 35 gal. of gas and 5 gal. of oil and grease; depreciation and overhead will be at least $20; the tractor and grader men will cost at least $12 more. The total cost is small compared with other methods of moving dirt.

Iowa Road-Maintenance Costs

The cost per mile of highway maintenance in Iowa for three years is summarized by W. H. Root, maintenance engineer, as follows:

Year	—Earth— Miles	Cost	Gravel Miles	Cost	—Paved— Miles	Cost	Total— Miles	Cost
1920	5,760	$224	792	$364	67	$79	6,619	$241
1921	5,223	297	1,157	451	236	89	6,616	317
1922	4,723	270	1,558	377	334	118	6,615	288

These maintenance costs may also be classified as follows:

Year	Patrol Average per Mile	Gang Average per Mile	Equip and Tools Average per Mile
1920	$123	$96	$22
1921	174	93	50
1922	177	68	43

Neither of the tables includes bridge maintenance or special case maintenance. Special case maintenance is classified in some states as "additions and betterments." It is work which in expediency is paid from maintenance funds but which is not strictly maintenance work. The following table shows the total expenditure per mile from maintenance funds.

Year	Average per Mile Maintenance Proper	Bridge Maintenance	Special Case	Grand Total
1920	$241	$0	$0	$241
1921	317	1	14	332
1922	288	3	14	305

How the Suburban Railways of London Handle Traffic Through Fog

London Correspondence

THOSE who have the good fortune to live in fogless cities have no conception of the inconvenience entailed to those who travel to and fro from London in the course of their daily work.

The railways serving the London suburbs have posters printed which are dug out at the beginning of the fog season and exhibited at all suburban stations intimating that "the company will not be held responsible for delays to traffic caused by fog," and so on. Invariably two or three trains per hour are cancelled, involving a reduction of 30 per cent, if not more, of the line's carrying capacity, and the passengers who would normally travel by the 30 per cent rush the remaining 70 per cent of passenger accommodation.

Delays to railway traffic through fogs are stupendous, and it is nothing for the commuter to be anything from a half-hour to an hour late at the office after a six-mile journey from his home. True, London's fogs are not so bad as they were, but they are still bad enough completely to disorganize all traffic in London; and it is nothing to see trucks proceeding through the heart of the city at a crawling pace, and a bus guided through the traffic by the conductor who walks in front carrying a lamp. Few serious railway accidents are attributable to fogs, although recently a collision occurred involving the death of several men. Trains running into bumper stops at terminals are the most common results of fogs.

When a fog descends on the London railway systems a number of men are called off the permanent way staff, doled out with a supply of fog signals and a fire in a brazier and placed in charge of the passenger safety. They take up positions at strategic points on the line and are instructed by ordinary arm signals placed close to the ground.

When this signal is at danger the fogman places two signal detonators on the rail and holds up a red lamp for the locomotive driver to see—if he can. If the line is signalled clear no detonators are placed, allowing the train to proceed. These detonators are constructed of a flat tin case loaded with black powder and caps and are fired by the pressure of the locomotive wheel. They are held on the rail by a clip. As a rule these detonators are placed on the rail by hand, though machinery is employed if the fogman has a large number of rails to care for.

The fog signal has certainly proved satisfactory so far as it goes but it is too primitive for modern traffic needs, and too costly. One trunk line uses over a half million of these signals a year and they cost a half dollar a dozen. Besides this cost there are also the wages of the fogmen whose number runs into several thousands on a "thick" morning.

On the rapid transit lines signals are placed along the track side to synchronize with the ordinary signals with the lights at eye-level. This method is fairly effective on the subway system but the only way in which the lines, both trunk and subway, can be made entirely independent of fogs is by the adoption of automatic train control, upon which a committee reported recently. It is estimated that equipping the trunk lines throughout Britain with some standardized form of automatic train control would cost around £4,700,000.

Feeder Railways of 24-in. Gage in Argentina

Freight Traffic Only—Light Branches Develop District Devoid of Roads—Economic Length—Track and Equipment

LIGHT narrow-gage railways of the portable type to serve as feeders in a large agricultural district of the province of Buenos Aires, Argentine Republic, have been built by the Buenos Aires Great Southern Ry. on account of the absence of good roads and in order to develop traffic and promote further development of cultivation. There are now four 24-in. gage agricultural railway systems totaling 150 miles.

The country is mainly flat and has a rich earth soil so that the frequent heavy rains during the winter months make access to the stations on the broad-gage (5 ft. 6 in.) main lines a difficult and costly matter. In fact the producers or farmers have been at the mercy of the local carters, with the result that charges for this service were excessive. Since the main traffic in the potato-growing zone is carried during the winter, the introduction of the light agricultural railways has been a great benefit to the farmers. Similar conditions exist in the cereal-growing zone, although the bulk of the traffic in this case is carried during the late summer and early fall. Climatic considerations vary considerably, however, and in recent years the roads have frequently been impassable for long periods, irrespective of the season of the year.

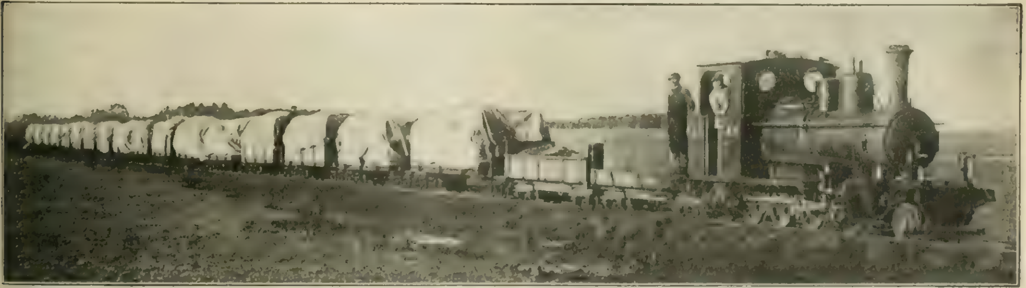


FIG. 2—TRAIN ON 24-IN. FEEDER LINE OF BUENOS AIRES GREAT SOUTHERN RAILWAY

It was thought at first that the railways might be laid along the public roads. But a little investigation showed that in such a position they would be liable to serious accidental and wilful damage by the heavy carts which travel these roads and are sometimes drawn by as many as twenty-five horses. Further, the light earthworks would be subject to damage by stray cattle. In view of these conditions the lines have been built across country. Of four separate systems, two are in flat country and two in rolling or hilly country. Three of these have been laid to serve cereal traffic while the traffic of the fourth and principal system is composed almost entirely of potatoes.

Farmers and producers made considerable objection to the railways in the early stages of the project, but as their great utility and benefit was soon proved this opposition has been replaced by urgent appeals for additional lines reaching other centers. Strong opposition was made also by the local carters, who had a complete monopoly of the transportation, but when they realized that there was no hope of successful opposition they turned their activities towards developing business at points beyond the influence of the railway.

It has been found that for railways of this class to be an economic and financial success they must extend considerably beyond a radius of fifteen miles from the main line station, as business within this area is subject to strong competition. The selection of sections to be served was governed by the extent of land already under cultivation and the possibility of further large areas being developed as a result of the construction of a feeder line.

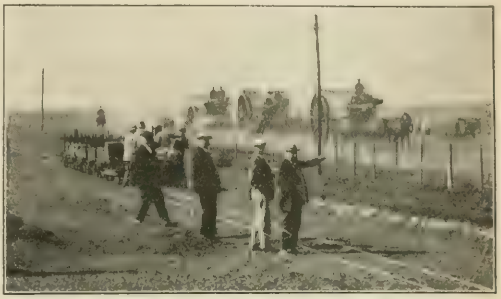


FIG. 1—OLD AND NEW TRANSPORTATION SYSTEMS IN COUNTRY DISTRICTS OF ARGENTINA

Note immense wheels of wagons hauled by 10 to 25 horses when loaded. Agricultural railways supersede wagons.

Adoption of the portable type of railway of 24-in. gage (60 cm.) was influenced largely by the fact that extensive experience in other parts of the world and particularly in France during the World War had proved this type of line capable of carrying large volumes of traffic successfully and economically. Furthermore, it provides a certain flexibility of operation since the track can be moved readily from one location to another, or removed and relaid in some more productive zone.

Track construction consists mainly of 20-lb. rails bolted to steel ties, with seven ties to each rail length of 15 ft. In a few stretches where traffic is intense 30- and 58-lb. rails are used in 25 ft. lengths spiked to nine or eight hardwood ties, respectively. Ballast consists only of the local earth. Streams are crossed by timber trestles, except that on the main line old steel girders from the broad gage lines are used, with brick substructures. The ties are laid directly upon the girders. Passing sidings, which serve also as loading tracks, are provided at 3-mile intervals. Stub end sidings for loading are built as required to serve the cultivated areas. There are no stations or signals. The maximum grades are 1.25 per cent for the outbound or empty direction and 0.66 on the inbound or loaded direction. Curves of 164-ft. radius are the minimum on open line and 131.2 ft. in yards, except for 98.4 ft. at turnouts with No. 4½ frogs.

The average traffic consists of eight freight trains daily. No passenger trains are operated as yet. Steam locomotives of the 4-6-0 type, weighing 12 tons and rated at 45 hp., can haul trains of seventeen cars of seven tons capacity, while 6½-ton four-cylinder gasoline engines of 40 hp. can haul twelve cars. These 7-ton cars weigh 2.3 tons and have brass bearings; 6-ton cars with ball bearings weigh 1.3 tons. All cars are mounted on four-wheel trucks.

These railways were built under the direction of R. G. Garrow, chief engineer of way and works of the Buenos Aires Great Southern Railway, Buenos Aires.

Discharge Through Adjustable Submerged Orifices

Experiments Made at Sacramento and Fort Collins Lead to Increased Accuracy of Measuring Irrigation Water

By H. A. Wadsworth
Instructor in Irrigation Practice,
College of Agriculture, University of California

Although the measurement of irrigation water through submerged orifices has long been a common practice in California and other western states the results from such measurements have always been subject to question because of the inaccuracy of the device. Nevertheless, many western canal companies accept this inaccuracy and continue the use of the adjustable submerged orifice in the computations of their water charges. Other canal companies, especially where ditch grades are flat and where the discharge may be subject to wide and sudden fluctuations, use the device because no better one is available.

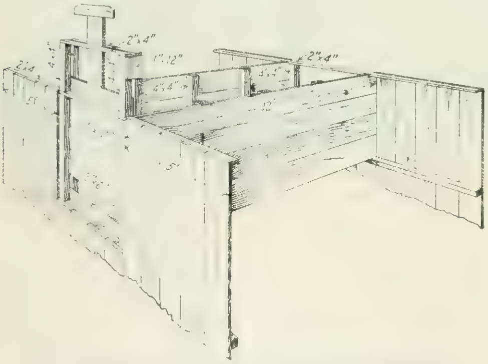


FIG. 1—CANAL HEADGATE USED IN KERN COUNTY

During the spring and summer of 1922, the College of Agriculture, University of California, in co-operation with the Bureau of Public Roads, Department of Agriculture, began a series of experiments aimed toward increasing the accuracy of the adjustable submerged orifice as a means of measuring irrigation water. The work was carried on at the field laboratory at Davis, Calif., and at the hydraulic laboratory at Fort Collins, Colo. Briefly, the experiments indicate that the size of opening is a decided factor, as are contractions and suppressions, and a new equation has been developed.

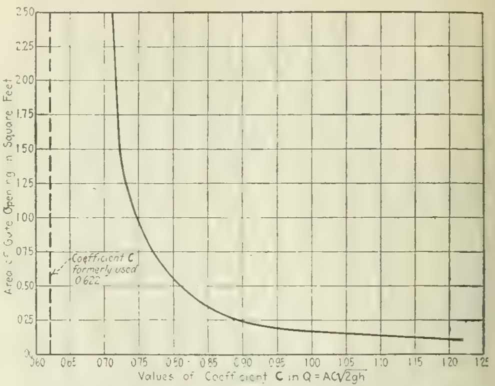


FIG. 2—EFFECT OF AREA ON *C* IN KERN COUNTY LAND CO. FLUME

From the time of its introduction as a means of measuring irrigation water until about ten years ago it was assumed that the common formula for the discharge through sharp-edged orifices of fixed areas would hold for crude timber gates as well. A value of 0.61 was consequently assigned to *C* in the equation

$$Q = AC\sqrt{2gh} \qquad (1)$$

Later observations demonstrated that 0.61 was too small a value for *C* and values ranging from 0.65 to 0.85 were used in an effort to make the device record within an acceptable degree of accuracy. This variation in the coefficient was attributed to structure differences.

In 1920 the Kern County Land Co., after considerable experimenting with headgates of the type in use on their system determined that the value of *C* was a function of the area of the opening. For very small openings of the gate conditions approached those of a short tube and the value of *C* became almost unity. Fig. 2 shows the effect of the area upon the value of *C* for the type of gate used by the Kern County Land Company. The type of gate used at the university is shown in Fig. 3.

Gates of this type were installed in the open air laboratories at Davis and at Fort Collins and 146 tests

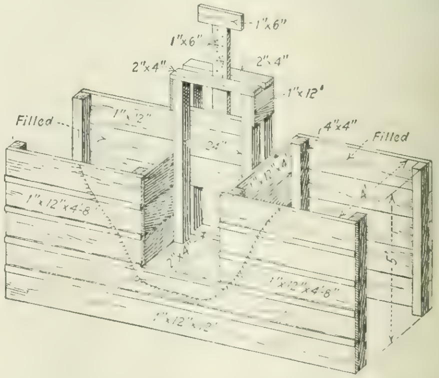


FIG. 3—TYPE OF ADJUSTABLE SUBMERGED ORIFICE USED IN UNIVERSITY EXPERIMENTS

Bottom and side contractions are partially suppressed.

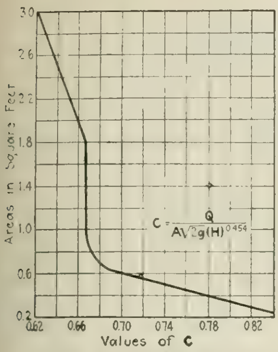


FIG. 5—VALUES OF C FOR LABORATORY GATES

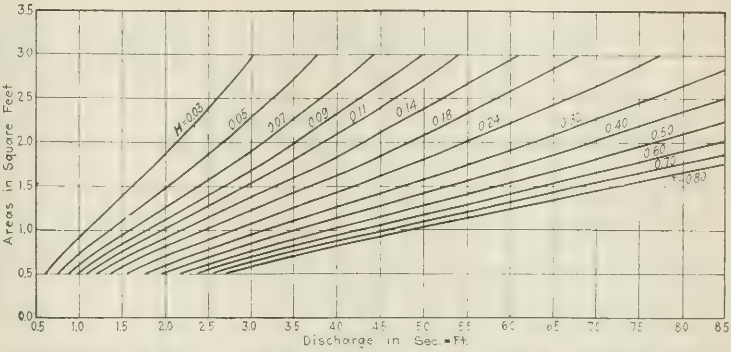


FIG. 6—DISCHARGE CURVES FOR LABORATORY GATES

run against standard rectangular weirs. These tests covered a range of discharge of from 0.5 to 13 sec.-ft. and a range of areas of from 0.3 sq.ft. to 3 sq.ft. The differences in head were carefully measured with hook gages. These hook gages were so set that they measured the elevation of the water level 10 in. above and 10 in. below the plane of the gate. These gages and the details of the laboratory installation are shown in Fig. 4. In computing the resulting values of *C* by the old formula it was found that *C* was not a simple function of the area. A new formula was devised.

$$Q = CA\sqrt{2g} \times H^{0.454} \qquad (2)$$

When this formula was used, the points were grouped to much better advantage. Fig. 5 shows the resulting values of *C* when plotted against the areas.

For convenience in the field a table has been prepared which will give the discharge through a submerged orifice of this type by two multiplications. Fig. 6 is a graphic presentation of the same relations. Repeated tests show an error consistently less than 5 per cent.

VALUES OF "$\sqrt{2g}\,(H)^{0.454}$" AND OF "C" IN THE FORMULA
$Q = A \cdot C \sqrt{2g}\,(H)^{0.454}$
FOR DISCHARGE THROUGH SUBMERGED ORIFICES OF THE TYPE SHOWN IN FIGURE 3

H Ft.	$\sqrt{2g}\,(H)^{0.454}$	*H* Ft.	$\sqrt{2g}\,(H)^{0.454}$	*H* Ft.	$\sqrt{2g}\,(H)^{0.454}$	A Sq. Ft.	*C*
0.01	0.992	0.41	5.35	0.81	7.29	0.2	0.855
0.02	1.41	0.42	5.41	0.82	7.33	0.3	0.816
0.03	1.63	0.43	5.47	0.83	7.37	0.4	0.777
0.04	1.85	0.44	5.53	0.84	7.41	0.5	0.738
0.05	2.04	0.45	5.59	0.85	7.45	0.6	0.700
0.06	2.22	0.46	5.65	0.86	7.49	0.7	0.680
0.07	2.39	0.47	5.71	0.87	7.53	0.8	0.672
0.08	2.53	0.48	5.76	0.88	7.57	0.9	0.668
0.09	2.68	0.49	5.81	0.89	7.61	1.0	0.667
0.10	2.80	0.50	5.86	0.90	7.65		
0.11	2.93	0.51	5.92	0.91	7.69		
0.12	3.07	0.52	5.97	0.92	7.73		
0.13	3.18	0.53	6.02	0.93	7.77		
0.14	3.29	0.54	6.07	0.94	7.81		
0.15	3.39	0.55	6.12	0.95	7.85		
0.16	3.49	0.56	6.17	0.96	7.88	1.8	0.667
0.17	3.58	0.57	6.22	0.97	7.92	1.9	0.664
0.18	3.67	0.58	6.27	0.98	7.96	2.0	0.660
0.19	3.76	0.59	6.31	0.99	7.99	2.1	0.656
0.20	3.85	0.60	6.36	1.00	8.02	2.2	0.652
0.21	3.94	0.61	6.41	1.01	8.06	2.3	0.648
0.22	4.02	0.62	6.46	1.02	8.10	2.4	0.644
0.23	4.10	0.63	6.51	1.03	8.13	2.5	0.640
0.24	4.18	0.64	6.56	1.04	8.17	2.6	0.636
0.25	4.26	0.65	6.60	1.05	8.20	2.7	0.632
0.26	4.34	0.66	6.65	1.06	8.24	2.8	0.628
0.27	4.41	0.67	6.70	1.07	8.27	2.9	0.624
0.28	4.48	0.68	6.75	1.08	[illegible]	3.0	0.620
0.29	4.55	0.69	6.79	1.09	[illegible]		
0.30	4.62	0.70	[illegible]	1.10	[illegible]		
0.31	4.70	0.71	[illegible]	1.11	8.40		
0.32	4.77	0.72	[illegible]	1.12	8.44		
0.33	4.84	0.73	6.96	1.13	[illegible]		
0.34	4.91	0.74	[illegible]	1.14	[illegible]		
0.35	4.98	0.75	[illegible]	1.15	[illegible]		
0.36	5.05	0.76	[illegible]	1.16	[illegible]		
0.37	5.11	0.77	7.12	1.17	[illegible]		
0.38	5.17	0.78	7.16	1.18	[illegible]		
0.39	5.23	0.79	7.20	1.19	[illegible]		
0.40	5.29	0.80	[illegible]				

This formula only holds for gates of the type shown in Fig. 3. Changing the width of the gate would probably effect the discharge although the active area remained the same. Changing the size of the gate guides would probably effect the contractions to such an extent that the formula would not hold.

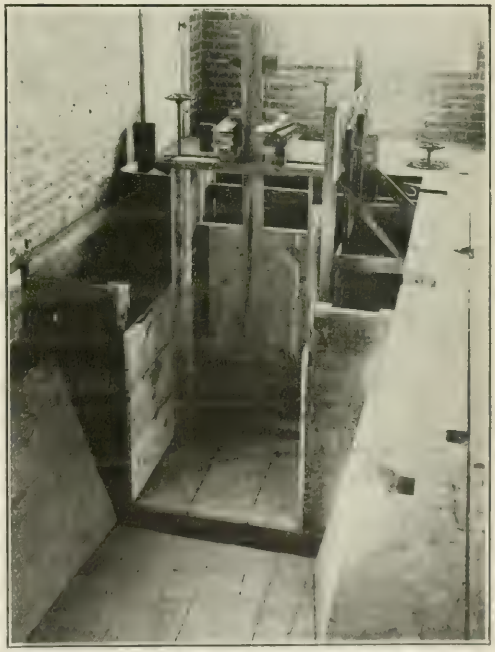


FIG. 4—LABORATORY INSTALLATION AT FORT COLLINS

The experience of the U. S. Reclamation Service and Kern County Land Co. shows that with complete contraction on sides and bottom, *H* has an exponent of 0.50. The present series shows that incomplete suppression of the side contraction results in an exponent of 0.454 for *H*. Still further suppression of the side contractions, such as would result by replacing the 4 x 4 in. gate posts by 2 x 4 in. posts, might reduce this exponent further.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Improved in Rewriting

REVIEWED BY LEONARD METCALF

Consulting Engineer, New York City

ENGINEERING ECONOMICS: First Principles—By John Charles Lounsbury Fish, M. Am. Soc. C. E., etc., Professor of Railroad Engineering in Stanford University, Author of Earthwork Haul and Overhaul. Second Edition. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 311. $3.

The second edition of this book shows marked advance in the author's conception and presentation of this subject. "The first edition," the author states, "dealt with economic choice of structure." The author now holds "that the fundamental problem of engineering economics is not choice of structure but, rather, choice of investment." This has involved a different sequence of presentation, a rewriting of the book—"a new writing that should begin with the problem of investment and follow the path indicated by the analysis."

The author first stimulates the interest of his student by the analysis of an apparently blind problem of investment. Then he introduces the effect of the factor of time, through a discussion of simple and compound interest, sinking funds, annuities, etc., and discusses depreciation allowance, operating and maintenance costs, and interest on capital. Four chapters follow on analysis of first cost—preliminary expenses, materials and labor, overhead costs, etc., and then on business units—the use of borrowed capital, the individual business, the partnership, private and business corporations.

A chapter is then devoted to "irreducible data on the problem of investment," based on the author's previous discrimination between reducible and irreducible data. "A quality whose effect on choice can be numerically expressed" is defined as "a reducible datum," and an irreducible datum as "a quality whose effect on choice cannot be so expressed." The choice of terms is unfortunately not suggestive, as under "irreducible data" the author includes data pertaining to safety of principal, safety and uniformity of yield, liability, marketability, collateral value, duration, control, management, units, probability of appreciation.

Then come chapters upon financial statements, cost keeping, miscellaneous forecasts on output, life, period of service, interest rate, population, earnings, price and wage rates; and two chapters devoted to valuation, including formulas for determining depreciation and salvage value. A brief chapter on "errors in estimating," and one on "engineering reports," conclude the text. In the appendix are given specimen incorporation papers, tables of formulas and of values, a bibliography, and a set of questions and problems.

The book marks a distinct step in advance over the first edition. The formulas and tables submitted are concise and helpful. Though the book is better adapted to classroom use than to the needs of the engineer, it will be read with interest by engineers.

It is probably not fair for the practicing engineer to criticize the teacher in his method of attacking his subject, but practical experience with young designing engineers suggests that a somewhat more direct presentation would be less formidable to the student and more likely to leave a lasting and friendly impression. It is desirable that the student should retain a lasting impression of the fundamental importance of this subject to him in his later work. A presentation of simple, and later more complex numerical problems, bringing comparisons and methods of analyses clearly before the student would be more effective and preferable to discussions, however clear and concise, which require not only close concentration but a fairly good knowledge of the subject to make the author's intent clear.

Revision of Eckel's Cements

REVIEWED BY P. H. BATES

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CEMENTS, LIMES AND PLASTERS: Their Materials, Manufacture and Properties—By Edwin C. Eckel, C. E., Affiliate Am. Soc. C. E.; Fellow, Geological Society of America. New York: John Wiley & Sons, Inc. Cloth; 6 x 9 in.; pp. 655; halftones and line cuts. $6.50 net.

The first edition of this volume (1905) was undoubtedly the best publication dealing with the sources of raw materials, the manufacture, testing, theories of constitution and hardening and using of all the common structural cements ever issued. If any adverse criticisms were to have been made at that time they would have referred to insufficient discussion of foreign conditions and a lack of foreign references—a lack which was completely overshadowed by the nice balance maintained throughout in the presentation of the matter pertaining to each cement. The author had avoided the tendency so marked in works of this type of getting lost in the endless detail of plant design and equipment. Such important and far less accessible information as the geology and quality of the sources of raw materials, the discussion of what takes place during burning, the theories of what the products are, what takes place when they set and harden, etc., was given in such completeness that the volume immediately attained the preëminence that it deserved and has maintained.

Although the present edition has over 100 pp. of new material it contains 57 pp. less than the older one, the reduction being about equally divided between the parts devoted to natural and portland cements. The revision is not as thorough as one would have expected after a lapse of seventeen years.

Based upon rate of increase of production the author has paid more attention to the revision of the matter dealing with portland cement than with other parts of the book. The wisdom of this is questionable. Lime is used more universally today than ever before although in certain classes of work it has almost reached the saturation point. According to figures cited, the value of hydrated lime in 1920 almost equaled the value of the entire lime industry in 1903. Surely this rather new product deserves more comment than in 1905, especially in relation to its use with portland cement in concrete. Enough has been published since then dealing with this one application of a lime product to fill a volume of a size equal to the one in question. The several associations interested in lime products have been very active in research and much valuable information has been rendered available since 1905. The gypsum industry has also made rapid strides forward and such products as gypsum block for non-load bearing walls and roof slabs and monolithic gypsum construction now overshadow the majority of other uses of gypsum but they are not mentioned.

The author refers to the fact that magnesia and oxychloride cements have increased in use at a rate exceeded only by that of portland cement (289 and 312 per cent, respectively), nevertheless the part devoted to this cement is "as was." The two methods given for the separation of lime from magnesia are of theoretical interest only, but the method used almost entirely for obtaining the magnesia from dolomite for the "85 per cent magnesia insulation" industry is not mentioned, nor is this absolutely essential product itself. The very rapid increase in the use of magnesia stucco calls for no comment other than a few formulas, which incidentally contradict the author's statement, in the introduction, that these cements have the least sand carrying capacity of all cements. The portion of the volume dealing with these three cements—lime, gypsum and magnesia—deserve as much careful revision as that devoted to portland cement.

A small amount of new material appears in the part devoted to hydraulic limes, grappiers, etc. The suggestion that these should have more attention in America on the basis of their cheapness is not borne out by domestic conditions. In this country even lump lime costs more than portland cement and both of the above mentioned products require further treatment in their manufacture than does lump lime. Hydraulic limes would cost more than portland cement in this country if manufactured on the same scale as lime, either lump or hydrate; even if manufactured in as large units as portland cement they could not be sold much cheaper.

The part devoted to natural cement has been materially reduced and doubtless rightly so. Quite properly the author allows this valuable cement to sink further into an oblivion originally induced solely because those manufacturing it could not unite on a statement of what its quality should be and what it should do in service and keep its qualities before the public.

Part VI, dealing with portland cement, shows the most revision, although at least 75 per cent of the old text is reproduced verbatim. Generally the new matter is good but attention should be called to the definition of portland cement according to which it is not necessary to clinker the raw mix. The discussion of costs and prices is interesting and is presented with special reference to the use of index numbers. But it is questionable if few besides economists will be impressed with the figures given in Table 215, showing a decrease in "True Price" from $0.995 in 1913 to $0.829 in 1920 when they recall, as shown in the same table, that "the price per barrel in currency" rose from $1.005 to $2.01.

The chapter devoted to testing and physical properties is unfortunately unchanged notwithstanding the great amount of work which has been done along these lines and published by the American Society for Testing Materials through its Committee C-1, which has issued a publication of 378 pp. discussing test methods and the results obtained from the use of different methods.

Only a page is given to the work of Rankin and his colleagues at the Geophysical Laboratory. This has been the most outstanding and conclusive work ever done in elucidating the question of what portland cement is. Older disproved theories are given considerably more prominence. No attention is called to the revision of Newberry's formula as given by himself and based on Rankin's work in Chapter V of the 1916 edition of Thompson's "Concrete: Plain and Reinforced," although the old formula is reproduced. One very striking omission is that of any discussion of waste heat boilers, which have been the source of the greatest economy in the industry since the introduction of the rotary kiln.

A series of specifications is given, starting with those of the New York State Canal of 1896 and ending with those of the U. S. Government, 1917, which are wrongly stated to be "Revised to Date." Nothing is said in regard to the "American Standard" of the American Engineering Standards Committee which is the latest standard arrived at through the co-operation of the U. S. Government and the American Society for Testing Materials.

The concluding portion, dealing with puzzolanic materials, is largely as in the 1905 edition. These are cements which are used but little and intermittently.

This review may seem to be unduly adversely critical, but the reviewer feels that the author made an unfortunate mistake in not bringing his book up to date, particularly in view of the great amount of research work which has rendered many data available. The volume still remains the best of its kind but its date of issue, for most purposes, is as of 1905.

History of Engineering and Technology

THE NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY: *Transactions* Vol. I., 1920-21. H. W. Dickinson, M. I. Mech. E., Honorary Secretary and Treasurer, the Science Museum, South Kensington, London, S. W. 7. Paper; 8 x 10 in.; pp. 89; 18 halftone and other plates.

Formed some two years ago to collect and preserve "records, MSS., drawings and illustrations of or relating to engineering work and industrial progress," including related biographical material, the Newcomen Society has recently published its first volume of *Transactions*. The opening paper is an "Introduction to the Literature of Historical Engineering to the Year 1640," by E. Wyndham Hulme, supplemented by a brief but valuable classified bibliography. The latter is chiefly of books French, German and Italian, but contains a number of interesting entries of English works. Of the other papers in the *Transactions* the one of most interest to American engineers is "The Mystery of Trevithick's London Locomotives," by Loughnan St. L. Pendred, editor of *The Engineer*. There are also papers on early iron-making in France and early spinning machines.

It is sincerely to be hoped that the Newcomen Society's small membership of about 120 will be rapidly increased now that it has a volume of *Transactions* as tangible evidence of its usefulness. The membership is open to all interested, at the modest fee of £1 a year. Thus far there are only five American members. Libraries of engineering schools and societies, of which only two in this country have subscribed, should make the *Transactions* widely available and many other engineers might well follow the example set by L. F. Loree, president of the Delaware & Hudson R. R., in joining the society.

Two Books on Reinforced Concrete

Reviewed by George Paaswell

Consulting Engineer, New York City

CONCRETE-STEEL CONSTRUCTION—PART I. BUILDINGS. A Treatise upon the Elementary Principles of Design and Execution of Reinforced Concrete Work in Buildings By Henry T. Eddy and C. A. P. Turner. Second Edition, Rewritten. Minneapolis, Minn.: Published by the Authors. Cloth; 6x9 in.; pp. 477; line cuts and halftones. $10.

ELASTICITY AND STRENGTH OF MATERIALS USED IN ENGINEERING CONSTRUCTION. Section I—By C. A. P. Turner. Minneapolis, Minn.: Published by Author. Cloth; 6x9 in.; pp. 85; line cuts and halftones. $5.

A small book just published, "Elasticity and Strength of Materials," by C. A. P. Turner, contains some extracts from an older and larger book on elasticity, and some data on the materials of construction. The older work is Eddy and Turner's "Concrete Steel Construction," published three years ago as a second edition of a considerably smaller book published in 1909. It purports to be a complete treatment of reinforced-concrete construction, with more particular reference to flat-slab analysis; in fact it is a thesis on the special mushroom slab of which the junior author is the inventor. The following comments deal with both works.

There are excellent chapters containing historical notes; and on the elements of elasticity and on concrete construction in general. Data on residual strains are presented with remarkable clarity (in striking contrast with the presentation of most of the other matter) and should be read by every one who would attempt a rational reconciliation of theory with experimental research. The authors seem to have covered in correct fashion the matter of the initial discrepancies between test and theory.

The general discussion of flat slab action is, for the most part, shrewdly presented and *as a qualitive study* is, in its essentials, correct. The treatment of continuous girders is ably presented, gives much new matter and covers this field as completely as one would require for concrete construction.

However, the spirit in which the books are written weakens their usefulness as text and reference works. It is not so much the true action of flat slabs that is sought as it is a justification of the mode of design of the patented mushroom slab. Obviously the books are written with this specific purpose in mind and the reviewer feels justified, therefore, in discussing at large and in detail the analysis covering this design.

Probably the most disturbing feature of the books is the lack of straightforward analysis. There is no short and simple path leading from a clear hypothesis to a well-founded conclusion. The introduction of so many varied methods of attacking the problem, none leading to definite quantitative results and all, for the most part, having little bearing on the meager algebraic analysis presented, is, to say the least, confusing. The work is sadly deficient in cold logic. It seldom emphasizes what is an arbitrary assumption on the part of the authors and what is recognized physical law. The reader infers, in a number of cases, that some of the statements given are founded on acknowledged law, when as a matter of fact the statements are based upon the most arbitrary of assumptions.

The authors trifle with and distort basic law in such disconcerting fashion as to leave doubt in the reader's mind as to the correctness of the most elementary of propositions. Thus in discussing the "law of rigidities" (the well-known theorem of least work) the universal truth of the law is noted, yet a static example of work is given which leaves the reader to infer that the law has decided exceptions. The exception as given is, of course, absurd. At another point a statical moment is divided up between slab and supporting girder in direct violation of all "laws of rigidity."

It is noted that under certain conditions the law of equality between horizontal and vertical shear is not valid. If the authors had stopped to note that the equality of vertical and horizontal shear is based upon the analysis of an infinitesimal prism, where all forces are either normal, passing through the centroid of the prism, or are tangential, they would have seen that the equality of such shears is as fundamental a law as any of the laws of equilibrium. Such an error on the part of the late Professor Eddy, a very conscientious analyst, is well nigh unpardonable. It is noted that the horizontal shears at the support of a continuous girder are zero. It has been overlooked that beam action (with the famous principle of local perturbations) is no longer valid at a reaction. The distribution of the reaction vitally affects the stresses in the beam at this point and it is not beam action that must be studied, but the manner of distribution of a load through a block, a problem not yet clearly understood. The decision of the Joint Committee on Concrete and Reinforced Concrete to allow for full horizontal shears at the support has not yet received worthy mathematical refutation.

In speaking of lateral deformation under a longitudinal load (the so-called Poisson ratio), the authors revive an old error. It is the very essence of lateral deformation that it is absolutely untranslatable into lateral stress. Every law of work and statics would be violated by such equivalent true or actual stress. Professor Burr has given a very clear demonstration of the faulty analysis contained in this assumption in "Elasticity and Resistance of Materials." The practical application of the phenomenon of lateral deformation has been made the occasion of much confused analysis. In these books values varying from one-tenth to one-half appear, with little justification other than their aid in analyzing the mushroom slab.

It is probably true that an action similar to the lateral deformation occurs in a flat slab, and a two-way reinforced slab by restraining this deformation increases somewhat the resisting powers of the slab. The finer the mesh the greater the resistance may be a justifiable assumption. One can not conscientiously say any more, however, than this qualitative statement. In the newer text, the remarkable statement is found that the correct value of the Poisson ratio for isotropic materials is 0.4142, in place of 0.25, based upon the "kinetic invariance" of volume under strain; noting that, with this determination, the century-long feud between the rari- and multi-constant elasticians has been settled. However, in view of the fact that volume is *not* an invariant under strain, the author has not yet put an end to the feud.

One of the fundamental notions introduced by the authors is the existence and effect of twisting moments. It is estimated that heretofore all designers have overlooked such moments, and that the introduction of the new type of moment explains, in proper fashion, slab action. As a matter of fact, any one reading the book will appreciate that the authors have arbitrarily chosen to call one or two component bending moments a twisting moment. In a very superficial sense, only, is it a twisting moment; just as in the case of a simple beam one may attempt an analysis on the basis of an applied twisting moment normal to the axis of the beam. Flexure problems are solved on the basis of bending moments and the plate problem is but little more than a problem in flexure. This does not mean that beam action and plate action are similar; the authors are correct in emphasizing the difference between beam strip action and plate action; but they fall into serious error in attempting to place the onus of the difference on the "twisting" moment. In every case noted, since the plate treated is a symmetrical surface, what is termed a twisting moment about one axis becomes a bending moment about the other, with absolutely no distinction in physical action.

It is well worth pointing out that at no place have the authors utilized (save in a qualitative sense only) the "twisting" moment. When a definite design is carried out, the famous twisting moment is ignored, as it should be, and flexure only is considered. To put it briefly, the authors have chosen, deliberately, or otherwise, to label one of two symmetrical bending moments a twisting moment and have not shown one iota of digestible analysis to justify such terminology.

To effect a practical analysis of flat slabs some arbitrary assumptions must of course be made. The general problem of the analysis of the plate under unrestricted conditions has to date proved insoluble. Some method analagous to the semi-inverse method of St. Venant in the beam problem must be adopted in plate analysis. Thus the best method of attacking the plate problem seems to lie in the assumption of zero shear planes based upon the symmetry of the plate and its loading. This is a dangerous method, since it is of obvious application only to a symmetrically loaded plate. With these assumptions static analysis proceeds and a resultant moment is found, based upon an assumed uniform distribution of loading upon supports. This resultant moment may be resolved into two component moments, at right angles to each other, but these, again, are still bending moments.

Fundamentally, the analysis of a plate is the study of the geometry of a curved surface. Gauss introduced the method of curvatures to determine the properties of the surface and elasticians have adopted this method, since curvatures determine bending moments. The twisting moment recognized among elasticians is essentially the rotation of an axis normal to the plate about itself as the plate is deformed. Such distortion is ignored in the text, and the twist has no place in the analysis.

In short, when the authors confine their attention to a qualitative discussion of plate action, they give with reasonable accuracy (ignoring the confusion between flexure and twist) what one may expect in the distortion of a flat slab under load. Beyond this point no confidence can be placed in any of the analysis presented. Distinctions between statical, external and resisting moments and attempts to combine the moment of inertia of two intersecting sections to give a resisting moment destroy most of the confidence of the reader in the design methods.

It must be remembered that no one has yet presented a successful solution of flat slab action, and the authors can not be harshly censured for their failure to present an acceptable solution. It may be mentioned in conclusion that the authors build a special type of flat slab that proves an apparent economy to the owner, carries safely all loads upon it and seems to meet, superficially at least, the qualitative requirements of flat slab action.

Forty Years of Landscape Architecture

FREDERICK LAW OLMSTED: LANDSCAPE ARCHITECT, 1822-1903—Edited by Frederick Law Olmsted, Jr., and Theodora Kimball. Vol. I. Early years and Experiences, Together with Biographical Notes. Forty Years of Landscape Architecture: Being the Professional Papers of Frederick Law Olmsted, Senior. New York and London: G. P. Putnam's Sons. Cloth: 6 x 9 in. pp. 131. $2.50.

Publication of the first of a series of volumes under the general title "Forty Years of Landscape Architecture," a series in preparation since the death of the senior Olmsted in 1903, was achieved late in 1922, the centenary of his birth. The joint editorship by F. L. Olmsted, Jr., and Miss Kimball, of the Harvard School of Landscape Architecture, is a happy combination, added to which was the assistance rendered by the wife of the senior Olmsted at the ripe age of ninety years.

The present volume opens with some forty pages of condensed biographical notes. These are followed by a section on Early Experiences as contributions to his later career, consisting of fragments designed for an autobiography, extracts from letters, papers, books and articles by the senior Olmsted. One of the most interesting features of the book is the light it throws on what proved to be the development of a professional career; a development which for many years came wholly through breadth of study, observation, civic and human interest, with certain practical applications which prepared the way for a brilliant and useful professional life, in which the senior Olmsted was largely an American pioneer.

From the biographical notes it appears that on Dec. 1, 1836, when still under fifteen, Olmsted was ready to enter college, but that on account of weak eyes this was given up and that in November, 1837, he went "to Andover, Mass., to study engineering with Prof. Barton," a connection he maintained at Andover and later at Collinsville, Conn., until May, 1840. Interspersed with an experience in business, a voyage before the mast to Canton, China, three engagements to get practical experience in farming, and establishment as a farmer on his own land, Olmsted attended lectures at Yale, where in June, 1847, he was made an "honorary member" of the class of that year. From 1847 to 1854, Olmsted made landscape improvements on his own farm, and established a nursery, besides recording his travel observations in "Walks and Talks of an American Farmer in England," "Seaboard Slave States," "A Journey in Texas" and "A Journey in the Back Country"—the latter an account of a horseback ride from New Orleans to Richmond.

A visit to A. J. Downing in 1851, shortly before the tragic death of that pioneer and promoter of landscape design in America, seems to have been an important factor in Olmsted's final choice of landscape architecture as a profession. In 1857 he was appointed superintendent of Central Park; early in 1858 he and Calvert Vaux were awarded first prize in a competition for plans for Central Park, and a few weeks afterwards Olmsted was appointed architect-in-chief of Central Park—a connection that continued for many years, with breaks and threatened breaks due to political attacks and interference. Parks, cemeteries, private and institutional, state and national grounds, the latter including the Capitol at Washington, with occasional engagements on village and city extension plans, occupied Olmsted more and more fully as the years went by. From 1890 on until its completion the grounds of the World's Columbian Exposition received much of his attention.

Although Olmsted died before city planning had much more than become recognized as an art and before its establishment as a profession in America, his work doubtless contributed more towards both than that of any other one man up to the time of his death: for while Downing, through his editorials in the *American Horticulturalist*, and through his books and some minor landscape planning, did much to create interest in landscape architecture and to spread sound ideas as to its fundamentals, it was left to the more practical Olmsted and to a later and riper time as well to put the slowly growing appreciation of landscape art into corporeal form through the creation and adornment of parks and other functionally designed open spaces.

Of the volumes to come in this promising series, the next will be devoted wholly to Central Park—towards the cost of which the Russell Sage Foundation has contributed because of the value of the material in connection with the survey of Greater New York and its environs, now being made. Other volumes will take up different lines of Olmsted's work; and the series will be rounded out by a general volume, with explanatory matter by F. L. Olmsted, Jr., this volume to be "an orderly and consistent presentation of the theory and practice of the landscape art as developed by Frederick Law Olmsted, Senior."

Such a series will do just honor to the great leader in the profession of landscape architecture. When may we expect equally just honor to be paid to some of the leaders of the civil engineering profession?

Federal Railroad Control

AMERICAN RAILROADS: Government Control and Reconstruction Policies—By William J. Cunningham, A. M., James J. Hill Professor of Transportation, Graduate School of Business Administration, Harvard University. New York, Chicago and London: A. W. Shaw Co. Cloth; 6 x 8 in.; pp. 409. $3.

Prof. Cunningham has set out to review American railroad history during the years 1917 to 1922 with special emphasis upon the period of federal control between Jan. 1, 1918, and March 1, 1920. During most of that time he was officially connected with the United States Railroad Administration, serving on the staff of the Director General of Railroads, first as manager of the operating statistics section and later as assistant director of operation.

In his first and second chapters the author has reviewed all too briefly the three periods of American railroad history: From 1830 to the Civil War, during which development was quite unrestrained and the public attitude one of liberality and encouragement; from the end of the Civil War until 1887, during which the roads began to reap the fruits of some of their earlier excesses and public antagonism began to show itself in the form of regulation by individual states; and finally the period from 1887 to 1917, which included the beginning of federal railroad regulation with the establishment of the Interstate Commerce Commission in 1887.

The bulk of the book deals in great detail with the events of 1917, which resulted in the assumption of government control over the operation of the roads, and with the post-war problems of the carriers. This section closes with a review of the Transportation Act of 1920 and of its operation during 1921. The book ends with a statement of the situation in July, 1922, at the commencement of the shopmen's strike.

The elements of this subject are so numerous and the issues are so controversial that it would be exceedingly difficult for any one to handle them to the general satisfaction in so small a compass. For example, the chapter on the financial results of the period of federal control comprises only six pages. There are few railroad executives whose views on this subject alone could be set forth to their satisfaction in six books of the dimensions of this one. It is probable, however, that this very condensation contributes in no small measure to the value of the book, for it is an exceedingly handy reference text for any one who may have occasion to review quickly the outstanding railroad developments of recent years so far as their governmental relations are concerned.

The Legal Side of Land Surveying

A TREATISE ON THE LAW OF SURVEYING AND BOUNDARIES—By Frank Emerson Clark of the Minnesota Bar. Indianapolis: The Bobbs-Merrill Co. Cloth; 6 x 9 in.; pp. 631; illustrated. $5.

There still remains in many sections of the West the "law" that fence-line priority means ownership. And the surveyor who goes into more or less hostile territory with only technical knowledge and training is ill-equipped even to bluff his way through difficult situations. Legal knowledge concerning what he is doing is almost as essential as technical ability.

The author of "Surveying and Boundaries," a lawyer and also a former surveyor of extended experience, supplies the field man all the legal ammunition he need carry. The volume reveals logical co-ordination of field problems with legal precedence. About 1,000 cases at law are cited.

In addition to its value as a legal friend to the surveyor, the book sets forth historical outlines of how public and private land surveys have been and are made, together with the histories of incidental problems. Of particular interest is a chapter on riparian rights, which goes into the detailed civil and technical history of scores of riparian-right controversies. Land surveyors who wish to be efficient in their work will do well to study the volume carefully.

Survey of Modern Industrialism

MODERN INDUSTRIALISM: An Outline of Present-Day Industrial Organization—By Frank L. McVey, Ph.D., LL.D., President of the University of Kentucky. Second Edition. New York and London: D. Appleton & Co. Cloth; 6 x 8 in.; pp. 358. $2.50.

By careful revision of the original and the addition of new material here and there, including three new chapters, the author has brought to date, in substance and in spirit, the excellent survey of modern industry and its relations to society and government that he wrote nearly twenty years ago while professor of political economy at the University of Minnesota; see *Engineering News*, Dec. 15, 1904, p. 552. To a consideration of industrial progress and problems in the United States, England and Germany in the first edition, the author has taken up Japan in the present volume, in a chapter on the Orient and the West. The other new chapters are on Industry and Taxation and the Widening Circle of Democracy in Industry. The revision of the opening chapter makes it a notable survey of the development of modern industrialism to the present time, embracing some of the facts and reactions of the world war. The volume is in three parts: History, Industry and Administration, the latter including chapters on government interference, regulation and ownership. The author believes in the necessity of extensive government regulation and apparently some degree of government ownership, the latter to be deferred, for the most part, until government is more efficient than now.

PUBLICATIONS RECEIVED

New Books and Revised Editions

ANALYTIC GEOMETRY—By Clyde E. Love, Ph.D., Associate Professor of Mathematics, University of Michigan. Cloth; 6 x 8 in.; pp. 306; illustrated. $2.25.

APPLIED BUSINESS FINANCE—By Edmond E. Lincoln, M. A. (Oxon), Ph.D. Sometime Assistant Professor of Finance, Graduate School of Business Administration, Harvard University. New York: A. W. Shaw Co. Cloth; 6 x 8 in.; pp. 772; illustrated with charts and forms. $4 net.

On organizing and financing in various aspects; also chapters on production, selling goods, and distribution of earnings. The business cycle is considered.

DESCRIPTIVE GEOMETRY—By Lawrence E. Cutter, M. Am. Soc. M.E., Associate Professor of Mechanical Engineering, Stanford University. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 244; illustrated. $2.50.

FABRICATION DE L'ACIER AU FOUR MARTIN—Por A. Barberot, Ingénieur des Arts et Manufactures, Directeur des Usines de Sainte-Marie et Gravigny, a Saint-Dizier. [Encyclopédie Minière et Métallurgy.] Paris: J. B. Bailliere et Fils. Paper; 6 x 9 in.; pp. 543; half tones and many line cuts.

HEIZUNG UND LUFTING DER BAHNHOFSCHOCHBAUTEN—Bearbeitet von Vaurat a. D. Carl Guillery in Pasing; Herausgegeben von Dr.-Ing. e. h. F. Loewe und Dr.-Ing. e. h. Dr. H. Zimmermann. Leipzig: Wilhelm Engelmann. Cloth; 7 x 10 in.; pp. 135; 82 line cuts and half tones in the text and two lithographed folding plates in colors.

LEHRBUCH DER EISEN- UND STAHLGIESSEREI—Von Bernhard Osann. Dr.-Ing. e. h. Fünfte, Neu Bearbeitete Auflage. Leipzig: Wilhelm Engelmann. Cloth; 7 x 10 in.; pp. 693; 756 line cuts and halftones.

The fourth edition of this book was reviewed by Dr. Richard Moldenke in *Engineering News-Record*, Feb. 17, 1921, p. 307.

LEHRBUCH DER ELECTROTECKNIK — Erster Band: Allgemeine. Elektrotecknik. Elektrotechnische Messkunde. Elektrische Maschinen und Apparate. Bearbeitet von F. Fischer, K. Hohage, G. W. Meyer. Leipzig, Germany: Wilhelm Engelmann. Cloth; 8 x 10 in.; pp. 753; 924 line cuts and half tones.

LEHRBUCH DES TIEFBAUNES—Erster Band: Vermessungskundo Erdboau. Stutz- Futter- Kai- und Staumaurn. Grundstrassen- Eisenbahn- und Tunnelbau. 6 bis 8 Auflage. Bearbeitet von O. Eggbert, H. Wegels, L. V. Willmann. Leipzig, Germany: Wilhelm Engelmann. Cloth; 8 x 10 in.; pp. 835; 1,475 illustrations.

THE MAKING OF INDEX NUMBERS: A Study of Their Varieties, Texts, and Reliability—By Irving Fisher, Professor of Political Economy, Yale University. [Publications of the Pollak Foundation for Economic Research.] Boston and New York: Houghton Mifflin Co. Cloth; 6 x 9 in.; pp. 526; 68 "ratio charts." $7.50.

MATHEMATIK—Von H. E. Timerding, Dr. Phil. Professor an der Technischen Hochschule zu Braunschweig. Boards; 7 x 10 in.; pp. 242; line cuts. Ranges from arithmetic to calculus.

PARLIAMENTARY LAW: Method of Transacting Business in Deliberative Assemblies, Uses of the Various Motions, Method of Conducting Elections, the Duties of Members and Officers, Discipline, Model By-Laws, Forms, and Definitions of Parliamentary Terms; also Several Hundred Questions in Parliamentary Law That Have Been Submitted to the Author and the Answers Thereto—By General Henry M. Robert, Author of "Robert's Rules of Order Revised," "Parliamentary Law Charts," and "Parliamentary Practice." New York: The Century Co. Cloth; 6 x 9 in.; pp. 588. $5.

PLASTICS AND MOLDED ELECTRIC INSULATION—By Emil Hemming. New York: Book Department, The Chemical Catalog Company, Inc. Cloth; 7 x 10 in.; pp. 313; line cuts and halftones. $5 net.

Deals with ceramic products, calcareous cements and artificial stone, glass, casein products, plastics in road construction and sundry materials in Part I, and with all sorts of molded insulation in Part II. Extensive patent lists are given for each main classification of material.

RATE MAKING FOR PUBLIC UTILITIES—By Lamar Lyndon. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. [illegible]; 2 graphs. $[illegible].

SAMPLING AND ANALYSIS OF COAL, COKE AND BY-PRODUCTS: Methods of the Chemists of the United States Steel Corporation—Pittsburgh, Pa.: The Carnegie Steel Co., Bureau of Instruction. Flexible Leather; pp. XVI 184; illustrated. $[illegible].

The fact that this volume is designed solely for the use of the chemists of the constituent companies of the United States Steel Corporation makes it of more rather than less interest and value to any chemist engaged in sampling and analyzing the materials indicated in the title. The volume covers a wide range and contains considerable material not included in the earlier edition. The committee responsible for the book consists of a half dozen chemists, including J. R. Campbell, of the H. C. Frick Co.; and C. B. Francis, of the Bureau of Instruction.

THE TWELVE-HOUR SHIFT IN INDUSTRY—By the Committee on Work-Periods in Continuous-Industry of the Federal American Engineering Societies. With a Foreword by Warren G. Harding, President of the United States. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 302. $3.50.

Reports and Pamphlets in Various Fields

ARIZONA HIGHWAY DEPARTMENT, 1920-22—By Thomas Maddock, State Engineer. Paper; 6 x 9 in.; pp. 240; illustrated.

CALIFORNIA STATE HIGHWAY COMMISSION: Report for 1920-22—Sacramento. Paper; 6 x 9 in.; pp. 214; illustrated.

THE CARNEGIE CORPORATION OF NEW YORK: Report of Henry S. Pritchett, Acting President, for 1921-22. Paper; 6 x 9 in.; pp. 80.

CENTRAL ELECTRIC STATIONS IN CANADA: Census of Industry, 1920—Ottawa, Ont.: Dominion Bureau of Statistics. Paper; 7 x 10 in.; pp. 48.

CHIEF OF ENGINEERS, U. S. Army: Report for 1921-22. Washington, D. C. Paper; 6 x 9 in.; pp. 2257 + 38.

CONNECTICUT COMMISSION TO INVESTIGATE THE POLLUTION OF STREAMS: Report to Legislature of 1923. Paper; 6 x 9 in.; pp. 21.

Recommends creation of State Water Conservation Commission and formation of sanitary districts. Among the members of the commission were Caleb M. Saville, manager and chief engineer, Hartford Water-Works, who served as chairman, and R. A. Cairns, city engineer, Waterbury.

ECONOMIC COMBUSTION OF WASTE FUELS—By David Moffatt Myers. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 50; line cuts. One copy free; 10c. from Superintendent of Documents.

JAPAN DEPARTMENT OF RAILWAYS: Report for 1919-20 English Edition—Tokyo, Japan. Paper; 8 x 12 in.; pp. 120; folding colored map in pocket.

NATIONAL BRICK MANUFACTURERS ASSOCIATION: Proceedings, 1922—Indianapolis; T. A. Randall, Secretary. Paper; 6 x 9 in.; pp. 207.

NATIONAL LIME ASSOCIATION PROCEEDINGS, 1922—Washington, D. C., 918 G St., N. W. Paper; 6 x 9 in.; pp. 104; illustrated.

OREGON HIGHWAY COMMISSION, 1920-22—Herbert Nunn, State Highway Engineer, Salem, Ore. Paper; 6 x 9 in.; pp. 150; maps.

PENNSYLVANIA HIGHWAY DEPARTMENT: A Survey of the Fiscal Policies of the State Highway Department of Pennsylvania for the Citizens Committee on the Finances of Pennsylvania—By William H. Connell, Formerly Chief of the Bureau of Highways of Philadelphia. Paper; 6 x 9 in.; pp. 114; folding chart showing functional organization of the department. Address Mr. Connell (now) Deputy Highway Commissioner of Pennsylvania, Harrisburg, Pa.

An abstract of this report appeared in Engineering News-Record, Dec. 7, 1922, p. 991.

PROTOKILL DER VERHANDLUNGEN DES VEREINS DEUTSCHER PORTLAND-CEMENT FABRIKANTEN, 1922—Charlottenberg, Germany: Zementverlag. Paper; 6 x 9 in.; pp. 200; illustrated.

RAILWAYS AND HARBORS, UNION OF SOUTH AFRICA: Report of General Manager, 1921-22. Pretoria. Paper; 8 x 13 in.; pp. 190; map, diagrams and half tones.

RAILWAY STATISTICS OF THE UNITED STATES OF AMERICA, 1921: Compared with the Official Reports for 1919 and Recent Statistics of Foreign Railways—Prepared by Slason Thompson, Bureau of Railway News and Statistics, Chicago, Ill. Paper; 6 x 9 in.; pp. 143.

RECOMMENDED MINIMUM REQUIREMENTS FOR SMALL DWELLING CONSTRUCTION: Report of Building Code Committee, United States Department of Commerce. Washington. D. C.: Department of Commerce. Paper; 6 x 9 in.; pp. 108; line cuts. 15c. from Superintendent of Documents.

RESEARCH IN HIGHWAY EDUCATION—By William Kendrick Hatt, Director Advisory Board on Highway Research, National Research Council, 1701 Massachusetts Ave., Washington, D. C. Reprinted from Proceedings of Second National Highway Conference.

TEST OF A HOLLOW TILE AND CONCRETE FLOOR SLAB REINFORCED IN TWO DIRECTIONS—By W. A. Slater, Engineer Physicist, Bureau of Standards; Arthur Hagener, Engineer, and G. P. Authes, Engineer Whiteacre Engineering Co. Paper; 7 x 10 in.; pp. [illegible]; [illegible] from Superintendent of Documents, Washington, D. C.

VALUATION OF PUBLIC SERVICE UTILITIES IN THE STATE OF WASHINGTON—By [illegible] H. Fletcher, [illegible] Valuation Engineer, Olympia, Wash. [illegible]; pp. [illegible].

[illegible] in Washington and [illegible] in that state, [illegible] railways there. The pamphlet is primarily for investors.

YEAR BOOK OF THE CITY MANAGERS' ASSOCIATION—Paper; 6 x 9 in.; pp. 264. 55c.

Contains Proceedings of 1922 convention and tabulation of city manager data.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Closes Discussion on Highway Location

Sir—Please allow me a brief rebuttal on the subject "Does highway engineering call for locating skill?"

Mr. Quackenbush estimates that less than 5 per cent of the mileage requires railroad methods, and that of this 5 per cent probably a large extent is controlled by politicians. If that is the case, we must leave more than 95 per cent out of this discussion, for the reason that a mere traverse of an existing road for the purpose of improving it has little to do with locating. He grants that a railroad locater, however, with proper consideration of the needs of a highway will likely do a better job.

Mr. Lavis thinks that the technique of surveys can be benefited by a study of railroad location, but that fundamental principles are different and cites steep grades and sharp curves as an example. Our answer is that the principles seem to be different but taking into account the same tractive effort and resistance why should they be different?

In relation also to the matter of grade, Mr. Patterson says that a pedestrian takes the short but steep trail, yet a cow takes the long but easy path. Although time is no object to a cow, there is another reason; she carries more freight than a pedestrian. As our highways begin to carry more freight our highway officials will regret the steep grades and short distances. In the early days our railroads used momentum grades. As they became able they eliminated them to an extent and jacked up the track; but with a concrete pavement down on these undulating grades, as they are styled by highway engineers, it will be a sorry job to use our concrete slabs as "relayers" when the grade is bettered. The turnouts for highways have their analogy in passing sidings.

Mr. Myers thinks that highway location calls into more attention a flexibility not allowed in railroad location. Which can exceed its rated horsepower under duty the more, a locomotive or a gasoline motor? A horse has the poorest rated horsepower, as it can exert under stress considerably more than its normal capacity. A steam engine comes next, a gasoline motor next and an electric motor last; and a highway locater is or should be restricted to maximum grades and curvature as would be a railroad locater. Understand me, the rules should be the same although the maximums are different in all cases. A politician's house to be served is as truly a controlling point as a river crossing and it will take equal skill to get the best line to either.

Now with regard to the fact that highways are built not for profit but for public service. Cogitate this a little. A dollar saved is a dollar earned; why should one need less skill than the other? The question will answer itself.

Mr. Tinsley also mentions the stiffer grades and sharper curves used by highway engineers. We admit that there is a difference in "degree" but no difference required in "skill."

Mr. Rader says he has located railroads ten years without first locating a railroad. I think, however, he must have used the railroad handbooks of Searles, Nagle, Allen, Webb, or possibly read Wellington. Where can you get a book dealing with location that does not apply to railroads? Sometimes a railroad is prone to sustained grades, sometimes not equally so a highway.

Nearly all writers including Mr. Gillette think that the undulating grade makes the highway a different proposition. If you were comparing a first-class railroad with a second-class highway, or vice versa, it could be said that the results were different but it is yet to be proved that the principles are different after studying Prof. Agg's experiments.

To summarize: (1) Curvature and grade offer the same resistance to tractive effort on highways as on railways; (2) Rise and fall and virtual grades affect locomotion or traction the same, comparing car with car or train with train; (3) Compensation for curvature is equally important; (4) Superelevation for railways has its counterpart in banking of highway curves; (5) Controlling points are limitations either on railways or highways. Where an improvement follows the old route, for example, the whole line is controlled and limited. R. S. BLINN.

Sparta, N. C., Jan. 23.

Another Pile Bearing Formula

Sir—To R. C. Norris, Civil Engineer, Muar, Johore, Straits Settlements, I am indebted for copies of his booklet of forty pages, entitled "Formula for Pile Driving, with Examples, Detailed Explanations and Test Records. A Reliable and Entirely New Method." Singapore, 1922.

Mr. Norris takes account *separately* (1) of the "Resistance (R_D) to *driving*," and (2) of the "grip" (G_P) or *additional* resistance due to the *re-compacting*, around the pile, of the soil which was disturbed by the driving.

For the resistance, R_D, in pounds, to *driving*, Mr. Norris uses the formula:

$$R_D = C\frac{W \times v}{S+1} + M = C\frac{W\sqrt{2gh}}{S+1} + M$$

$$= C\frac{8\sqrt{h}\,W}{S+1} + m\,(W+w);$$

where

C = a coefficient (ranging from 0.7 to 0.9) intended to cover losses of energy in fall of ram;

h = height of final fall of ram, in feet;

W = weight of ram, in pounds; w = weight of pile, in pounds;

$v = \sqrt{2gh} = 8\sqrt{h}$ = theoretical velocity of ram at instant of its striking the pile-head;

S = penetration or "set" of pile, in inches, under last blow before rest;

g = gravity acceleration = 32 ft. per sec. per sec.;

m = a coefficient ranging from + 1.1, for $S = 26$ in., to − 3.5 for $S = 0.1$ in. When $S = 2$ in., m = zero.

Mr. Norris's method of treating the additional resistance, due to "grip" (somewhat simplified) may be illustrated as follows:

At Perth Amboy, N. J., in 1875 (see Trans. Am. Soc. C. E., 1892, August, pp. 148 and 153) four piles, in a square, were driven L = 33 to 35 ft. into "pretty fair mud"; W = 1,700 lb.; h = 25 ft.; S = 2 in. By means of a platform, the four piles were loaded with 80 "long" tons (179,200 lb.), giving an average resistance, R_L, to *loading*, of 44,800 lb. per pile, under which all but the largest pile (18 inches diameter at top) had settled; maximum settlement = 3 in.

Since, in this case, S = 2 in., we have m = 0; and Mr. Norris's formula for resistance to driving, with C taken at 0.85 gives

$$R_D = 0.85 \times \frac{8 \times \sqrt{25} \times 1{,}700}{3} = 19{,}266 \text{ lb.}$$

Taking R_L = 44,800 pounds, we have

"Grip," G_P, for entire pile, $= R_L - R_D$ = 44,800 − 19,266 = 25,534 lb.

Number, n, of 10-ft. lengths in the driven length, L = 33/10 = 3.3;

"Grip," G, per 10-ft. length of driven pile $= G_P/n$ = 25,534/3.3 = 7,737 lb.;

K = resistance, R_D, to driving, per ten-foot length of driven pile, $= R_D/n$ = 19,266/3.3 = 5,838 lb.;

G/K = 7,737/5,838 = 1.33.

In other words, in this case, we find the "grip" = 1.33 × the resistance to driving.

Mr. Norris assumes K_S = 7,000 lb. per driven 10-ft. length of a 12 in. pile, in "pretty fair clay" (S = 2 in.), as a "standard" value of K.

Then, for a corresponding "standard" value, G_S, of G, we should have:

$G_S = (G/K)\ K_S = 1.33 \times 7{,}000 = G\ (K_S/K) = 1.2 \times 7{,}737 = 9{,}310$ lb. per driven foot-length of pile.

Conversely, for the Perth Amboy piles, we should have:

$G = G_S\ (K/K_S) = 9{,}310\ (5{,}838/7{,}000) = 7{,}737$ pounds per ten-foot driven length;

$G_P = \frac{L}{10} G = \frac{33}{10} \times 7{,}737 = 25{,}534$ lb.; and

$R_L = R_D + G_P = 19{,}226 + 25{,}534 =$ say 44,800 lb., as above.

Mr. Norris adopts the following standard values of K_S, G_S and S_S:

	For wooden piles, 12 in. diam.			For concrete piles, 14 in. square		
	K_S	G_S	S_S	K_S	G_S	S_S
Pretty fair clay	7,000	8,300	2.0	3,000	2,820	1.75
Stiff clay. . . .	10,000	22,340	1.5	3,000	4,200	1.00

In the following comparison, R_N is the extreme load on one pile, calculated by Mr. Norris by means of his formula; and R_L is the actual static load causing settlement, as nearly as it can be gathered. See Trans. Am. Soc. C. E., 1892, August, pp. 148-155.

	R_N	R_L	R_N/R_L
1. Aquia Creek. .	19,415	13,333	1.46
	19,798	13,333	1.48
3 Mississippi .	27,100	33,600	0.81
4 Perth Amboy.	44,394	44,800	0.99
5 Fort Delaware.	36,748	40,000	0.92
7. Buffalo.	90,000	75,000	1.20
. . Muar, concrete pile, 14 in. square . . .	20,109	20,160	1.00

The two Aquia Creek cases, above quoted, were selected from a list of twelve cases. Mr. Norris takes weight, w, of pile $= 56 \times 40 = 2{,}240$, which appears excessive. Taking $w = 1{,}000$, I obtain $R_N/R_L = 1.14$ and 1.09 respectively, in place of his 1.46 and 1.48. With $w = 1{,}000$, I obtain, for the other ten Aquia Creek cases, $R_N/R_L = 1.20$, 1.43, 1.11, 1.00, 1.44, 1.22, 1.12, 1.17, 1.49 and 1.46 respectively.

Having found the extreme resistance, R_L, to loading, in any case, by his formula, Mr. Norris uses a safety factor ranging from 0.5 to 0.7, according to the circumstances of the case. **John C. Trautwine, Jr.**

Philadelphia, Pa., Feb. 6.

Stresses in Arch Dams

Sir—In your issue of Jan. 18, 1923, p. 131, Lars Jorgensen takes issue with some of my statements regarding deflections and stresses in arch dams.

A theoretical investigation of the deflections of the Salmon Creek Dam in Alaska indicates that according to standard formulas, tension stresses of over 2,000 lb. per square inch would have to exist in order to permit the dam to deflect elastically as much as was actually measured. Such high tension stresses in concrete are obviously impossible, and the natural conclusion is that the concrete has cracked under excessive strain.

Mr. Jorgensen admits that the vertical construction joints open up under the influence of low temperatures and the shrinkage of concrete. This fact illustrates in a striking manner that the standard bridge-arch theory can with equal correctness be applied to arch dams.

In view of this it is reasonable to assume that the simple cantilever theory is equally applicable for the vertical sections of arch dams. Inasmuch as the theoretical cantilever stresses in many arch dams are very much in excess of the ultimate tensile strength of concrete, it must be concluded that horizontal cracks exist in these structures.

Experience has shown that apparently neither vertical nor horizontal cracks endanger seriously the stability of such a dam under ordinary conditions. However, open cracks in an unreinforced concrete structure are very undesirable, and should be avoided, if possible, by improved methods of design.

An investigation of arch and multiple arch dams is being made by a committee of engineers under the auspices of the Engineering Foundation. The deflections and stresses, temperature changes, etc., will be measured on a number of arch and multiple-arch dams already built, and also on specially constructed test dams. It is hoped that such tests may lead to improvements in the design and construction of future dams.

An arch dam designed scientifically for combined cantilever and arch action was recently constructed on the river La Jogne in Switzerland. The deflection measurements during the first season seem to indicate that theory and practice agree very well.

In order to obtain harmonious action between vertical cantilever and horizontal arches, the span of an arch at crest should not be more than 2 to 2½ times the height of the dam. For damsites of greater width, horizontal and vertical cracks in the dam are liable to occur. For this reason, in certain European countries, notably in Italy and Sweden, multiple-arch dams are being constructed in preference to single arch dams. The investigations of the leading hydraulic engineers of those countries clearly indicated the superiority of the multiple arch type of dams which combines the advantages of gravity and arch dams without involving certain undesirable features inherent in those two types. **Fred A. Noetzli.**

San Francisco, Calif., Feb. 1, 1923.

Remedy Suggested for Low Road-Bids

Sir—An editorial in the *Engineering News-Record*, Jan. 11, 1923, p. 52, calls attention to the low bidding on road work during the year 1922 and assigns a possible reason. It further goes on to state that contractors should organize and be more on a business basis.

What is meant by organization? Does it mean that a few contractors should gather together, write a constitution and by-laws, elect officers, collect dues, air their views and intercede here and there in the interest of members? It is admitted that such an organization will do some good, but will it put contracting on a safe business basis? Will it prevent work being bid under cost or at too low a figure to return a reasonable profit? If so, how?

What is usually accomplished by an organization such as we speak of in other lines of business? For instance, the tobacco pool, blue-grass-seed pool, hemp-seed pool, brick association, cement association, sand and gravel association, hardwood manufacturers association, etc.? Isn't it true that the articles manufactured by the members of these various concerns have a market value, fixed by the producers so as to return a profit?

Why not perfect a practical organization? Let all contractors in a state join an association, list their equipment, organization and financial status so that it can be determined with a great deal of certainty what class and what amount of work each contractor is capable of doing during a season. Select from their number men to go over each piece of work that is to be let, analyze the cost of each item, add a reasonable profit and submit a bid under the name of the association.

If any outsiders desire to bid, let them do so as usual.

The state road department should make detailed estimates of the cost of doing each unit of work and it would be a very easy matter to determine if the association is submitting reasonable bids. If the work is awarded to the association it is in turn assigned to the contractors best fitted to build that particular type of road. Through such an arrangement every contractor's equipment and organization could be kept busy and work at the greatest efficiency.

The state road department, in addition to a bond, would have the assurance that the work would be properly organized, proper equipment would be used and that the work would be completed on time, and should there be need of completing any section in a rush it could be done very easily.

Such an organization would be a practical one, a legitimate one and contractors would be allowed to make a reasonable profit and contracting would be placed on a business basis that would be recognized by all financial institutions. There is not any organized opposition to the price of cement, brick, lumber, sand and gravel, crushed stone, gasoline, bread, hair cut, price of room in a hotel, price of tobacco, cigars, cigarettes, and in fact practically every known commodity used by man today.

Then why not permit a contractor to make a reasonable profit and allow him a business standing.

Winchester, Ky., Jan. 16, 1923. **Rodman Wiley.**

Would Avoid Adjectives in Engineer Titles

Sir—Without special regard to the term "sales engineer," the writer would be glad to see the use of such expressions as "sanitary engineer," "concrete engineer," "bridge engineer," "sewer engineer," and the like—when employed, of course, as titles for the practising engineer and not as designations of a particular professional class—discontinued for all time. A much more dignified usage would be "engineer of bridges," "engineer of sanitation," "engineer of concrete construction," or "engineer in charge of such and such branch of work" as the case may be.

The writer remembers being discouraged by a prominent contractor from taking up the practice of sanitary engineering at graduation, his argument being directed against the title "sanitary engineer" and not of course against the professional practice. In another instance the chief of an important department of a large railroad company refused to be designated by the title "bridge engineer" and insisted in correspondence that he be addressed as "engineer of bridges" at all times. The abridged titles that have been enumerated doubtless were originated with intent to emphasize by the shortest route certain special knowledge possessed by the holder. Too often, however, the effect is opposite to that intended, and one may assume that the professional outlook of the engineer in question may be quite restricted. These points are for the most part merely formal, but the writer believes that they should be emphasized and insisted upon by those who have the dignity and advancement of the engineering profession at heart.

Ames, Iowa, J. H. Griffith.
Jan. 24.

Suggested Relocation of Automobile Headlights

Sir—The regulation of automobile headlights is one of the biggest problems that traffic officers will have to solve. It is always a nervous strain to drive at night on even a moderately traveled road, because there is a glare from the lights of every passing car, even though they have special lenses; and nowadays it seems to be considered a disgrace ever to change to dimmers when passing. At a speed of 25 or 30 miles an hour, which will be reasonable upon our improved roads, there must be good illumination for 100 to 150 ft. in front of a car in order to allow time for stopping in case of an obstruction.

The present headlights are placed at a height of only 2½ or 3 ft. from the ground, with the result that some of the light rays must be almost horizontal if they are to illuminate the road for any distance ahead. However, since the rays can be concentrated to as small an area as desired, why not point the lamps downward, and concentrate them so that the center of the beam would strike the road 100 or 150 ft. away, with the top of the beam striking about 200 ft. away? There would then be no rays pointing straight ahead to blind an approaching driver, and the road would get the full effect of the lights.

But it would be still better to place two smaller lights, one of them movable, at the upper corners of the windshield, incorporating them in the general design of the car, and doing away with the lower headlights. They would be 5 or 6 ft. from the ground instead of 2½ or 3 ft. thus affording better illumination of the road and less possibility of glare ahead, and with one of them movable, like the very useful spotlight, they would give every service desired of a headlight, and at the same time there would be none of the glare and discomfort which are caused by headlights as they are now placed.

This would be a somewhat radical design, as headlights have had their present position since automobiles were first designed (one of the reasons, perhaps, why they are unsatisfactory today), and it might require some change in the design of the windshield and its bracing; but the problem would be easy compared to most problems that have been solved by automobile designers. The change in the appearance of the car would not be nearly so noticeable as has been caused in the past by changes in design. Objections such as these would not count if the lights accomplished their purpose of eliminating the dangerous glare.

These suggestions might not solve the headlight problem completely, but if they were carried out they would make night driving much more pleasant and very much safer, and it is certain that some change will have to be made soon in the headlight laws if accidents at night are to be prevented.

John C. Allman,
Resident Engineer,
Illinois Division of Highways.

Carbondale, Ill., Jan. 19, 1923.

Reaction Against Road Expenditures

Sir—In *Engineering News-Record*, Nov. 23, 1922, p. 886, the editorial entitled "Reaction against highway expenditures" has been, to me, very interesting as it is an answer, in part, to a question which has been frequently asked in the last few years, "How far will the public go in its expenditures for improved highways." Although this review does not answer this question wholly and a complete answer to the question is impossible at the present time, nevertheless it does answer in so far as it shows that a large part of the people have reached that point where they are beginning to ask the question and the very fact of their so doing is proof that if the peak of construction has not been reached or is not in sight, at least such construction is going to be examined from the point of practical need rather than impractical desire.

Some years ago the construction of improved highways was a county proposition. Then it became a state proposition although largely controlled by the county unit. Today it is an interstate and nation-wide proposition yet controlled to some extent by the county unit.

It seems to me that you might well have added a seventh "line" to your table at the bottom of the second column, which would have read something as follows:

7. Ignorant and unjust criticism of the public or taxable units by state highway officials.

It sometimes seems as if the fact that public works are carried on with moneys obtained by taxation and that taxes are paid by the public and levied and collected by and through the authorized political agents (authorized agents or representatives frequently derogatorily spoken of as "the politicians"), is overlooked. That the very life blood which permits the highway departments to grow and function, is furnished by bodies of men who are honored by being chosen to govern us, and in the next breath we dishonor them by sneeringly calling them politicians when to be a politician by the first definition of the word is one of the most honorable professions in the world.

Might I suggest one other "line" to be added to the above mentioned table at the bottom of p. 888 as follows:

8. Learn the first definition of the word politician as given in Webster's Unabridged Dictionary and teach it and practice it whenever possible.

This article in the *Engineering News-Record* is primarily an article to officials and employees of State Highway Departments but the *News-Record* is not read only by these men but frequently gets into the daily papers through quotation and thereby your statements become matters of public reading and interest. It is not necessary for me to go into a detailed explanation of the following suggestion and the reasons therefore. Therefore I will only suggest that there also be added one more "line" to the aforementioned table as follows:

9. That public officials in dealing with highway situations in their respective states or districts do not publicly condemn the entire system or department upon the acts of one official or the condition of one piece of road a few miles in length.

"Keep the public sold on highways" but keep them sold by honest representation of the product and welcome honest and intelligent criticism as earnestly as you oppose dishonest and ignorant criticism. T. M. Ripley.

Hornell, N. Y., Jan. 18, 1923.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Director Roberts Resigns in Cleveland

Mayor's Retrenchment Campaign Turns To Arbitrary Meddling With Water Department

Staff Correspondence

On Feb. 5 Arthur B. Roberts, formerly a member of the consulting engineering firm of Withington-Roberts-Wright Co., and during the past year Director of Public Utilities of the City of Cleveland, resigned from the city service, together with his first assistant, George W. Kneisly, as the result of personal antagonism developing between them and Mayor Kohler through the mayor's interference with the operation of the water department, which was in Mr. Roberts charge. The resignation is the outcome of long-continued turmoil and progressive disorganization in the technical and other departments of the city government initiated by the mayor during the past year in execution of his purpose to economize in the cost of running the city government. Previous events in this reorganization so far as the technical departments are concerned, were the dismemberment of the technical staff of the sewage-disposal branch, the death of the assistant chemist through an accident due to his having to undertake unfamiliar duties, reduction of the operating force at the sewage and water purification plants, salary reductions, and other items of reorganization in the service and utilities departments.

EXPENDITURES EXCEED INCOME

Municipal expenditures in Cleveland for several years past have exceeded the city income, and during the past half dozen years Cleveland has accumulated a bond indebtedness between $5,000,000 and $10,000,000 on account of running expenses. The Kohler administration, beginning with 1922, undertook to reform this condition by sharp curtailment of expenditures, including reduction of force and of salaries in various departments, the virtual abolition of the force of the Park Department, and the like. As a result, it was recently announced by the mayor, the city lived within its income during 1922. The reorganization and retrenchment measures, however, are said to have been unwise and not merely ineffective but harmful in a number of instances, and in their later developments to have jeopardized the efficiency of the city's technical work in vital manner. They were applied in dictatorial and offensive manner and aroused resentment among the department heads.

Political factors are also claimed to be involved. The preferential voting system instituted in Cleveland at the last election destroyed local machine control and enabled Kohler, former chief of police and later dismissed on charges, to carry the election. It is charged that the methods used in the administration during the past year have in part been due to a desire to develop political dictatorship. A further factor in the matter is that with the beginning of 1924, city manager government will be instituted.

Chief among the points of contention that led to the resignation of Director Roberts were the demand of the mayor that the engagement of J. W. Ellms as consulting engineer of water purification be terminated, that contracts for auxiliary works at the Baldwin reservoir and filtration plant be awarded to the general contractor for that plant, and that the offices of the Water Department be rearranged to suit the mayor's ideas. A contract had just been awarded by the Water Department for a special-brick chimney at the filtration plant, to cost $12,000, and the award of this contract to an independent contractor was a special object of the mayor's attack, who demanded that the general contractor's bricklayers should build the chimney. Mr. Ellms has been in advisory charge of the operation of the water filtration plants since 1916, with liberty to carry on outside work. A year ago the city entered into a contract for his half time services in directing the filter plant operation, to cover 1922 and 1923. The mayor roundly declares that "Ellms is no good" and that he is not worth 50 cents a day, and has ordered the city treasurer to hold up his pay.

Last Headings on Shandaken Tunnel Holed Through

The last pair of headings on the Shandaken tunnel of the Catskill aqueduct for New York City's water supply were holed through at 3 a.m. Feb. 13, between Shafts 2 and 3. This event marks the opening up of a continuous stretch of 18¼ miles of tunnel for the delivery of water into the Ashokan reservoir.

Thaddeus Merriman is chief engineer and the Shandaken Tunnel Corp. (Ulen Contracting Corp.) is the contractor.

Louisville Company May Get Ohio Power Rights

Washington Correspondence

Judging from arguments presented at a hearing before the Federal Power Commission and by the apparent attitude of Secretary Weeks, its chairman, it is presumed that ultimately an award for power rights at the Falls of the Ohio River will be made to the Louisville Hydro-Electric Co. The city of Louisville is contesting the company's argument to be granted such power rights. Arguments for the Louisville Hydro-Electric Co. are based on the fact that it already has in operation a new unit which will furnish an additional 30,000 hp. With this installation it is in a position to make the best use of the variable power to be developed at the dam, it was contended.

Michigan Engineers' Society Gets Public Contact

Meeting Augmented by Industrial Show—Legislation and Deep Waterway Symposium

Engineering News-Record Staff Report

Muskegon, Mich., knows a convention of professional engineers was held there Feb. 7, 8 and 9, if the record-breaking attendance of laymen at an engineer's meeting is any criterion. At a Rotary Club luncheon, at a Kiwanis Club luncheon, at the society's annual banquet and dance, at the industrial exhibition, where 34 firms showed the tools, works and equipment of the engineer, and at the civic banquet in the Elks Temple attended by nearly five hundred representative people of the city, the members of the Michigan Engineering Society, which is the state division of the American Association of Engineers composed of eleven chapters, obtained a contact with the citizen seldom experienced. Chapter achievements, drainage legislation, building-code operation, waste disposal, stream pollution and resort sanitation, lowering the lake levels by the Chicago drainage canal and an extended symposium on the Great Lake-St. Lawrence deep waterway were features of the program.

CHAPTER ACTIVITIES

In the symposium on chapter activities Port Huron, Saginaw, Pontiac, Lansing, Detroit, Ann Harbor, Flint and Muskegon were reported in a flourishing condition, handling local civic activities and making the engineer's influence felt as a citizen. Muskegon was awarded first honors because of the opportunity it afforded the society of an unexampled contact with the public. Grand Rapids is just emerging from a struggle with constitutional difficulties in working out an amicable arrangement with the local club of 150 members. Battle Creek is a new chapter. Cadillac did not report.

Thanks to the official publication the society has recently climbed out of debt and expects soon to put the secretary, C. B. Huff, back on a full-time basis. He reported 65 new members, 21 resignations and 70 dropped (most of whom had left the state) and 50 per cent of his time given over to the service department. The state organization wants less money spent on national conventions by concentration of representation from other states. This plan is exemplified by Michigan when only three delegates are sent from the eleven chapters. The Salt Lake convention cost about $1 per member.

In the newly-adopted constitution and by-laws explicit support is given to the engineers license law and the Board of Examiners. Two cases of violations are under consideration by the board.

In the symposium on the Great Lakes-St. Lawrence waterway six papers and an introduction giving the present status of the problem were presented. Gardner S. Williams, in reviewing the situation, indicated favorable sentiment from the North Central states, those in the Northwest and West and in western Canada, with New England favorable by a small margin. The South and Pacific States are indifferent. Active opposition centers in New York with support from Atlantic Coast shipping and railroads east of the Mississippi River. Before the papers are printed, Mr. Williams, who has charge of the symposium, hopes to have investigated a government-built railroad of four tracks from the Middle West to the Coast over which the railroads would be allowed to run their trains without charge. Private rather than federal financing of the St. Lawrence project seems the more likely at present.

The following contributions to the symposium were made: F. C. Shenehon, vice-president, H. M. Byllesby & Co., gave fundamental physical and hydrographic data, and stressed the inevitability of the development. Henry Holgate, consulting engineering, Montreal, asserted that improvement of present waterways to 22-ft. depths is the next step in navigation, further improvement not being imperative now. Herbert C. Sadler, professor of marine engineering and naval architecture, University of Michigan, was of the same opinion as Mr. Holgate as to ocean liners sticking to the ocean. From 60 to 70 per cent of the vessels of the world could use a 25-ft. channel and 70 to 90 per cent if it were 30 ft. M. G. Barnes, chief engineer, division of waterways, Illinois, made a plea for the development of the Mississippi pending the completion of the St. Lawrence project. Lewis M. Haupt, consulting engineer, Cynwyd, Pa., answered the layman's objections with reviews of former projects. A paper by Hugh L. Cooper, consulting engineer, New York, on the power development presented a year ago before the American Institute of Electrical Engineers, will be included in the symposium which the society will print and distribute.

SANITARY ENGINEERING

Of the sanitary engineering subjects, S. A. Greeley, consulting engineer, Chicago, in discussing garbage problems stressed the point that the unfortunately large record of failures in refuse collection and disposal warrants much greater attention to the engineering details in the development of the various projects. Major E. D. Rich, state sanitary engineer, outlined the comparatively new methods of collection at Lansing, where city-owned flared cans, easy to nest, are washed in boiling water at the piggery 5 miles from town before return to the householder.

E. F. Badger, chemical engineer, State Department of Health, spoke on the nuisance and injurious effects of concentrated industrial wastes on fish life. So badly polluted have some rivers become that the department recently ordered six cities to prepare plans for treatment of wastes. Resort sanitation came in for an extended discussion with an account of the work done by the motorized laboratory as described in *Engineering News-Record*, Sept. 14, 1922, p. 430.

J. G. D. Mack, state engineer of Wisconsin, outlined the status of the lawsuit between Wisconsin and the Sanitary District of Chicago over the lowered lake levels due to alleged unlawful withdrawal of water beyond the 4,167 sec.-ft. permitted by the government. Mr. Mack stated that the governor had sent him to Michigan to learn whether Michigan was interested.

Prof. Clarence T. Johnson, University of Michigan, gave the fundamental considerations in an ideal drainage law on which the society's legislative committee (H. L. Hudson, consulting engineer, Highland Park) and the County Drain Commissioners Association are at work.

Newly-elected officers of the society are as follows: President, James R. Rumsey; vice-president, C. E. Wood; treasurer, H. A. Shuptrine; and L. E. Ayres, director-at-large.

Six-Year Index

To make the contents of past volumes available quickly *Engineering News-Record* has compiled a complete, classified index of articles published during the period 1917-1922, inclusive, beginning with the first issue of the journal formed by the consolidation of *Engineering News* and *Engineering Record* on April 5, 1917.

The index will be published in March. It has been prepared solely as a service to readers. The edition is limited but while the supply lasts will be sold for $3. With each order for the 1917-1922 index will be sent free one of the 1910-1917 indexes of *Engineering News*, a limited supply of which is on hand.

Orders for the index should be sent in immediately, addressed to: "Index Editor, Engineering News-Record, 10th Ave. at 36th St., New York, N. Y."

Kansas Engineers Favor Uniform Traffic Regulations

Highway construction and traffic regulation were prominent features of the annual meeting of the Kansas Engineering Society, held at Topeka, Kan., Dec. 14 and 15. Resolutions were adopted urging adoption by the state legislature of regulations covering the weight, speed and size of motor vehicles; also laws governing traffic regulation, such laws to apply uniformly throughout the state and to conform to those of other states. In view of increasing motor vehicle traffic the Society also favored a continuance of federal aid and a state system of highways in compliance with the federal-aid law. Papers presented included the following: "Economical Floor Systems and Reinforcement of Steel Bridges," Ira E. Taylor; "Drainage and Flood Protection in Kansas," Clark E. Jacoby; "Use of Tractors in Road Construction and Maintenance," L. E. Curfman; "Quality of Concrete for Highways," Roy A. Seaton; "Problems of the Engineering Profession," Lloyd B. Smith. The officers for 1923 include the following: President, P. L. Brockway, city engineer of Wichita; vice-president, L.E. Curfman, State Normal College, Pittsburg, Kan., secretary, C. P. Buck, vice-president of the Perfection Metal Products Co., Topeka, Kan.; new member of executive committee, F. W. Epps, bridge engineer of the State Highway Department. The next meeting will be held at Wichita, Kan., but the date was not decided.

New York Road Builders Face Big Year

Meet at Annual Banquet and Discuss Problems Looming as Result of Heavy State Program

Engineering News-Record Staff Report

On the eve of his leaving the office of state highway commissioner, Herbert S. Sisson was the guest of the New York State Road Builders' Association at its sixteenth annual banquet held in Albany on Feb. 7. The incoming commissioner, Col. Frederick S. Greene, whose appointment had been confirmed only that day, was expected also, but he was unexpectedly called from the city.

Commissioner Sisson acknowledged the co-operation accorded to him by the contractors engaged on the state road work, and emphasized the advantage derived by the state from having its highway construction in the hands of contractors working under conditions that insure them a reasonable profit. He reminded those who would have public officials run their offices as they would "their own business" that should any official attempt such a departure he soon would find himself either removed from office or in jail. Mr. Sisson extended his best wishes to his successor.

John H. Gordon of Albany, president of the association, presided. Other speakers were, T. Warren Allen, former state commissioner and now in federal aid work; H. K. Bishop, also with the Federal Aid Bureau in Washington; Guy Miller, district engineer on federal aid projects in the Eastern states; William Hill, president, Pennsylvania Highway Builders' Association, and Fred E. Ellis, president, Massachusetts Road Builders' Association and a trustee of the New York Association.

All dealt constructively with the problems that confront the highway construction industry, including labor shortage, rising costs and the need for closer co-operation between contractors, engineers, commissioners, and the manufacturers of materials and equipment. Mr. Ellis pointed out especially that the contractor is necessarily in the position of a "short seller" who, every time he takes a contract, must sell that which he does not then own and which he must create in future markets.

Portland Engineer To Build Willamette River Bridges

R. E. Kremers, principal assistant city engineer, of Portland, Ore., and who has also been bridge engineer and chief of the bureau of construction in that city, has been appointed by the Multonomah County commissioners to direct the work of building the Burnside and Ross Island bridges on the Willamette River for which $3,000,000 and $1,600,000 respectively were voted last November. The work will be under the jurisdiction of the Board of County Commissioners, although the City of Portland contributes to the extent of about 93 per cent of the Multonomah County taxes.

The contract under which the work is to be carried on had not been officially signed on Feb. 3, but it was expected at that time that the contract would be entered into very soon.

New Jersey Highway Commission Nominated by Silzer

Following the passage by the New Jersey legislature on Feb. 13 of the new law creating a bipartisan state highway commission of four members, Governor Silzer has sent the following nominations to the Senate: General Hugh L. Scott of Princeton, republican, two years; Percy Hamilton Stewart of Plainfield, democrat, two years; Walter Kidde of Montclair, republican, four years; and Abraham Jelin of New Brunswick, democrat, four years.

Mr. Jelin's public life, according to the executive's statement, has been limited to holding the office of street commissioner in New Brunswick from 1910 to 1913 and that of assessor there since 1915. He is a real estate operator and contractor and said to be thoroughly acquainted with road building.

Mr. Kidde is an engineer and president of Walter Kidde & Co., of New York. He also heads the Barlow Foundry of Newark and is a director of the Street & Apparatus Co. of New York, and other corporations.

Mr. Stewart is a former mayor of Plainfield and in 1919 was appointed by Governor Walter E. Edge to the State Board of Education. He was renamed by Governor Edwards in 1920.

General Scott is known not only for his long service in the United States Army but for his work among the Indians in the West. He was Chief of Staff in 1917 when he retired, but was recalled to the service and placed in command at Camp Dix until May, 1919. He has had wide experience in the building of roads in Cuba, the Philippines and the United States.

Organize Regulating District for Upper Hudson

Pursuant to the river regulation section of the state conservation law, the Water Control Commission of New York state has, upon the petition of several interested communities, established a regulating district for the watershed of the Hudson River, extending from its headwaters to the vicinity of Ravena, about twelve miles below Albany. In addition to that city, the district includes Troy, Watervliet, Cohoes, Glens Falls and other important communities. The board of the regulating district, appointed by the governor, consists of Henry M. Sage, president; Edgar H. Betts and Erskine C. Rogers. Ranulf Compton has been appointed secretary-treasurer and E. H. Sargent engineer to the board.

River regulating districts in New York state are created, according to the terms of the conservation law, for the construction, maintenance and operation of reservoirs to regulate the flow of streams when required by the public welfare, including public health and safety. The districts are public corporations, having among other powers, that to exercise the right of eminent domain, to issue bonds and to levy assessments and taxes upon properties that are benefited by the regulation works. The Black River Regulating District has already been established under this law.

Technical Society Booklets Ready for Distribution

Engineering News-Record has prepared for free distribution booklets containing essential information on about 300 national, state, district and local technical societies. Data in the booklets contain the names of the president and secretary of each society, the date of the annual meeting and the approximate membership. The booklets may be had by addressing "Editorial Department, Engineering News-Record, McGraw-Hill Co., 10th Ave. at 36th St., New York City."

Public Roads Bureau Approves Perth Amboy Bridge Plans

Plans for the new Perth Amboy bridge across the Raritan River, in New Jersey, have been approved by the U. S. Bureau of Public Roads. This bridge, to be constructed by New Jersey with Federal aid, at an estimated cost of $3,000,000, will carry the traffic from the metropolitan district of New York to the south, a large part of which is bound for Philadelphia and New Jersey coast resorts. The structure is to replace one constructed in 1906 which is no longer adequate in width of roadway or strength to carry modern traffic. The new bridge will consist of 1,089 ft. concrete viaduct, 1,538 ft. of steel plate girders, a 360-ft. swing draw, and 5,490 ft. of earth fill approaches. The roadway will be 38 ft. wide to accommodate four lines of traffic with sidewalks on each side. Construction will be commenced during the coming season.

Frank Page Nominated as Road Builder's President

Frank Page, chairman of the State Highway Commission of North Carolina, has been nominated by the nominating committee of the American Road Builders' Association as president for the 1923-24 year. Other nominations include: For vice-president, E. L. Powers, W. F. Keller, S. F. Beatty, and Samuel Hill; for treasurer, James H. MacDonald; for directors, one-year term, J. R. Draney, W. A. Van Duzer, and Frank Sheets; for directors, two-year term, E. J. Mehren, I. W. Patterson, William R. Smith, H. K. Bishop, J. H. Cranford, C. M. Babcock, and H. S. Carpenter; and for directors, three-year term, S. T. Henry, R. Keith Compton, Fred A. Reimer, Charles M. Upham, H. G. Shirley, Will P. Blair, and Frank Terrace.

Conference on Interstate Highway Co-operation Is Pinchot Plan

Invitations to the governors of all states have been issued by Governor Pinchot of Pennsylvania to send representatives to a highway conference at Harrisburg, Pa., on March [illegible] and 24. The purpose of the conference will be to consider the policy and practice of state highway construction, methods of state highway maintenance and the whole problem of traffic regulation.

News Brevities

The next convention of the American Society for Municipal Improvements will be held at Memphis, Tenn., Nov. 12-16. Charles C. Brown, St. Petersburg, Fla., is secretary, and W. W. Horner, St. Louis, Mo., president of the society.

Headquarters of the Canadian National Railways are to be established in Montreal. This decision ends speculation rife during recent months as to whether the roads would be administered from Ottawa, Toronto or Montreal.

Amalgamation of the Grand Trunk Ry. with the Canadian National Railways has ended the individual existence of the former road, which for more than sixty years has been one of the chief transportation systems of the Dominion.

The American Association of State Highway Officials has opened general offices in Washington, D. C., in the Munsey Building. W. C. Markham, former legislative expert with the Bureau of Public Roads, is in charge. His title is that of executive secretary.

At the recent annual meeting of the American Institute of Consulting Engineers C. W. Leavitt, New York City, was elected president, and Allen Hazen was elected vice-president. Col. F. A. Molitor continues as secretary.

A bill was introduced into the New York Legislature last week, by Assemblyman Vaughn, by which the New York State Bridge and Tunnel Commission is empowered to investigate the desirability of a bridge or tunnel between Tottenville, Richmond County, and Perth Amboy, N. J., for pedestrians and vehicular traffic.

The Washington Committee on Public Utility Information has been formed with offices in the Henry Building, Seattle, and E. H. Thomas, director of the committee. The committee is backed by private light and power companies of the state, and interurban electric lines. The purpose of the bureau is to promote better relations between the utilities and their customers, and to give the public such utility information as it may desire.

Special Rule Sought for Navy Contractors' Relief Bill

Having reported with amendments a bill for the relief of contractors and material men who had fixed-price contracts with the Navy Department during the war and suffered loss through priority orders, wage awards or other directions of a governmental agency, the House committee on naval affairs will ask a special rule for the consideration of this measure before adjournment of the present session of Congress.

A bill of this character has been before one or the other branch of Congress for nearly three years without coming to a vote. The present bill recommended by the House committee is that which was passed by the Senate [illegible], although amendments have been made by committee.

St. Louis Votes $87,372,000 Bonds for Municipal Improvements

By popular majorities exceeding the necessary two-thirds the voters of St. Louis, Mo., on Feb. 9, approved 20 out of 21 items for sewerage, water-works, paving, buildings, and other municipal improvements. The approved items total $87,372,000. The item defeated was $1,000,000 for a National Guard Armory.

The items voted on were arranged on the ballot in an apparently haphazard fashion, numbered from 1 to 21. In the accompanying table showing the 20 items that carried, the items have been classified by main objects and the totals under each class supplied.

The total number of votes cast was approximately 90,000 against a registration of about 275,000 (including women) at the election last November. The highest vote cast for any one item was 77,170 for $12,000,000 of water-works enlargements, the negative vote being 12,325. Next to this was 77,162 for $4,500,000 of hospital additions, but here the adverse vote was higher, being 12,905. The least popular project, besides the defeated National Guard Armory, was the small item of $400,000 for an aquarium in Forest Park, which carried by a vote of 62,633, to 27,919. The $6,000,000 item for a memorial plaza and hall had next to the lowest majority, the vote being 64,080 to 25,789.

ST LOUIS BOND ISSUES AUTHORIZED AT ELECTION ON FEB. 9

No.			
6	River Des Peres Improvement (sewerage)	$11,000,000	
5	Sewer construction	8,000,000	
			$19,000,000
	Buildings, including in some cases sites and equipments		
13	Municipal auditorium and community center	5,000,000	
12	Additions to hospitals	4,500,000	
5	New court house and site	4,000,000	
20	Reconstruction public markets	1,250,000	
11	Municipal power and service building, including machine shop, garage, and laundry for municipal requirements	1,000,000	
15	Fire engine houses and equipment	772,500	
10	Aquarium	400,000	
			17,922,500
1	Street opening and widening (city's share)	8,650,000	
3	Paving, repaving and improving streets	5,800,000	
			14,450,000
21	Water-works enlargements:		
	Missouri River plant, including pumping station, pumps, etc	5,100,000	
	Conduits and right-of-way	1,977,500	
	Reservoir	1,150,000	
	Distributing mains	2,740,000	
	Contingencies	1,032,500	
			12,000,000
4	Street lighting equipment		8,000,000
	Municipal plaza and buildings		6,000,000
8	New public parks, playgrounds, recreation fields and swimming pools—land buildings, etc.	2,500,000	
9	Improvements to old public parks, etc.	1,300,000	
			3,800,000
17 & 18	Approaches (railway) to Municipal Bridge		3,000,000
2	Union Station plaza		2,600,000
16	Grade crossing elimination—city's share		1,600,000
Item 19, $1,000,000 for National Guard Armory, defeated.			$87,372,500

Five-Year Construction Plan for Bluefield, W. Va.

A five-year municipal improvement plan for Bluefield, W. Va., with a series of tables exhibiting the plan in detail, showing how it might be financed and how it would affect the tax rate year by year, has been submitted to the city directors by Clarence C. Ridley, city manager. The plan provides for a total expenditure of $750,000, of which over $400,000 is for sewers, about $150,000 for paving, $100,000 for parks and playgrounds, and the remainder for buildings and minor work. A topographical survey of the city has been made and consulting engineers are working on plans for a comprehensive sewerage system.

Transportation Survey to Be Made in New England

Washington Correspondence

Much importance is attached, at the Bureau of Public Roads, to the transportation study which is to be made in New England by the Joint New England Railroad Committee. This survey is to cover railroad, highway and waterway transportation, with the idea of developing methods for their correlation.

The executive committee, which will direct the work, is headed by James J. Storrow, of Boston. Other members are James F. Dewey, representing Vermont; George L. Crooker, Rhode Island; E. Kent Hubbard, Connecticut; Carl E. Milliken, Maine, and Lester F. Thurber, New Hampshire. A. B. Fletcher has been brought on from California to take immediate charge of the study of highway transportation.

National Museum of Engineering and Industry Planned.

A joint committee on a national museum of engineering and industry appointed by the four Founder Societies is formulating a plan for a national museum of engineering and industry with a large central institution and local branches in different sections of the country, with exchange facilities.

This museum for the United States will be similar in plan and educational purposes to the Science Museum, London, and the Conservatoire des Arts et Metiers. Paris, but will be on a larger scale.

The project has the co-operation of the Smithsonian Institution in Washington, D. C., and will be developed with the assistance of the Federated American Engineering Societies.

The members of the Joint Committee are: Edward D. Adams and Charles L. Clarke of the American Institute of Electrical Engineers; Frederic A. Delano and Dr. George F. Kunz of the American Institute of Mining and Metallurgical Engineers; Clemens Herschel and Nelson P. Lewis of the American Society of Civil Engineers; and Reginald P. Bolton and Holbrook F. Porter of the American Society of Mechanical Engineers.

Steel Unit Stresses Discussed

Arguments in favor of analytical study of the factors which should determine working stresses in steel structures were expressed in a discussion of the subject before the structural subsection of the New York Section, American Society of Civil Engineers, on Jan. 31. Several speakers took the view that increase in working stresses for steel in building service requires no study of safety factors but is justified by the improvement in steel manufacture since the days when the present 16,000-lb. unit stress first came into use. A rather different view was taken by others, who advocated high unit stresses on the basis of making full provision for each of the attacking forces and other service elements, providing in each for the contingencies that may affect it, rather than providing for these contingencies in a reduced unit stress. Thus, the chance of increase of load is to be provided for in the assumed loading rather than in a lowered unit stress. The question of whether the effective ultimate strength of steel is the elastic limit or a higher value was also discussed, with some disagreement of opinion. The opposite cases of transmission towers and steam turbine foundations were cited as instances of the failure of ordinary considerations governing unit stresses. Transmission towers are frequently designed for working stresses equal to the yield point of the material, a practice which is successful because of the small chance of overload and the economic necessity of light design. Turbine foundations, on the other hand, are always designed with very low unit stresses, because rigidity is an essential and foundations designed for normal unit stresses have been found to lack rigidity. Some attention was also given to the subject of making special allowance (of thickness) for corrosion. However, a case was cited of the beams in the concrete floor of the ice cream room of a restaurant, which on alteration of the building were found to be almost entirely gone, illustrating that in many cases corrosion must be prevented by waterproofing or other protection rather than allowed for by extra metal.

To Survey Traffic Needs Between Los Angeles and Harbor

Richard Sachse, chief engineer, California Railroad Commission, will serve as chairman of a joint committee which is to conduct a study of transportation developments between the City of Los Angeles and the harbor at San Pedro. Other members of the committee are H. Z. Osborne, chief engineer, Board of Public Utilities, and J. W. Ludlow, harbor engineer of Los Angeles. The joint action was agreed upon after the city council had passed a resolution calling for a report that would give "careful consideration to the proposition of obtaining a unified railroad system between the city and the harbor, either under municipal control or private control, as the interests of the public may demand, having in mind all dangerous grade crossings now existing and speedy and adequate movement of freight to and from the harbor. In view of the magnitude of this problem the conclusions are to be returned at as early a date as possible."

Engineering Societies

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 13-15.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

American Waterworks Association, Canadian Section will have its annual convention at Toronto, Feb. 22 and 23. C. D. Brown, Walkerville, Ont., is secretary.

The Boston Society of Civil Engineers in its meeting February 21, will have a "Symposium on City Pavements."

The Engineers Society of Pennsylvania will give a smoker Feb. 17, in honor of Governor Pinchot, who has long been a member of the society.

Personal Notes

E. H. SARGENT, formerly in charge of the Bureau of Water Power in the State Engineer's department of New York state, and engineer for the New York Water Power Commission, has been appointed engineer for the Hudson River Regulating District, with headquarters at Albany.

H. G. PERRING has resigned as chief engineer of Baltimore to become supervising engineer of the Public Improvement Commission, which is charged with the responsibility of disbursement of the $55,000,000 loan for public improvements in the city of Baltimore, including the school building program, covering the expenditure of $22,000,000.

SANDERS & SWEENY, consulting engineers of Anderson, S. C., have dissolved partnership. **F. R. SWEENY**, of the above firm, has organized a new engineering firm under the name of F. R. Sweeny & Co., to enter into a practice of civil, mechanical, electrical and industrial engineering, paying particular attention to textile engineering.

NEWTON A. K. BUGBEE, secretary-treasurer of the Newton A. K. Bugbee Company, engineers, of Trenton, N. J., has been reelected State Comptroller of New Jersey by a joint session of the Legislature for a three year term. Mr. Bugbee has held the office for several years.

CLOYD M. CHAPMAN has become affiliated with Dwight P. Robinson & Co., Inc., as consulting materials engineer. Mr. Chapman, who has been active in the work of the American Society of Testing Materials and the American Concrete Institute, will in the future represent Dwight P. Robinson & Co. in the societies' committee work

FREYN, BRASSERT & CO. have been engaged as consulting engineers by the Columbia Steel Corp. of San Francisco for the construction of a new blast furnace plant at Provo, Utah.

FRANK A. RANDALL, formerly of Berlin, Swern & Randall, Chicago, announces that he will continue independently the practice of structural engineering in Chicago.

H. N. RODENBAUGH, chief engineer of the Florida East Coast Ry., has been appointed general manager of the road, succeeding the late **J. F. BECKWITH**.

EARL WHEELER has become vice-president of the Roger Black Company, Inc., engineering and construction, New York City. Colonel Wheeler was formerly director of electrical and mechanical engineering of the Engineer School, U. S. Army, and for several years local manager of the General Electric Co.'s sales office at Washington. During the war Mr. Wheeler was successively a major and a lieutenant-colonel, connected with the procurement and distribution of engineer supplies. Later he was in charge of the engineering and purchasing department, responsible for all specifications, purchases and contracts, in addition to production; and still later, in charge of the general engineer depot at Washington. Since the war Colonel Wheeler has been engaged on engineering and financial promotion of foreign trade and public utility projects.

DR. THOMAS STOCKHAM BAKER, who for the past eight months has been acting president of Carnegie Institute of Technology, was recently elected president of the Institute. Dr. Baker succeeds Dr. A. A. Hamerschlag, who was president of Carnegie for almost 20 years. Dr. Baker has been secretary of Carnegie Tech since March, 1919. He is a graduate of Johns Hopkins University with an A.B. degree in 1891 and a Ph.D. in 1895. From 1895 to 1900 he was associate in German language and literature at Johns Hopkins and from 1900 to 1908, professor of German. In 1909 he became director of the Jacob Tome Institute at Port Deposit, Md., where he remained for ten years, leaving to accept the secretaryship at Carnegie.

EUGENE J. RIGHTS, for the past 14 years erection engineer for Lewis F. Shoemaker & Co. and the Shoemaker Bridge Co., has been appointed professor of civil engineering at the University of Porto Rico, Mayaguey, P. R. Among the difficult erection jobs handled by Mr. Rights were the wet dock crane for the American International Shipbuilding Corp., at Hog Island, Philadelphia, and the Newburyport Bridge for the Boston & Maine R.R., which was described in *Engineering News-Record* of Dec. 7, 1922.

ALBERT A. NACK has resigned as building inspector for the city of Sheboygan, Wis., and will engage in the contracting and engineering business in that city.

THEODORE B. PARKER, formerly assistant hydraulic engineer for the Electric Bond & Share Co., and, prior to that position with the Utah Power & Light Co., has entered the hydraulic division of Stone & Webster, Inc., of Boston, Mass.

M. H. CUTLER, formerly of the Turner Construction Co., and the Morrison Skinner Co., has entered the organization of Stone & Webster, Inc., Boston, Mass., as an engineer in the structural division.

THEODORE B. MOODEY, civil engineer of Greeley, Colo., has been appointed county highway and bridge engineer for Weld County, Colo., relieving John Wortham, resigned.

W. S. DAWLEY, formerly chief engineer of the Chicago & Eastern Illinois R.R., and also the Missouri & North Arkansas Ry., has assumed an interest in the McKelvey Construction Co., St. Louis, Mo. During the war Mr. Dawley served the United States Railroad Administration as field engineer for the southwest region.

EDGAR A. KINGSLEY, who has been a consulting engineer at Little Rock, Ark., has joined the organization of Benham Engineering Co., Kansas City, Mo., and will be located in Oklahoma City, Okla.

Obituary

LE GRAND BROWN, deputy chief engineer of Rochester, N. Y., since 1919, and for many years identified with railway work in upper New York, died in Rochester, Feb. 8, aged 60 years. Mr. Brown began his professional career with what is now the Rome, Watertown & Ogdensburg R.R. in 1882. From 1884 to 1885 he was in Florida on land surveying and railroad location. Returning to Rochester he aided in the location of the Rochester branch of the Lehigh Valley R.R. In 1890 he was made chief engineer of the Rochester R.R. From 1891 to 1895 he was employed in engineering and construction work with the Rochester Water Works. Later he became engineer for the Rochester Ry., still later going to California to do consulting work.

H. J. SEAMAN, one of the pioneers in the portland cement industry and for many years general superintendent of the Atlas Portland Cement Co., died at his home in Ventnor, N. J., on Feb. 9 at the age of 64 years. Mr. Seaman was the co-inventor with E. H. Hurry of the famous Hurry-Seaman process of rotary kiln manufacture of portland cement.

HARRY R. RUST, contractor, Philadelphia, Pa., died suddenly Jan. 21, aged 56 years. He was born in Bedford, England, but came to this country at an early age. In 38 years in the contracting business in Philadelphia he had built many large commercial buildings and plants as well as school buildings.

BERNHARD E. FERNOW, who in [illegible] was made first chief forester of the United States, died recently in Toronto, Can., at the age of [illegible] years. In [illegible] he became dean of the school of forestry at Cornell and later was professor of forestry at other universities of this country and Canada, at the time of his death being professor emeritus of Forestry at the University of Toronto.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

More Suggestions—

For Better Equipment and Repair Parts Service

IN the Dec. 14 issue was begun a discussion of "Better Equipment Maintenance and Repair Parts Service," which has continued during succeeding weeks. Its object is to show how some of the misunderstandings between maker and user of construction machinery can be avoided. This week's contribution is a recital of experiences by a manufacturer of conveying and crushing machinery and electric locomotives.

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From the Jeffrey Manufacturing Co., Columbus, Ohio

BEFORE a manufacturer can fill a repair order he must have sufficient description of the part to be furnished properly to identify it. Simply to give a name does not help much and oftentimes adds confusion. Therefore, the first information necessary is the class of machinery, as parts of the same name are used on different classes of machines.

Next, the type of machine is required, for different types are gotten out to meet the different conditions in the field. As long as there is progress and development in machinery, just so long will new models be brought out, so that it is necessary to know the model. As there may be more than one size of the model or variations, these should also be noted.

In order to make all this more simple each machine is given a serial number or, if it is an installation of equipment which is more or less special for a particular job, it is given an order or job number which will identify it as that particular installation. This serial or job number should always be given in ordering repair parts.

Different parts of like name are often built into the same piece of apparatus, so that having located the record of the machine, one is at a loss to know just which bearing, gear or shaft, etc., is required. Sufficient description should be given to identify each particular part wanted.

USE PARTS NUMBERS

Catalogs, lists of parts or blue prints are always furnished the customer. These should be preserved and referred to when ordering. The part number given therein should be used. This will insure receiving the correct material and will save considerable time in looking up work after the order has been received by the manufacturer. This, in turn, will permit quicker delivery on the order. If a parts catalog is not at hand, then a full description should be given. For example, if a shaft is being

(Continued on p. 325)

Commerce Department to Help Study Lumber Industry

Washington Correspondence

An important step forward in the campaign looking to the elimination of waste in industry is about to be made. Plans are practically complete for a survey of the lumber industry with the idea of developing the wastes which can be eliminated profitably. Waste cannot be eliminated, to an important extent, by legislation. If it is to be prevented, it must be made profitable. The contemplated investigation will be made under a co-operative agreement between the Department of Commerce and the lumber industry and the plan is to extend this form of co-operation rapidly to other industries. It is believed that a systematic and nationwide study of wastes, by industries, will reveal many practical opportunities for the utilization of byproducts.

Associated Equipment Distributors Elect Officers

At its annual meeting in Milwaukee, Jan. 12-13, the Associated Equipment Distributors elected the following officers for 1923:

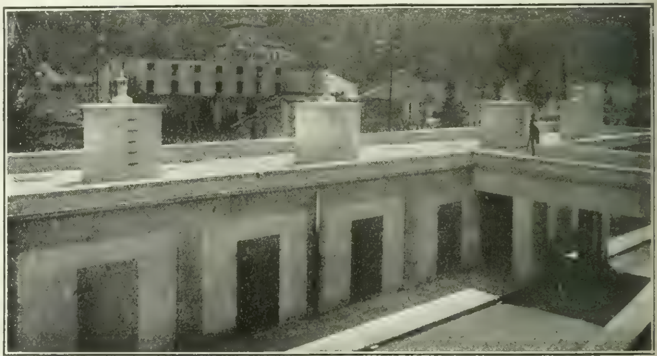
K. B. Noble, the K. B. Noble Co., Hartford, Conn., president; E. D. Townsend, Beckwith Machinery Co., Pittsburgh, first vice-president; William Bunting, Bunting Hardware Co., Kansas City, Mo., second vice-president; W. B. Louer, W. B. Louer Co., Chicago, treasurer; M. R. Hunter, Hunter Machinery Co., Milwaukee, secretary.

The foregoing officers, together with the following additional members, will constitute the new executive committee: F. B. Connelly, Billings, Mont.; R. H. Hyland, Chicago; D. M. Edgerly, Omaha; J. A. McDivit, Baltimore; George F. Smith, St. Louis; M. S. Seibert, Columbus; and William H. Ziegler, Minneapolis.

Italian Garbage Process Ready for Use in U. S.

New American Company Organized to Introduce Beccari System, Producing Fertilizer Byproduct

A GARBAGE disposal process of Italian origin, which produces by natural fermentation in a special type of aerated cell, a dry, inert mass possessing value as a fertilizer, is being introduced in the United States by the American Beccari Corp., New York City, a newly formed organization, headed by J. Waldo Smith, consulting engineer and formerly chief engineer of the New York Board of Water Supply which built the Catskill aqueduct. Associated with him are other well-known engineers, including Jules Breuchaud, vice-president of the new company and president of the Underpinning & Foundation Co., Inc.; James F. Sanborn, secretary, former department engineer on the Catskill aqueduct; John B. Goldsborough, general manager and Francis Pruyn, vice-president of the Underpinning & Foundation Co., and E. Payson Cooke, general manager. The corporation has been operating for several months an experimental plant in Paterson, N. J., although large-scale installations have been in service for some time in both large and small cities of Italy, including Florence, Naples, Genoa, Milan and Turin.



ONE OF THE BECCARI GARBAGE DISPOSAL PLANTS IN OPERATION IN ITALY

Charge is introduced through openings in roof and removed after conversion to fertilizer humus through lower doors; view shows ventilating towers.

The process has been developed by Dr. Giuseppe Beccari, Italian scientist and inventor, and is designed to handle garbage only—not mixed refuse. In the Beccari process the fermentation of organic matter in the garbage takes place in covered masonry cells, each about 10 ft. high and 8 x 9 ft. in plan, built generally in groups of four, and charged through openings in the roof. Liquids are drained off and a supply of air introduced through a slotted false bottom or grating with outlet connection to a sewer and air inlet ports. Extending horizontally around the inside of each cell are four continuous curbs or baffles projecting a couple of inches from the surface of the wall and spaced about 2 ft. apart. In each corner of the cell is a vertical air passage. The upper part of the chamber communicates with a tower several feet high

FOUR-CELL UNIT AT PATERSON, N. J.
Construction view of experimental plant showing corner air ducts and horizontal curbs around chamber.

containing four horizontal shelves or baffles on which are placed layers of absorbent earth and sulphate of iron, whose function is to fix the volatile products (nitrogen and ammonia) carried upward by the air current.

It is essential in the functioning of the process that air comes in contact with the garbage. The charge is introduced into the cell through an opening in the roof, after which air, entering through the ports under the false bottom, passes upward through the grating and corner air ducts and along the channels formed beneath the projecting curbs above referred to. The air leaves the chamber through the ventilating tower at the top. One of these towers serves a four-cell unit.

The garbage is allowed to remain in the cell from 35 to 40 days. The fermentation raises the temperature of the material to about 150 deg. F., during which chemical and bacterial action reduces the mass to the form of a dry, inoffensive humus, which is removed through doors in the bottom and disposed of as fertilizer.

Each cell may be charged with about 24 cu.yd. of garbage and the engineers of the Beccari company estimate that for a high-class residential community plant capacity may be figured on a basis of one cell per 1,000 population.

Advocates of this method of garbage disposal make the following claims for it: It creates no nuisance; it is extremely simple and cheap in operation having no mechanism or moving parts; it is a flexible system of units and as such is suitable for both large and small scale installations; it creates no dust, smoke or gases; it lends itself to locations at many points within a city thus reducing haulage; it produces a fertilizer the sale of which reduces cost of operation.

Construction Equipment Exported

According to figures given out by the U. S. Department of Commerce exports of power shovels and other types of construction equipment for November, 1922 were as follows: Nine power shovels valued at $127,953; dredging machinery totaling 193,090 lb. valued at $16,678; 9 cranes at $28,566; and 318 hoists and derricks value at $95,748.

Three of the power shovels, costing $32,387 went to Japan and two each to Rumania ($26,180) and Spain ($21,675). Egypt took one power shovel at $15,031. Brazil was the biggest consumer of dredging machinery, with shipments totaling 145,816 lb. Latin-America was the leading purchaser of cranes during November.

Equipment and Repair Parts

(Continued from p. 32[illegible].

ordered, the kind of metal, diameter, length, and size and position of keyways should be mentioned, together with any other additional information which may be necessary.

If a gear or sprocket is being ordered, the following should be noted: Kind of material; spur or bevel gear, or pinion; number of teeth; pitch diameter and pitch; face, bore, length and size of hub; keyseating dimensions, and size and number of set screw, if wanted. If there are any numbers or letters stamped on or cast into the parts wanted, it will be well to give them.

If the description cannot be made clear in writing the order, then a sketch should be drawn showing all dimensions and sent with the order. If it is not convenient or practical to make a sketch and it is possible to send a sample, this should be done.

CHANGED EQUIPMENT

If parts are ordered to change the equipment already installed the manufacturer should be notified so that he can change his records. This should be done regardless of whether the parts necessary to make the change are ordered from the original manufacturer of the equipment or not—that is, if you ever expect to order replacements from the original manufacturer—so that his records can be kept complete and up-to-date as to your requirements.

A customer desiring to make a change in his equipment sent in an order for some sprockets and chain which, on the face of the order, had all the indications of being a repair order. The description was insufficient to tell just what was wanted. A careful checking of previous orders showed that material resembling the description had never been furnished and it seemed evident that the customer had made a mistake. This was explained to him in a letter. He immediately replied that he knew what he wanted, had given sufficient information and directed this company to send on the material. He never mentioned the fact that a change was being made. There was but one of two things left to do—turn down the order, or make a guess. The guess was made that the customer was making a change and the material that would be required was shipped. The guess proved correct in this case. However, considerable time could have been saved both to the customer and manufacturer if the customer had been specific.

When second-hand or used machinery is purchased, the manufacturer should be notified and list of parts and other information necessary to the correct ordering of repairs should be obtained.

SHIPPING DIRECTIONS

Shipping directions must also be noted carefully. First, as to the way shipment is to be made—freight, express or parcel post—and, second, as to destination. Express companies refuse to receive shipments addressed to points where they do not have offices unless the shipment is addressed "Put off at owner's risk" at the station without an office. This fact is often overlooked, so that the shippers must choose the point with an office without having all of the information at hand. Local conditions often change, but these changes cannot be noted in a shipping guide which is only gotten out at stated intervals.

The Equipment Problem

From the report of the Committee on Methods presented at the annual convention of the Associated General Contractors in Los Angeles, Calif., Jan. 30-Feb. 3.

The development of construction equipment has progressed in the past with very little contact between the manufacturers and users of construction machines, and the breach between the two agencies has precluded many advantages to both parties that are obtainable through their joint study of the contractor's equipment needs. The contractor, on one hand, has felt at times that the equipment manufacturer tried to see how many different kinds of bolts and nuts he could incorporate into his machines and, on the other hand, the manufacturer has felt that the contractor was the most non-cooperative being in existence. This attitude is rapidly disappearing, however, and your Association has established a joint committee with leading equipment manufacturers to serve as a medium in bringing these two interests together and overcoming their difficulties through joint action.

At a joint meeting held in Detroit last October, which was attended by some 40 representatives of well-known equipment companies, a committee of 15 contractors and equipment manufacturers was appointed to investigate some 15 different subjects of mutual interest. The committee is to formulate recommendations concerning matters of business transactions that are capable of immediate determination, and to continue investigation of standardization and other matters that require more extensive deliberation.

The manufacturer has shown a hearty spirit of cooperation and your committee believes that continuation of the work of this joint committee will result in many benefits to construction companies in both their field operations and in the business end of construction.

Another question which is just as important as the specifying of material is the ordering of material on time. Do you wait until you are up against it or do you allow sufficient time to permit the manufacturer to get the material to you? This is especially important where material has to be made up. Every factory must have a certain amount of work on hand to operate economically. Orders must take their rotation through the shops. Rush orders always disturb the schedule. This means an increase in the cost of production and delay on other orders. Even if emergency orders are shipped from stock there is always more or less delay because of transportation.

It would, therefore, seem best for customers to make a careful inspection of all equipment at necessary intervals, note parts which are showing wear and which will require replacement in a short time, and order these parts at once. Note should be made, also, of parts that are apt to break and extras should be kept on hand as insurance.

AVOID "RUSH" ORDERS

Many lines of business are seasonal. Machines should be gotten in repair before the rush season is on. Yet this is often not done and consequently many orders are placed [illegible] of time and immediate delivery cannot be made in all such cases.

You may ask, "Why doesn't the

manufacturer prepare for this rush season?" He does, but his estimates may be off in some cases.

A number of similar machines may have been installed. During a slack period part of them have been robbed to keep the others going. These machines should be put in repair and arrangements made for the necessary material far enough ahead so that the manufacturer will have sufficient time to get the necessary parts out.

One of our customers had a number of machines. In order to keep a few going during a slack period, he robbed the others until nearly all of them were out of commission. He did not order parts until the rush season was on and then demanded that he be furnished sufficient parts on an emergency basis to put all of his equipment back into service. The only possible way this could have been done would have been to upset schedules and rob other orders, which would not have been fair to other customers who had ordered on time.

IDLE MACHINES NEED CARE

Machinery should be properly taken care of and protected when idle. Many parts are permitted to rust and corrode when not in use, requiring immediate replacement when operation is resumed.

During a recent slack period many users left their electrical equipment in damp places which permitted the armatures and field coils to become saturated with moisture and caused the resistance to rust out. The motors were then started up under load without properly drying them, which resulted in short circuits and blow-outs. This created an abnormal demand on the above-mentioned items, far beyond the manufacturer's estimate, so that new supplies had to be arranged for with the consequent delays.

When it is found that some parts are showing excessive wear or breaking too frequently, a careful inspection should be made to discover the cause. If this cannot be determined, a service man should be called in to get at the seat of the trouble.

The manufacturer realizes that his future depends upon the service he is now giving and is putting forth every effort to render that service, but there are many instances where he is put under a tremendous handicap by his customers. The right understanding of each other's position and a willingness to co-operate would materially help the manufacturer render the kind of service demanded by the customer.

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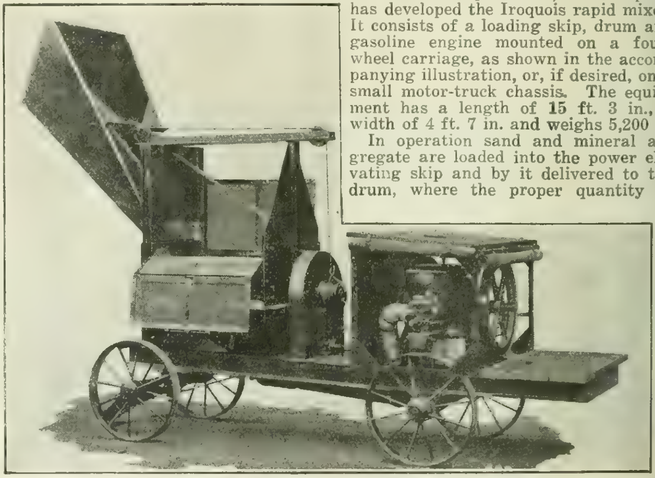
(To Be Continued Next Week with Experiences of the Blaw-Knox Co., Pittsburgh)

Court Denies Infringement of Waterproofing Patent

In an order issued Dec. 16, 1922, Judge Julian W. Mack, sitting in the United States District Court in New York City, entered an order dismissing a suit for infringement of patent brought by Arthur B. Harrison against Gardiner & Lewis, Inc., in the matter of United States Patent No. 1,347,095 for waterproof fabric and process for producing the same. The plaintiff is the manufacturer of Minwax waterproofing materials and the defendant produces Karnak, a waterproof fabric.

Business Notes

WALWORTH MANUFACTURING CO., Boston, maker of pipe, valves, fittings and tools for steam, gas and water supply service, acquired Feb. 1 the business and property of the Hiram Rivitz Co. of Cleveland, Ohio, which will be operated as a subsidiary of the parent organization under the name, Walworth Ohio Co. S. R. Mitchell becomes vice-president and general manager of the new Walworth unit at Cleveland. The Rivitz property includes a modern warehouse and pipe shop, a large pipe storehouse, and the service station, all in Cleveland, in addition to the warehouse and store in Youngstown. The Ohio company will take over from the parent organization its western division, including territory in Ohio and Western Pennsylvania. At the Cleveland warehouse will be maintained complete stocks of valves, fittings and tools for steam, gas and water supply. With the exception of its president, who retires from the field, the Rivitz organization will be maintained.



BLAW-KNOX CO., Pittsburgh, has purchased 19 acres of river frontage at Blawnox, Pa. This tract, asquired from the T. A. Gillespie Co., adjoins the company's present works and will be used for expanding plant facilities, according to Albert C. Lehman, president. The company is now working 100 per cent capacity and is handling a number of contracts from the Texas Co., American Sheet & Tin Plate Co., Milwaukee Electric Railway & Light Co., contracts in connection with the construction of the Welland canal, Canada, and also a large volume of construction for Japan.

WALLACE & TIERNAN CO., INC., Newark, N. J., re-established on Jan. 2 an office in New York City to keep in closer touch with its customers in the metropolitan district. The new office is in the Woolworth Building and is in charge of Alan M. E. Johnstone.

DRAVO EQUIPMENT CO. has been organized to represent manufacturers of contractors and road builders equipment in Pittsburgh, Chicago, Cleveland, New York and Philadelphia. The company will carry stocks in all these cities and will have service facilities. The general sales office is temporarily located at 1,100 Diamond Bank Building, Pittsburgh.

Equipment and Materials

Portable Hot-Mix Plant for Bituminous Pavement Repairs

To supply a demand for a small, inexpensive, portable plant for producing hot bituminous paving repair mixtures, the Barber Asphalt Co., Philadelphia, has developed the Iroquois rapid mixer. It consists of a loading skip, drum and gasoline engine mounted on a four-wheel carriage, as shown in the accompanying illustration, or, if desired, on a small motor-truck chassis. The equipment has a length of **15** ft. 3 in., a width of 4 ft. 7 in. and weighs 5,200 lb.

In operation sand and mineral aggregate are loaded into the power elevating skip and by it delivered to the drum, where the proper quantity of Genasco liquid asphalt is added. While the agitating blades of the drum are revolving 2 pints of gasoline are introduced into the drum and lighted. The mixing process is then continued for 6 min., at the end of which time the flame has died out and 4 cu.ft. of hot asphalt mixture are ready to spread.

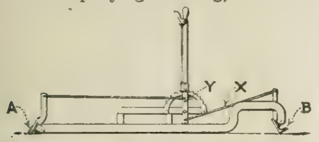
This mixing process is patented in conjunction with the use of Genasco liquid asphalt, which provides a material that, when flashed, burns until the lighter factions are driven off, leaving a hot asphaltic mixture at a temperature of from 250 to 350° F. The material, the manufacturers claim, is not coked by this process when properly used.

Supplementary equipment for the rapid mixer includes tampers, smoothers, asphalt shovels, rakes, cutters, and push broom. A 5-ton roller also is recommended, although satisfactory compression may be obtained by the use of a 1,000-lb. hand-roller with a compression of 50 lb. per square inch. The equipment described is recommended by its maker for contractors having bituminous pavement under guarantee where the repair yardage is not sufficient to warrant economical operation of a standard asphalt plant. It is also designed for use by cities and townships, traction companies with responsibility for pavement maintenance between car tracks and for maintenance of state highways.

Road Maintenance Drag Has Adjustable Blades

Designed as an improvement over the ordinary earth road drag the Austin-Western Road Machinery Co., Chicago, has placed upon the market a "Planetainer" with adjustable front and rear steel blades, each 8 ft. long.

The weight of the device, shown in the accompanying drawing, is 450 lb. and the length of the runners 8½ ft. The equipment is designed for operation with a tractor or roller. Among the advantages claimed for this equipment is that the long runners, traveling over a surface planed smooth by the front blade, prevent either blade from dropping down into and digging out low spots in the road. However, by adjusting the angle of the blades, all of the weight may be concentrated upon them, or, if desired, upon the runners. In all 18 variations in adjustment are possible by means of the notched and lever arm. The relation of blade A and B may be reversed by fastening rod X in hole Y.

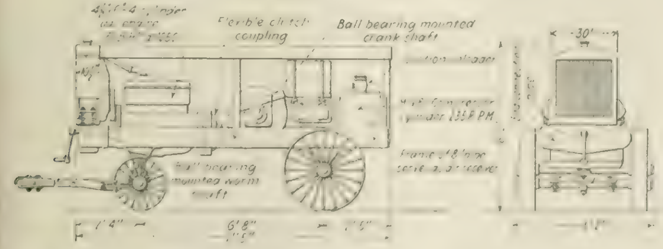


Pipe Frame for Compressor Serves as Air Receiver

In the design of one of its latest types of Traylor portable compressors, the Cement Gun Co., Allentown, Pa., has introduced a novel feature by making the bearing frame of 8 in. pipe to serve the double purpose of supporting the weight of the equipment and acting as an air receiver. The pipe frame is connected with a cast steel head and air is inletted at one end of the pipe and outletted at the other, thereby insuring large receiver capacity and cooling area. The equipment is mounted on four steel-tired wheels and weighs 6,500 lb.

The compressor is of the horizontal type, slow speed, with 9 in. cylinder and 8 in. stroke, power being furnished by a 4½ x 6 in. four cylinder Buda gasoline engine. The rig delivers 100 cu.ft. of free air per minute at 100 lb. per sq.in. pressure. A small pump bolted to the side of the frame supplies water under pressure to the jackets of the compressor, or may be used in connection with the cement gun or other work where water is required.

The outfit can be furnished with electric drive and mounted on either metal wheels or rubber tired automobile wheels, springs and axles.


Flexible clutch coupling
Ball bearing mounted crank shaft
30"
Ball bearing mounted worm shaft
1'4"
6'8"

American Power Shovel Demonstrated in India

Primitive and modern methods of excavation and material handling were the subject of a recent demonstration on the Worli Road near Bombay, India, in which a gasoline-driven power shovel made by the Pawling & Harnischfeger Co., Milwaukee, was operated before a group of engineers representing the local railroad companies, public works department, the Sukkur barrage, the Sutley irrigation project, and the Sardha canal.

After the machine had operated as a power shovel the boom was removed and replaced with a dragline attachment with which a sewer trench was excavated. Earth-handling methods ordinarily employed by native labor consist of scooping up the material by hand into containers which are carried, often by women, on the top of the head, as shown in the picture.

The Pawling & Harnischfeger Co. is introducing its excavating machinery in the Far East and believes that the power shovel and dragline have a particular application in India, where a drainage and flood control work.

Publications from the Construction Industry

Locomotive Repairs by Welding—METAL & THERMIT CORP., New York, has issued the fourth edition of its Thermit locomotive pamphlet (67 pp., illustrated) intended for railroad superintendents of motive power, general foreman, blacksmith foreman and Thermit welders. Chief among the revisions in this edition are instructions for applying improvements in practice in Thermit welding which have been developed by research. The drawings and instructions illustrating and describing welds on various parts of locomotive frames and other locomotive and railroad equipment have been completely revised since the publication of the previous edition.

Manhole Castings—WILLIAM E. DEE Co., Chicago, is distributing a 51-p. illustrated catalog of its manhole and gutter castings. Among them is a reversible manhole curb, which is claimed to be lighter and more economical than the one-piece castings, and the D. & D. safety and noiseless manhole cover which rests on lugs instead of the old style ledge in the frame, doing away with jarring and rattling. The support is not on the top of the lugs but on the sides inclined at 45 deg., so that wedging action is produced. A wide variety of solid and slotted covers are illustrated for manholes and catch-basins.

Concrete Floor Forms—NATIONAL CONCRETE METAL FORMS CORP., New York, in a 20-p. illustrated pamphlet, offers instructions for framing the D & R system of forms for concrete floors. The forms are of No. 16 gage metal, in 3-ft. lengths, and are removable after the concrete has set. Steps in setting up and removing the forms are described in detail for the benefit of construction foremen and there are tables indicating the quantities of form lumber required per 1,000 sq.ft. of decking and per 100 lin.ft. of shoring.

Centrifugal Pumps—DE LAVAL STEAM TURBINE Co., Trenton, N. J., describes small single-stage centrifugal pumps for motor or belt drive in a leaflet and in an instruction manual just issued. These pumps are made in [illegible] sizes, and are designed for capacities ranging from [illegible] gal. per minute against [illegible] ft. head up to [illegible] gal. per minute against [illegible] ft. head. They contain few and simple parts, which are manufactured to limit gages to insure interchangeability. The publications give tables and instructions for selecting pumps for different conditions and [illegible] to determine the proper speed and how to select piping, valves, fittings, and driving pulley or motor to secure an efficient and satisfactory installation.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Trend of Business Indicates Increased Activities

According To National City Bank Of New York All Domestic Conditions Give Promise For A Good Year

The National City Bank of New York in its survey of general business conditions at the outset of the year, makes the following report:

"The trend of business in the first month of 1923 has been very satisfactory. There is no slackening of industry, and all domestic conditions give promise for a good year. Industry is about as active as it was ever known to be or can be with the present labor supply. The steel industry has its capacity pretty well sold up to the middle of the year, which is significant as to the outlook in the various lines of construction. The railroads are taking a great deal of steel, likewise the builders and automobile and implement manufacturers. House-building is headed toward another big year and office building construction now promises to go ahead of last year. Road-building will continue on about the same or larger scale, and manufacturers of cement, plaster, lumber and all building materials, furniture and furnishings are looking for a record year.

RAILROAD WAGE SITUATION IMPROVED

"Railroad traffic is heavy and the roads are expecting to have the best year yet experienced since they were taken back from government operation. The companies are cultivating friendly relations with their men, and endeavoring to adjust wages satisfactorily by direct negotiations.

"The textile industries are active under the pressure created by an upward tendency of prices. This upward tendency thus far is wholly the result of advances in raw materials. Wool is in strong position all over the world, on account of diminishing stocks, and this is particularly so of the high grades. In all countries the labor cost of making clothes has increased so much that the cost of the raw wool in a suit is a comparatively small item, and the tendency is to expend the labor cost on the best materials. This is especially so in the United States, where the new tariff is favorable to the high grades. The final ginning reports indicate that the cotton crop has fallen short of 10,000,000 bales, which emphasizes the fact already recognized that a critical situation exists in the cotton industry.

"The opening of woolens in the past month for orders for next Fall delivery has established prices ranging from 12½ to 16 per cent over those for last season, and these are accepted by the trade as justified by the higher costs.

"The prices of grains have been unfavorably affected by the strained situation in Europe. The position of the farmers is to some extent prejudiced by the advances that have occurred in the things they must buy, while with the exception of cotton late movements in farm products have been reactionary rather than upward.

"The banking situation is very comfortable, with an abundant supply of credit for all good borrowers. Rates, however, have undergone little change of late, as the outlook for demand is considered good. Business men as a rule, while exhibiting confidence, are following conservative policies and showing little inclination to become extended, which is the part of wisdom in present conditions.

THE COAL SITUATION

"The bituminous coal operators and miners of the central competitive field, which virtually means all the unionized territory, have come to the agreement to have no strike this year. This understanding was reached by the action of the operators in deciding to make no effort to reduce the present wage-rates —in other words by their conceding without a contest the issue over which the strike was called last year. Doubtless that was the easy way of dealing with the problem so far as the operators were concerned, and there remains only for the consumers of coal to pay the price.

"Wages are now fixed on a basis which is justified upon the theory that the miners will have work approximately only two-thirds of the time. In other words, there are too many miners for the amount of coal to be mined, and inasmuch as it has been considered an undue hardship to require some of them to find other work, public sentiment has supported the doctrine that the price of coal should carry the burden of idle time."

Steel Ingot Output and Unfilled Tonnage Increase

A total of 3,251,694 tons of steel ingots were produced during January, by the thirty companies which turned out 87½ per cent of the country's steel ingot output in 1921, according to reports received by the American Iron and Steel Institute. This represents an increase of nearly 17 per cent over December and more than doubles the output for January, 1922.

The increasing business of the United States Steel Corporation is indicated by the heaviest unfilled steel tonnage in the last twenty-three months, that of 6,910,776 tons on the books Jan. 31, 1923. This shows a gain of slightly over 2 per cent as compared with the preceding month.

Steel ingot production and unfilled tonnage for the month of January, during the last three years, is shown in the following table:

January 31	Tons of Steel Ingots Produced	Unfilled Tonnage on Books
1923	3,251,694	6,910,776
1922	1,593,482	4,241 678
1921	2,203,186	(Feb. 28) 6,933,867

The daily pig-iron output during January averaged 104,181 tons, an increase of nearly 80 per cent as compared with August, 1922. The January figures compare very favorably with those of October, 1920.

Are You Making the Best Use of This Section?

The Business Side of Construction has a definite policy, as those who read it regularly will have learned.

The first issue of each month carries *Engineering News-Record's* Construction Cost and Construction Volume Index Numbers. These show the current cost of general construction and its actual physical volume, compared with conditions in 1913. The money value of contracts awarded in the various classes of construction is also given. The other regular features are "Labor Rates and Conditions Throughout the Country," and the "Monthly Prices of Construction Materials." There are four pages of prices covering the materials of construction.

The second issue of each month features "Production and Materials Stocks in a Dozen Cities." The large, carefully compiled table tells that there are plenty of brick in Atlanta, that the supply of cement in Minneapolis is more than sufficient to meet all normal requirements, that ten cars of asphalt are available in Denver, that mill shipments of structural steel are slow in New York.

The third issue features recent public bond sales, and presents figures of yield, rate, price, and the houses handling the important issues. Some fifty issues are analyzed.

The first issue of every month carries the full list of prices of construction materials and the cost and availability of skilled and unskilled (union and non-union) labor.

All the other issues publish the "Weekly Construction Market," which presents the prices charged for materials and the rates paid common labor in eight of the leading centers of the United States, and the same for Montreal. "Changes Since Last Week" interprets the data.

Construction News requires few words. It has been running for many years. From it engineers, materials men, architects, and other men interested in construction activities obtain work every week. It is a Sargasso Sea of data, requiring only study and segregation. Practically every state in the Union is represented in its superficially dull looking columns each week. Successful construction men study this section each week.

Decision in Metal Trim Case Expected When Board Meets

Washington Correspondence

A decision in the metal trim case which has been a disturbing factor among the buildings trades for two years is expected to be handed down by the National Board for Jurisdictional Awards in the building industry which has been called to meet in Washington Feb. 19. The case was considered two weeks ago at a meeting in Chicago.

It is the metal trim case, or the refusal of the carpenters' union to abide

(*Concluded on p. 330*)

Value of January Bond Sales Higher Than December

Long-term State and municipal bond sales during January amounted to not less than $93,000,000, according to the *Commercial and Financial Chronicle.* Although the actual number of issues during January was somewhat below the December average, the money value of January bonds was over $32,000,000 greater than the preceding month. This is due to heavy financing by several States and municipalities. January disposals were about $14,000,000 under the $108,000,000 mark reached during the corresponding month last year, when, with municipalities borrowing freely, the number of issues was twice as large.

Temporary loans totaled over $67,000,000 for January, of which $43,325,000 were issued by New York City alone.

Canadian disposals amounted to more than $25,000,000, including $10,053,000 by Toronto; $4,800,000 by Alberta; $2,000,000 by British Columbia and $2,000,00 by Greater Winnipeg Water District.

Among the more important issues of the month were: Detroit, Mich., $20,163,000 4¼s and 4½s, at 100.307, a basis of about 4.37 per cent; North Carolina, $10,073,000, 4½s at a $1,000 premium, or a basis slightly under 4½ per cent; California, $5,000,000 4¼s at 100.324, a basis of about 4.23 per cent; Oregon, $5,000,000 4s and 4½s at 100.029, a basis of about 4.40 per cent; Rochester, N. Y., $4,805,000 4s at 100.77, a basis of about 3.93 per cent; Los Angeles, Calif., $4,500,000 4¾s at 103.11, a basis of about 4.51 per cent; Chicago, Ill., $3,000,000 4s at 98.0792, a basis of about 4.22 per cent; Ft. Worth, Tex., $2,750,000 5s at 105.74; and Chicago, Ill., $2,500,000 4s at 98.17, a basis of about 4.22 per cent.

Of the thirty-four representative issues listed in the accompanying table, three sold at par, thirty above and only one below par; the yields ranging from 3.12 to 5.75 per cent.

Rates varied from 4¼ to 6 per cent. The single 4¼ issue was located in Pennsylvania. All the 6's were sold in Alabama, New York and Ontario. The 4½'s were disposed of in Indiana, Massachusetts and North Carolina, while the 5½'s were all in North Dakota, North Carolina and Ohio. Securities drawing between 4¾ and 5¼ per cent were distributed geographically as follows: Southern states, 7; Middle Western, 4; West of Mississippi, 2; Middle Atlantic, 2, and Far Western, 1, the single 5¼ issue being in Iowa.

Federal Reserve Review of Business Conditions

Production and prices remained relatively constant in December, while trade and credit showed the usual increases in the holiday season, followed by declines in January, according to the Federal Reserve Bulletin of February. During January a number of basic materials advanced in price, while cotton, rubber and lead reached the highest points since 1920. Some of the various industries are reviewed as follows:

Construction was somewhat curtailed in the northern districts during December and January, as a result of severe snow storms. Operations have increased in many sections of the South. The average level of building material prices was unchanged in December. Prices of building materials, however, are now 85 per cent above the average for 1913, whereas the index for all groups published by the Bureau of Labor Statistics has only increased 56 per cent. Shipments of cement showed a marked reduction in December, but were slightly larger than in December, 1921. Production of cement and of various kinds of brick was moderately curtailed, as is customary in the early winter.

Lumber movement during December and early January was featured by an excess of orders booked and shipments over the amount cut. Production, although large for this time of the year, was necessarily curtailed because of winter weather; and shipments which usually exceed the cut at this season were particularly heavy because improved transportation facilities enabled many delayed shipments to be forwarded. Furthermore, dealers are preparing for spring demands by building up stocks and by placing orders for future delivery.

Iron and Steel—Demand for iron and steel products continues to be very strong, and factory operations are on as large a scale as the labor supply permits. Pig-iron production amounted to 3,087,000 tons in December, an increase of 8.3 per cent, while steel-ingot output declined 3.8 per cent to a total of 2,780,000 tons. Prices renewed their upward movement in January, after declining for 3 months. Advances were registered both in pig-iron and finished steel prices. Unfilled orders of the United States Steel Corporation decreased 1.4 per cent during December and totaled 6,746,000 tons at the end

REPRESENTATIVE PUBLIC BOND SALES DURING JANUARY, 1923

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Maturity	Dated	Purchased By
North Dakota......	Real estate developments	$1,650,000	5½	. .	4.50	1945–48	Nov. 1, 1922	C. W. Whitis & Co. and Clark Williams & Co., both of New York
County								
Arlington, Va.	School	275,000	4¾	100.92	.....	1953	Jan. 26, 1923	Bumpus, Hull & Co. of Detroit
Audubon, Ia.	Drainage	19,800	5¼	101.28		1927-33	Feb. 1, 1923	Geo. M. Bechtel & Co., Davenport
Du Bois, Ind....	Road improvement	15,000	4½	100		1924-33	Feb. 1, 1923	[illegible] Bank
Floyd, Ind.	Road	22,360	4¾	101.005	4.64	1924-43	Nov. 15,1922	Peoples' State Bank of Detroit
Franklin, O.. .	Sewer Water mains	8,600 7,500	5	100.807	4.84	1924-32 1924-31	Dec. 1, 1922	Provident Savings Bank & Trust Co. of Cincinnati
Gibson, Ind....	Road	7,600	5	101.31	4.745	1924–33	Jan. 15,1923	Farmers' National Bank of Princeton
Paulding, O...	Road improvement	67,600	5	101.258	4.71	1925–31	Feb. 1, 1923	Provident Savings Bank & Trust Co. of Cincinnati
Perry, Ind.	Road	35,000	5	101.50	4.69	1924–33	Jan. 15,1923	City Trust Co. of Indianapolis
Summit, O.	Sanitary improvement	26,000	5	101.57	4.75	1924-36	Jan. 1, 1923	W. L. Slayton & Co. of Toledo
Warren Water Dist., Mass.	Water	175,000	4½	103.20	4.22	1926-53	Feb. 1, 1923	E. L. Day & Co. of Boston
Wood, Ohio	Road bridge	37,000	5	100.17	4.97	1924–28	Mar. 1, 1923	Provident Savings Bank & Trust Co. of Cincinnati
Township								
Columbus City School Dist., Franklin Co., O.	School building	400,000	5	105.7836	4.44	1925-48	Feb. 1, 1923	Barr Bros. & Co., Inc., of New York
Sioux Falls Independent School Dist., Minnehaha Co., S. D........	School building	300,000	5	106.36	.....	1943		A. C. Allyn & Co. of Chicago
Municipality								
[illegible], Mich.	Sewer	$25,000	5	100.3464	4.91	1925-29	Feb. 1, 1922	[illegible]
[illegible]	Sewer	56,000	6	102.50		1932	Oct. 1, 1922	[illegible]
Asheboro, N. C.	Sewer	7,500	[illegible]	100		1923–52	Dec. 1, 1922	[illegible] Asheboro
Athens, Ala.	School	20,600	5	91	5.62	1953	Jan. 1, 1923	[illegible]
Atlanta, Ga.	Street	75,000	5	102.79		1925-32	Jan. 1, 1923	Citizens' & Southern Co. of Atlanta
Bradley Beach, N. J.	Improvement	[illegible]	[illegible]	[illegible]	4.94	1925-42	Feb. 1, 1923	[illegible]
Charlotte, N. C.	Street improvement [illegible]	700,000 100,000	4½ 4½	100.41 100.03	4.72 4.49	1925-43 1926-63	Feb. 1, 1923	[illegible]
Crown Point, Ind.	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
[illegible], N. Y.	[illegible]	[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Fort Edward, N. Y.	[illegible]	8,000	5	100		1924-27	[illegible]	[illegible]
Hamilton, O.	[illegible] light works [illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		100.17	[illegible]	[illegible]	[illegible]	[illegible]
Los Angeles, Calif.	[illegible] improvement	[illegible]		101.67				[illegible]
[illegible]	Fire Dept. and City building	[illegible]		[illegible]	4.80	[illegible]	Feb. 1, 1923	[illegible]
Middleburg, N. Y........	Bridge	[illegible]		[illegible]	4.60	[illegible]	Feb. 1, 1923	[illegible]
Nacogdoches, Tex.	Street improvement	[illegible]		100.44		[illegible]	Jan. 30, 1923	[illegible]
Reading, Pa.	School	300,000	4¼	[illegible]	3.12	1924-40	[illegible]	[illegible]
Statesville, N. C.	Local improvement Assessment	[illegible] [illegible]	5½ 5½	[illegible] 103.267	5.11 5.11	[illegible] [illegible]	Jan. 1, [illegible]	[illegible]
Upper Arlington, O.	Sewer	[illegible]	[illegible]	[illegible]	5.385	[illegible]	Oct. 2, 1922	[illegible]
Grimsby, Ont.	Water works	30,000	6	101			[illegible]	[illegible]

of the year. Particularly large orders have been placed by farm-implement manufacturers, railroads, and automobile factories since the beginning of 1923, and wire mills have been obliged to allocate their output for the first quarter of the year.

Automobiles—Production of automobiles was only slightly curtailed in December and was almost three times as large as a year ago. Passenger-car output totaled 207,501, as compared with 215,225 in November and 70,435 in December, 1921; while the number of trucks produced was 19,640, as compared with 21,291 in November and 8,183 in December, 1921.

Decision in Metal Trim Case

(Concluded from p. 328)

by the previous decision in this case, which has threatened the existence of the Board. While this body is purely unofficial, it has accomplished so much toward bringing order out of the previous confusion among trades unions that official Washington has come to depend heavily upon its functions.

The carpenters' union has insisted that it was not given full opportunity to present its case at the first hearing, which preceded a ruling that metal trim work belonged to the jurisdiction of the metal workers' union.

Bids wanted on grain elevator, Montreal, Que., for J. S. Metcalfe Co., Ltd., $10,000,000; warehouse, Cincinnati, O., for Cincinnati Terminal Warehouse Co., $2,000,000.

Large contracts let during week: Hotel, Minneapolis, Minn., to C. F. Haglin & Sons Co., $3,000,000; Y. M. C. A. building, New York, N. Y., to G. A. Fuller Co., $1,200,000.

Next week—Trend of lumber production and shipments during last thirteen months.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of February 1; the next, on March 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.29	$3.95	$4.40	$3.05	$3.30	$3.95	+$3.35	$3.80	+$3.75
Structural rivets, 100 lb	3.85	4.60	5.25	3.75	4.00	4.95	4.75	4.25	5.50
Reinforcing bars, ¾ in. up, 100 lb	3.19	3.85	3.15	2.95	3.20	3.62½	3.30	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	51%	53%	45%	59½%	55-5%	38%	+38.2@46.5%	45%	+32.76
Cast-iron pipe, 6 in. and over, ton	56.00	50.00	56.00	+54.20	+58.50	65.00	+57.00	+57.00	55.00
Concreting Material:									
Cement without bags, bbl	2.60@2.70	2.75	2.25	+2.20	+2.39	2.85	2.71	2.90	+2.88
Gravel, ¾ in., cu.yd	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd	1.00	1.24	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd	1.75	2.00	2.00	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	61.00	+37.00	50.00	56.50	42.75	54.00	36.00	29.00	+95.00
Lime, finishing, hydrated, ton	16.80@17.10	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	3.00@3.25	1.85	2.50	1.40	—1.25	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	+12.00	11.00	11.00	17@19	12.00	15.50	13.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0859	.115	....	.0836	.065	....	.11	+.115
Hollow partition tile 4x12x12, per block	.1230	.0859	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal	+.99	1.03	1.07	1.02	+1.07	+1.19	1.04	.86	1.02
Common Labor:									
Common labor, union, hour	.60	.35	.30@.50	......	......	.50@.55	.56¼	.50@.60	......
Common labor, non-union, hour	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.50	....	—.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine casing. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.91). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Following the recent advances in coke and pig iron, steel shapes and reinforcing bars rose to a minimum of $2.25 per 100 lb., Pittsburgh, in small lots for early delivery; plates $2.35. This advance is equivalent to $2 per ton over last week's maximum of $2.10 per 100 lb. at the mill.

The present price level is up to the emergency quotations of the early part of September, at which time a 20 per cent wage increase and heigher fuel costs caused an advance. An unusual demand for oil-country goods, fabricated structural steel and automobile and agricultural implement materials, is responsible for the present rise. Shapes and bars, however, quoted at a minimum of $2.15 and plates at $2.20, on exceptionally large contracts.

Wrought steel pipe advanced in San Francisco and Montreal during week. Cast-iron pipe rose $1 in San Francisco and Seattle and $2 per ton in Minneapolis and Chicago.

A firmer cement market is reflected in the following changes: advances of 10c. per bbl. in Cleveland, Duluth, Minneapolis, Pittsburgh and St. Paul; 14c., in Detroit and 15c., in Cedar Rapids, Chicago, Cincinnati, Davenport, Indianapolis, Milwaukee, Peoria and Toledo.

Lumber prices also show considerable firmness due to heavy demand for railroad car materials and bridge timbers, to orders from retail yards to replenish depleted stocks and to continuance of construction activity.

Linseed oil rose 3c. in New York and Minneapolis and 6c. per gal. in Denver, during week. General tendency of lead and linseed market higher.

A Consolidation of Engineering News and Engineering Record
McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

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A Sensible Grandstand

AFTER the multitude of magnificent stadiums which have of late sprung up in the colleges and cities of this country, the sensible steel grandstand recently completed at the University of Iowa has a refreshing simplicity. The difference between $6 and $20 per seat in first cost is a great deal; more than enough, to our mind, to make up for the loss in beauty and monumental value the huge concrete or concrete and steel stadium possesses, especially when the added psychic value is gained at an expenditure which might well be devoted to more practical educational ends.

Shandaken Tunnel Holed Through

LAST week witnessed an important stage in the completion of the Schoharie development of the Catskill system for the additional water supply of New York City. The last pair of headings in the 18.1-mile Shandaken tunnel through which water impounded by the Gilboa dam will flow by gravity into the Ashokan reservair and thence, through the Catskill aqueduct, to New York, was holed through early in the morning of Feb. 13, opening up continuous stretch of hard rock tunnel 95,740 ft. long which, when lined with concrete, will have a horseshoe cross-section 11 ft. 6 in. by 10 ft. 3 in. and a capacity of 600,000,000 gal. daily. The Shandaken tunnel takes rank as the world's longest continuous tunnel, exceeding by the slight margin of 51 ft. the city aqueduct tunnel (95,689 ft.) for the delivery of Catskill water within the city limits. The contract for the Shandaken tunnel was awarded Nov. 9, 1917, but on account of conditions arising out of the war progress was interrupted and the work did not get into full swing until the beginning of 1921. From that time, however, the headings from six shafts and one portal have advanced rapidly until the final wall of rock in the 120 miles of waterway between the Schoharie reservoir and the City Hall, has been blasted away. Even with the additional water available in New York by the development of the Esopus and the Schoharie sources the problem of the city's ultimate supply is not solved. Each year brings increased demands for water and even now, with the completion of the second phase of the original Catskill project in sight, investigation of supplementary sources are in progress. In water supply—as in other fields of engineering—it is necessary to plan far ahead.

Transit Again Active

RAPID-TRANSIT questions are again stirring in various cities. Since the war there has been little real interest in the subject, for cities and citizens have been kept so busy in trying to make ends meet that they have had no time left to make plans for costly improvements. But the need for transportation is steadily becoming more urgent, and with the present more promising outlook for municipal finance the transit problem again takes a leading place. Philadelphia, five years after stopping work on its Broad St. subway trunk line, is about ready to continue, and would be actively preparing for work were it not that the city council has just revoked the earlier authorization to build the subway. The measure is apparently political, and is bound to cause great loss to the city if it is allowed to delay work very long. Rapid-transit construction in Philadelphia may be considered a matter of the early future. In Pittsburgh, where a hastily planned loop subway for street cars was approved by referendum some years ago, and a $6,000,000 bond issue voted for its construction, nothing has been done since that time to build such a subway, and the city now finds a large part of its credit tied up by the subway vote. Abrogation of the bond issue vote is now being agitated; it will bring the city one step nearer rapid transit, for traffic downtown is concentrating and slowing up, as elsewhere. Detroit is in a more advanced condition: it is just entering upon a genuine study of transit possibilities. Having the most difficult geographical problem, because of its large and widely scattered territory, it enjoys the advantage of owning its street car system, and thus is not hampered by the problem of arranging for operation, which is a disturbing factor in such communities as Cleveland and Philadelphia. The present-day transit planning, however, is not merely a resumption of former planning, for conditions have changed much by the increase of automobile traffic since the transit problem last engaged general attention. The correlation of rapid transit and surface traffic problems has hardly yet been approached, but it is sure to claim attention within the next year or two. With planning thus active, it is hardly to be doubted that definite action toward rapid-transit construction in at least one or two cities is not far ahead.

A Neglected Obligation

LAST week the American Society of Civil Engineers devoted an evening to the presentation of a paper on the design of reinforced-concrete columns attacking the "excessive and therefore unsafe stresses" permitted by the Joint Committee specifications of 1917 and 1921 on the basis of a long scholastic investigation of test results. Though the paper was by a non-member, who has not hitherto had any prominence as a student or investigator in reinforced concrete, the paper had been published in the "Proceedings" of the society and had thus been given permanent standing in engineering literature. As a unique study of a somewhat standardized subject and as an attack on commonly accepted methods of design this paper deserved an adequate discussion which it did not receive. The meeting was poorly attended, and those who commented on the paper contented themselves with generalities about concrete and columns rather than discussion of the unconventional magnification of the theory of error as applied to tests, which is the critical issue in the paper. The Joint Committee has, we believe, entered into a solemn pact not to discuss publicly any of the provisions of its specification, which may account for the fact that none of the society's representatives on that committee spoke on the paper. If this is so, it is only another instance of the unwisdom of the committee's policy of silence, because an unanswered criticism is apt to become an unanswerable criticism, particularly when it is dignified by the use of 75 pages of the "Transactions" of the American Society of Civil Engineers. Will not the Joint Committee relax its regulation in time for the written discussion?

Organized Discussions

ANOTHER thought arises from this incident. Discussion at technical meetings must be organized and fostered. There is a long-held fallacy that a good —or a bad—paper will bring out its own discussion. Hundreds of apathetic technical meetings have proved this fallacious. Those best fitted to discuss a given subject are least apt to volunteer their opinions; too often to them it is old straw that will not stand rethreshing. They need some centralized urging that their opinions are worth while and that, though their views may be hackneyed to the expert few, they are novel and interesting to the many who lack the expert knowledge. The American Society of Civil Engineers can do much to improve its regular monthly meetings by some direction of the discussion, by some attitude other than the conventional one that the very fact that the society has accepted and printed a paper is sufficient urge to the oral discussion. The only excuse for the monthly meeting, now that the social feature has become so atrophied, is a live discussion; and, frankly, the discussions of late in these meetings would discredit the weakest local society, so scattered and meager have they been. Some organized planning is obviously required.

St. Louis Bond Election Significant

THE TWENTY-ITEM $87,372,500 bond issue authorized Feb. 7 by the voters of St. Louis will finance the largest, most varied and best planned program of municipal improvements ever attempted by an American city. The largest municipal bond issue heretofore authorized by popular vote appears to have been $51,750,000 for a variety of improvements at Baltimore, Nov. 2, 1920 (*Engineering News-Record*, Oct. 28 and Nov. 11, 1920, pp. 866 and 960). That twenty items should have been approved at St. Louis and only one defeated is all the more remarkable because majorities were well in excess of the necessary two-thirds, the affirmative votes running as high as 86 per cent of all the votes cast for the $12,000,000 of water-supply extension bonds.

The St. Louis program is the result of several years of study and campaigning with extensive and highly commendable co-operation between the city officials and various civic organizations, the latter functioning through a large joint committee. After quite extensive investigations, a $24,000,000 bond issue of 18 items went to popular vote on May 11, 1920, but of these only five, totaling but $3,815,000, received the necessary two-thirds majority, although every item had a substantial excess of one-half of the votes cast, the yea votes ranging from 62 to 69 per cent of the total. Not daunted by the failure of 12 of 18 items and a much larger percentage of the total amount of bonds proposed, study was soon begun on the much more comprehensive program just adopted, the items at the 1920 election having been chosen from those considered most urgent, in view of the generally unfavorable conditions of that time. Many of the items defeated in 1920 are included, some with enlargements, in the bond issues just authorized.

Although 20 of the 21 items and all but $1,000,000 of the $88,372,500 submitted at the recent election carried by more than the necessary two-thirds, the majorities ranged from about 65,000 to 35,000 in a total vote averaging 90,000. The five highest majorities were water-works, hospitals, fire department, sewers and grade crossing elimination, and the five lowest (also in order of decreasing majorities, were railway approaches to the free municipal bridge (two items), municipal auditorium, municipal plaza and hall, and an aquarium in Forest Park. The highest and lowest majorities (of the 20 items carried) were for the largest and smallest items, $12,000,000 for water-works and $400,000 for the aquarium already mentioned. This is another illustration of discrimination in voting, and of the fact that it was the object rather than the amount of the item that counted.

There is food for reflection in the fact that less than a third of those entitled to vote went to the polls. In the 1920 election about 44 per cent of the registered vote was cast, but the total registration of 1923 was much larger than that of 1920, on account of the subsequent extension of the suffrage to women.

Altogether, the results of the St. Louis bond election are most encouraging. They show that a well-framed program of municipal improvements, brought home to the understanding of the voters, will be endorsed even in this time of high construction costs and relatively high bond interest rates. They also show that under such conditions an item-by-item vote is no more and probably less of a risk than voting on a lump sum. With a bond market eager for municipal securities and the St. Louis results in view, other municipalities may well be encouraged to frame and submit similarly well-considered bond-issue programs, for most cities and towns are far behind on much-needed construction.

A Start on Departmental Reorganization

THE reorganization of the departments at Washington, like every major reform, moves slowly. It is four years since the engineers of the country got together to promote the idea of a Department of Public Works consolidating all the engineering functions of the government, and as a co-ordinate reform the reclassification of all the government bureaus for more economical control. It is nearly two years since President Harding appointed the Brown commission to prepare a plan which would bring about this reform. The engineers' activities did not persist very long, mainly because it soon became evident that the Brown commission was working along the lines suggested by the Department of Public Works idea and that if the reform came it would have to come from the inside through the medium of that commission. The administration plan, labored over for two years, fought out at the Cabinet table and, if rumors be true, the cause of one resignation from that body, and fairly wrung from the reluctant department and bureau heads, is now made public. It goes to a busy Congress, engrossed in a multitude of things undone, and stands little chance of consideration for a year unless, perchance, the President is forced to call an extra session.

On the ground that what should be done had best be done quickly it is too bad that the commission could not have completed its work last summer so that the present Congress could have taken action. As it is, however, there is a long time for the plan to be studied, not as a suppositious project but as a definite program with all the weight of the administration behind it.

While the Brown proposal is much wider in its concept than that proposed by the engineers a preliminary study shows that it covers most of the changes advocated for the Department of Public Works. To be sure there is no new department of that name or even a change to that name of an old department, but under the Department of the Interior are grouped most of the engineering activities of the government or at least those engineering activities not specifically a part of the operation of one of the other departments. The army and the navy still retain the engineering work peculiar to their needs, which is rational and desirable, and give up those activities which are strictly of a civilian nature.

Under this latter classification comes the relinquishment of the river and harbor work by the Corps of Engineers, which will doubtless prove the greatest bone of contention in the plan. This change is rational, too, but it will not be complete unless some definite scheme is enforced whereby the officers of the corps are given responsibility in varied lines of engineering so that when war comes they will not only have engineering experience but the mental poise and backbone that only responsibility confers.

No one need believe that any scheme for reorganizing the departments at Washington will have easy sledding, much less one which involves such wholesale shifts as this one. Probably a reorganization bill that emerges from committee will bear little resemblance to the plan which the President presents, but at least we are nearer a solution of the confusion that now exists than ever before. Bearing in mind the changes that Congress will probably impose, there is no need now of spending too much time analyzing and discussing the present proposal, but it can be said that it is a good start toward a reform in government engineering practice that should benefit both the government and the engineers who serve the government.

Political Road Control

NEW JERSEY with $20,000,000 to spend on roads this year has made the administration of its highway department an issue of partisan politics. Incidentally the state since Jan. 22 has been without a responsible head of its road-building activities. These facts possess a disquieting significance not confined to the effect on highway development in the single state directly concerned. They exemplify a reversion of thought on public roads work which is being manifested in many states and which if it not checked may undo much that has been accomplished in the last few years toward putting state highway administration on a fairly high plane. They point to the necessity of organized corrective effort akin to that which created the demand of the last few years for road improvement.

Considering the New Jersey situation specifically, there will be few mourners for the old, eight-man, bipartisan highway commission. The smaller commission of four, provided by the new law, although it is still bipartisan, is a much preferable working organization. One may commend also the personnel of the new commission as it has been named for confirmation. There is no great cause to criticize any of the minor provisions of the new law and some of them can be praised. All this granted, the fact remains outstanding that the law is purely the creation of partisan politics. Not one provision, from the bipartisan requirement to the number of commissioners and the appointive power, was decided on any basis except compromise between a democratic governor and a republican legislature.

The calm assumption by the executive and the legislature of the right to discuss and arrange the highway business of New Jersey as a political issue and the complacent acceptance by the public of this assumption, constitutes today the hazard to highway development which thoughtful engineers most fear. The condition is not peculiar to New Jersey; it exists in a number of other states where, however, it is not quite so bold in displaying itself naked to the world.

The discouraging truth is that all over the country a determined effort is being made to swing the great work of roadbuilding into the list of public activities which proceed under political favor. Power has been lent to those who seek this goal by an economic condition which has set the people astir to ease their burden of high taxes and high costs. Watching their highway bills pile up to hundreds of millions a year, taxpayers are in a fit temper to follow the leader who promises relief by calling back the old regime of local direction and control. Such leaders are not lacking and they are getting followers in exactly the degree that the people have not been educated in the highway business.

Following a period of active education of the public to the need of good roads there has been a period of no schooling. Rampant propagandists as they were in large part, the old "good roads" organizations accomplished their object of creating an active public sentiment for improved highways. With the first lesson taught education ceased. Federal and state highway departments and associations of roadbuilders have taken up educational work only as it has concerned the technique of highway building and operation. Their work has been remarkable but, with rare exceptions, they have done little to teach the people generally the business of highway engineering and highway transport. There is need for some one to perform this task.

Few would care to see repeated the methods of the old "good roads" boomers, but a revival of their spirit would do much to change the present situation which is worrying federal and state highway officials. They are largely helpless because of the laws which control their activities and define the objects for which they may spend public funds. Educational propaganda is not one of these objects. This work must be inaugurated and advanced by the engineering and industrial associations concerned with highway development. It should be made a major item of their programs as soon as they can function officially to do this.

Huge Airship Hangar for U. S. Army: Scott Field, Illinois

Three-Hinged Trusses on Side Bents for Structure 206 x 810 Ft., 162 Ft. High—Large Timber Traveler—Motor-Operated Rolling Doors—Towing Trolleys

By Hilmar F. Smith
Late Supervising Engineer, Quartermaster Corps, U. S. Army. (As noted in *Engineering News-Record*, Jan. 18, 1923, p. 137, Mr. Smith died Jan. 6, 1923.)

Typical of the great steel-frame buildings which have been developed in recent years for housing airships is the U. S. Army hangar or shed which has been completed recently at Scott Field, near Belleville, Ill. This immense shed is 810 ft. long and 206 ft. wide, with a clear interior height of 150 ft. at the center. Its main framing consists of a row of three-hinged arches seated on A-frame bents which form the lower portions of the sides. The ends are closed by rolling doors. Docking rails and conduits extending through and beyond the building carry manually-operated trolleys to which cables are attached for towing the airships in and out. To meet the conditions of prevailing direction of winds, the center line of the hangar lies 5 deg. east of true north. A general view of the building with its rolling doors partly open is given in Fig. 1.

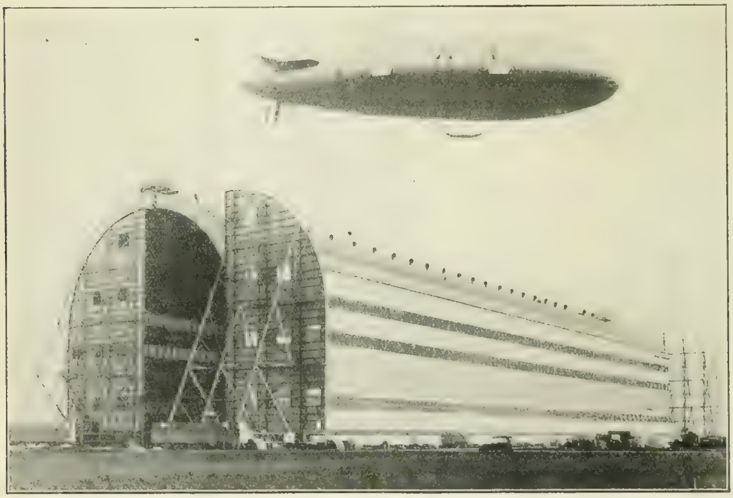


FIG. 1—U. S. ARMY AIRSHIP HANGAR AT SCOTT FIELD, BELLEVILLE, ILL.

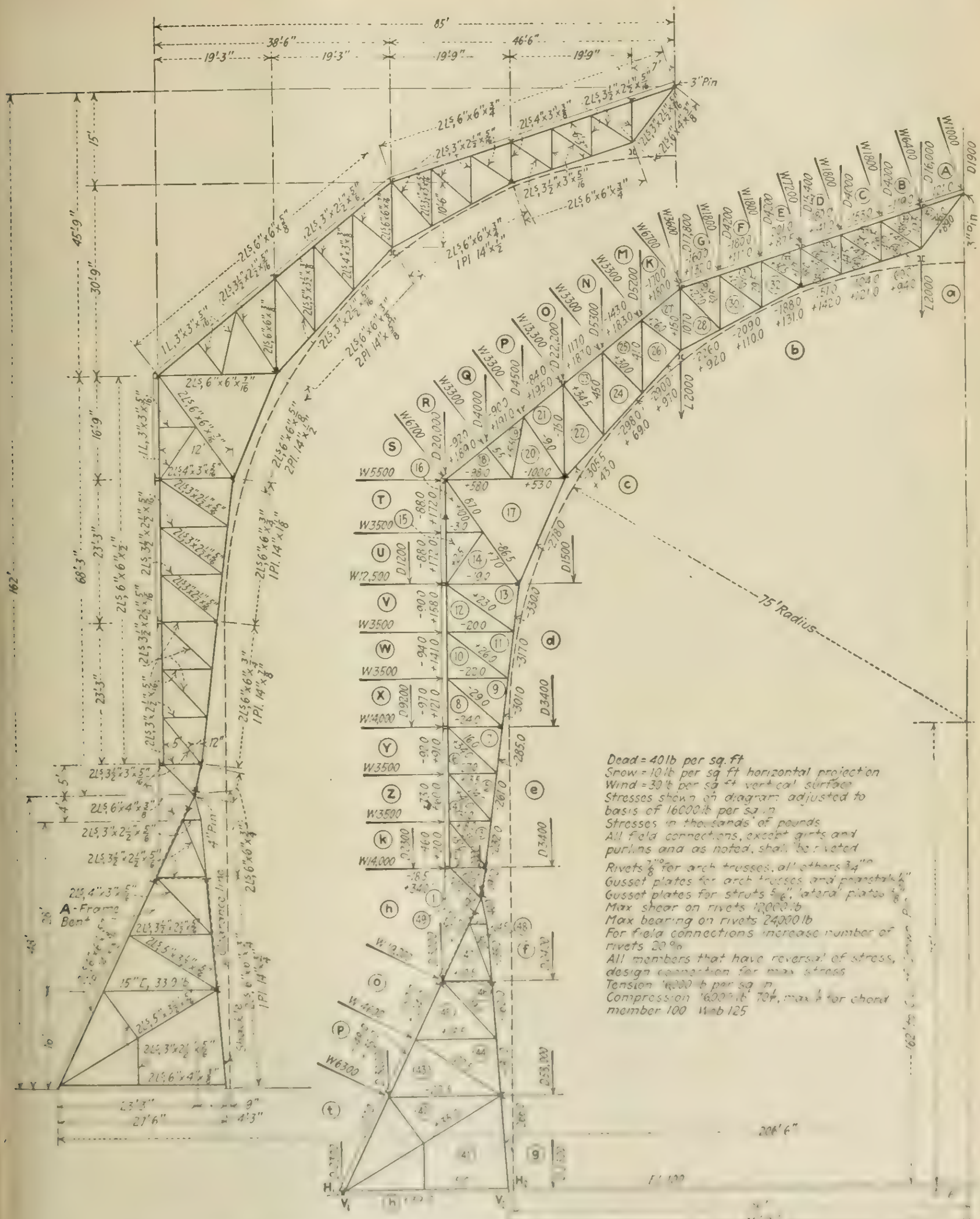
An electrolytic hydrogen-gas plant is an important accessory. It is located 1,400 ft. from the hangar and has a gas-holder of 500,000 cu.ft. capacity. Other auxiliary works include: (1) An oil-cracking plant which also houses a 50-hp. boiler for heating the gasholder; (2) a boiler house 200 ft. distant to supply low pressure steam for heating the enclosed rooms of the hangar; (3) a sewage ejector station of 100 gal. capacity per hour, discharging to the sewer system of the military post, 2,000 ft. distant; (4) 3,000 ft. of electric conduit delivering 2,300-volt current to a substation for supplying power to the hangar and gas plant, and (5) 3,700 lin.ft. of 16-ft. road paved with bituminous macadam.

Foundations—Along each side of the building there are two rows of footing pedestals, spaced 27 ft. 6 in. c. to c., to carry the inner and outer legs of the A-frame side bents. The inner rows are 75 ft. 9 in. from the center line or 151 ft. 6 in. apart. These footings carry the steel bents of the sides and are rectangular in plan, approximately 15 x 7 ft. at the base, with the larger axis transverse to the building. They are designed for a maximum soil bearing of 4,000 lb. per square foot. No piles are used for the foundations.

At each end of the building are heavy reinforced-concrete foundations for a pair of standard-gage tracks 50 ft. c. to c., carrying the rolling doors. Each track has rails anchored to a concrete stringer 12 ft. wide and about 6½ ft. deep, these stringers being connected at intervals by cross walls. Concrete bumper posts limit the travel of the doors. Along each side of the building and across the narrow closed portion of each end is a curb wall on which the siding or sheathing rests. This curb also forms one side of a concrete gutter carrying roof water to the storm-water drains.

Steel Frame—The main structural framing consists of twenty-eight three-hinged arch trusses spaced 30 ft. c. to c. and resting on A-frame bents carried by the pedestal footings. At the apex of each bent, 48 ft. above the floor, is the 4-in. shoe pin of the truss, the span c. to c. of pins being 160 ft. The 3-in. center pin is 162 ft. above the floor. A typical cross-section showing the trusses and bents is given in Fig. 2. Parts of the framing plans, elevations and sections are given in Fig. 3. The inner legs of the A-frames and the bottom chord of the truss conform closely to a clearance line vertical for 75 ft. on each side and then forming a circular curve of 75 ft. radius. The end trusses carry packing plates cut to this curvature, as shown.

Two lines of longitudinal struts connect the bents, one of these being in a vertical plane and the other in a horizontal plane. Three struts in a horizontal plane connect the vertical portions of the trusses along each side. Four struts in vertical planes and spaced about 20 ft. apart connect the arched portions of the trusses. Two of these upper struts carry trolley runways and are designed for an additional live load of 2,000 lb. The location and construction of the struts is shown in Fig. 3. In 10 of the 27 bays there is bracing to connect the trusses in pairs. In each bay



Dead = 40 lb per sq. ft
Snow = 10 lb per sq ft horizontal projection
Wind = 30 lb per sq ft vertical surface
Stresses shown on diagram adjusted to basis of 16000 lb per sq in
Stresses in thousands of pounds
All field connections, except girts and purlins and as noted, shall be riveted
Rivets ⅞" for arch trusses, all others ¾"
Gusset plates for arch trusses and pedestals ½"
Gusset plates for struts 5/16", lateral plates ⅜"
Max shear on rivets 12000 lb
Max bearing on rivets 24000 lb
For field connections increase number of rivets 20%
All members that have reversal of stress, design connection for max stress
Tension 16000 lb per sq in
Compression 16000 lb 70 l/r, max l/r for chord member 100 Web 125

FIG. 2—TYPICAL CROSS-SECTION OF ARCH TRUSSES AND A-FRAMES IN SCOTT FIELD HANGAR

the struts carry intermediate framing consisting of an I-beam rafter to support the roof purlins and I-beam posts in the sides to support the girts.

Expansion movements are provided for by 1½ in. slots in connections at trusses Nos. 7, 13, 16 and 22. Three main stairways afford access to three longitudinal walks under the roof, connected by three transverse cat walks. The roof was designed for a snow load of 10 lb. per square foot (horizontal projection) and a wind load of 30 lb. per square foot (vertical section).

Steel Erection—There are 3,200 tons of structural steel in the building. Special equipment was required for the erection of so lofty a structure. Each half truss was shipped in four sections: (1) The vertical portion

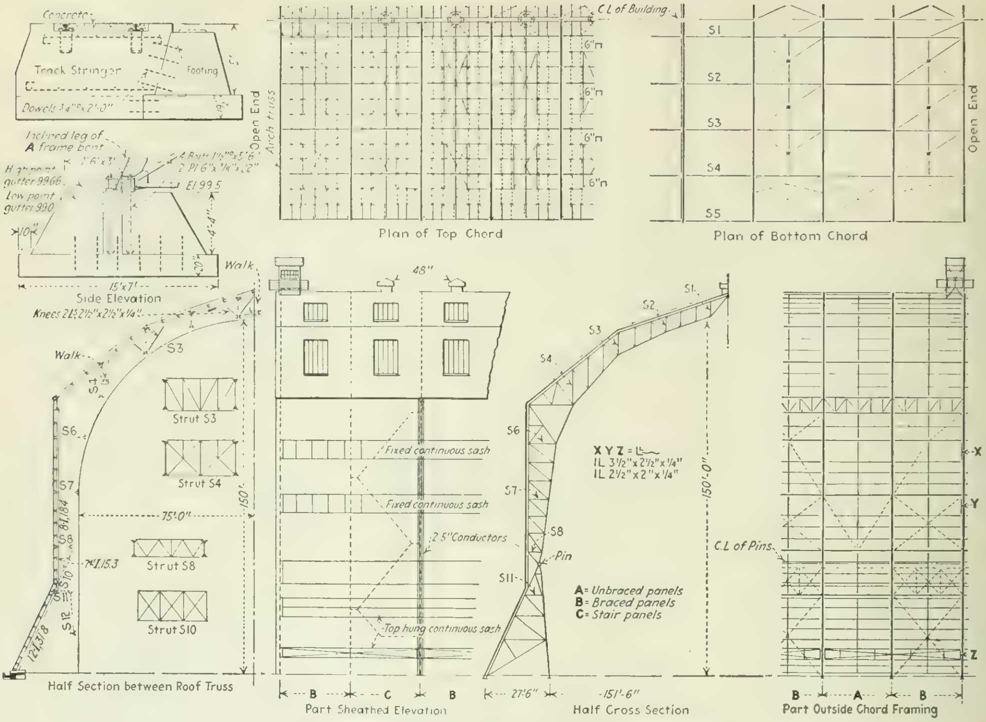


FIG. 3—FRAMING PLANS, ELEVATIONS AND SECTIONS

from shoe pin to eave line, 63½ ft. long; (2) the bottom chord tie between this and the next section; (3) the section from eave to hip line, with a pitch of 9$\frac{15}{16}$ in. per foot, and (4) the section from hip to peak, with a pitch of 3$\frac{15}{16}$ in. per foot. Two standard-gage tracks, 100 ft. c. to c., were laid along the site, each track 50 ft. from the center line. Between these tracks was the erecting traveler constructed of heavy timbers, as shown in Fig. 4. Prior to the erection of the traveler all the A-frames were placed, with the intervening struts to tie them together. Upon completion of the traveler, at the north end of the site, the trucks for the north doors were set on their tracks and the steel framing was erected for these doors in their closed position. In this way a definite tie was available for the first truss. The traveler then moved back, erecting the trusses and framing as it proceeded.

Truss erection began with hoisting the 6-ton plumb section of truss into position by means of a derrick boom on top of the traveler. There it was pinned and held in position from the outrigger platform of the traveler by setting the truss section in a slot formed by overhanging timbers clamped to the outrigger platform. Then the 1½-ton bottom chord tie was erected. The two upper sections of truss were riveted together on the ground and the complete 9-ton section was then raised into position, the top pin being driven when the two half trusses were swung into place, both sides being erected simultaneously.

Tracks on either side of the traveler permitted the

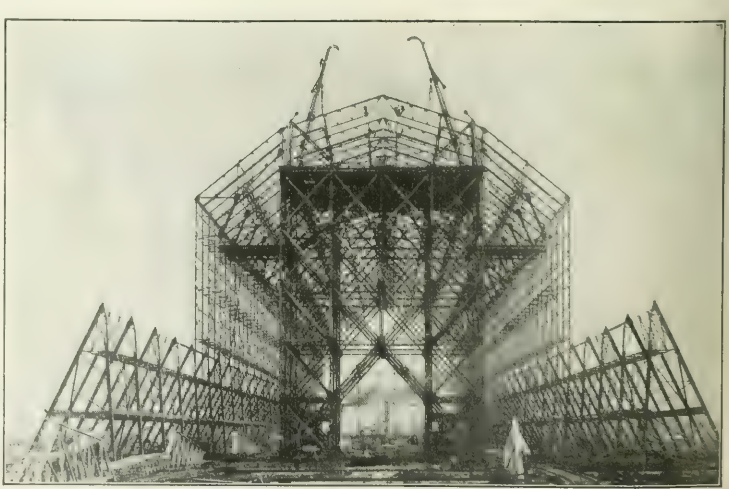


FIG. 4—ERECTION TRAVELER IN U. S. ARMY HANGAR

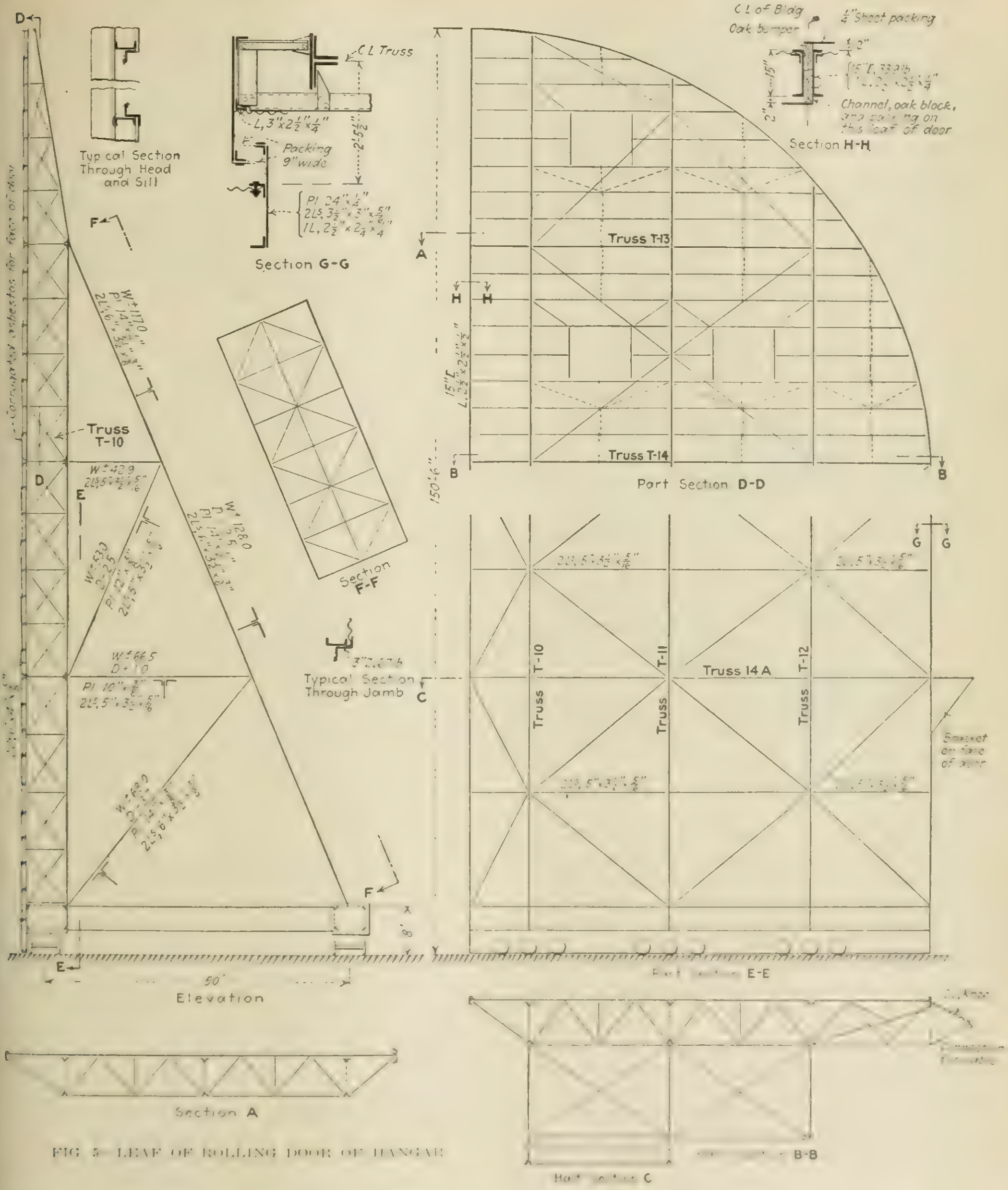


FIG. 5—LEAF OF ROLLING DOOR OF HANGAR

operation of two derrick cars for feeding steel on either side, thus keeping both sides up to the same rate of progress. At the south end the traveler was backed out of the building and clear of the south door tracks in order to erect the south doors, a 120-ft. boom being fitted to one of the derricks for this work.

After the first two trusses had been erected and the first bay filled in, no difficulty was experienced in handling this equipment for the steel erection. In a 44-hour week erection was at the rate of three trusses with bays filled in, or an average of approximately 50 tons daily. The last five trusses were erected in about a week, but scant attention was paid to fitting up as the pace was rather too fast. Fig. 4 shows the traveler, with several of the trusses erected on the A-frame bents.

Traveler—In this huge erecting structure, the general construction of which is shown in Fig. 4, the posts were built up of two 6 x 10-in. timbers, except that the two posts carrying the derrick masts were composed of pairs of 8 x 12-in. timbers. Cross-struts were pairs of 4 x 10-in. pieces in the upper half and 6 x 12-in. in the lower section. Tension diagonals were 3 x 10-in. and stiff diagonals two 6 x 10-in. and 10 x 10-in. Timbers doubled in this way permitted the use of steel gusset plates in a very convenient manner for bolting at all points. Longitudinal struts capped the posts in each section and were 10 x 10-in. timbers, except that the sills were 10 x 12-in. The outriggers consisted of brackets of two 6 x 10-in. timbers with 3 x 12-in. joists and a 2-in. plank floor. The top deck of the traveler proper was similarly constructed.

On each side of the top deck was a steel stiff-leg derrick with hoisting capacity of 1, 2 and 15 tons for 84-, 74- and 60-ft. lengths of boom. These booms had goose-neck ends, as shown, to give greater reach. For the operation of this traveler, three hoisting engines were required: (1) A hoist with two drums for load at 60-ft. boom and for topping lift, and two spools for swing lines to rotate the boom for derrick No. 1; (2) a similar hoist for derrick No. 2; (3) a hoist with two drums for the runners on the two derricks, the runners handling light loads at 80-ft. boom. The traveler itself was mounted on movable sections of rail laid 80 ft. apart. It was moved by two sets of blocks and tackle anchored in the direction of movement and wound on the spools of the hoisting engines.

Sheathing and Sash—All siding on the building and the end doors is of corrugated sheets consisting of a core of metal of No. 24 gage dipped in hot asphalt, on which an asbestos protective coat is rolled on both sides, the sheet then being painted with a protective coating of aluminum color. On vertical seams the sheets are bolted at 18-in. intervals. Horizontally they are strapped to the girts at every third and eighth corrugation with cupped sherardized bolts and galvanized iron straps. These girts are approximately 4½ ft. apart. At expansion joints a 16-oz. copper roll is used. Concrete tiles 2 x 4½ ft. are used for the roof, on purlins 4 ft. apart. Every tile is fastened to the purlins with copper wire and clips to eliminate the remote chance of a strong wind lifting them out.

Skylights 16 ft. wide are placed one above and one below the hip, on either side of the ridge, a sheet of actinic wired glass being built in each tile in this area, which extends the length of the building. Under the skylights are diamond-mesh wire screens as a protection in case of breakage of the glass. Two runs of fixed sash 8½ ft. high are placed on either side, located between the eave and lower pin connection. Three runs of 5-ft. movable sash are located in the rake below the shoe pins. Each door leaf has nine sash panels. Actinic wired glass ¼ in. thick is used throughout.

On each side of the building is a 10-in. square box gutter hung at the eave, carrying water from the roof to seven pairs of 5-in. downspouts discharging into an open concrete gutter having three 12-in. drains to the storm-water system. On the ridge are twenty-five ventilators, 48 in. in diameter. The floor is a 4-in. concrete slab on a 16-in. tamped cinder fill, and is covered with 1 in. of mastic.

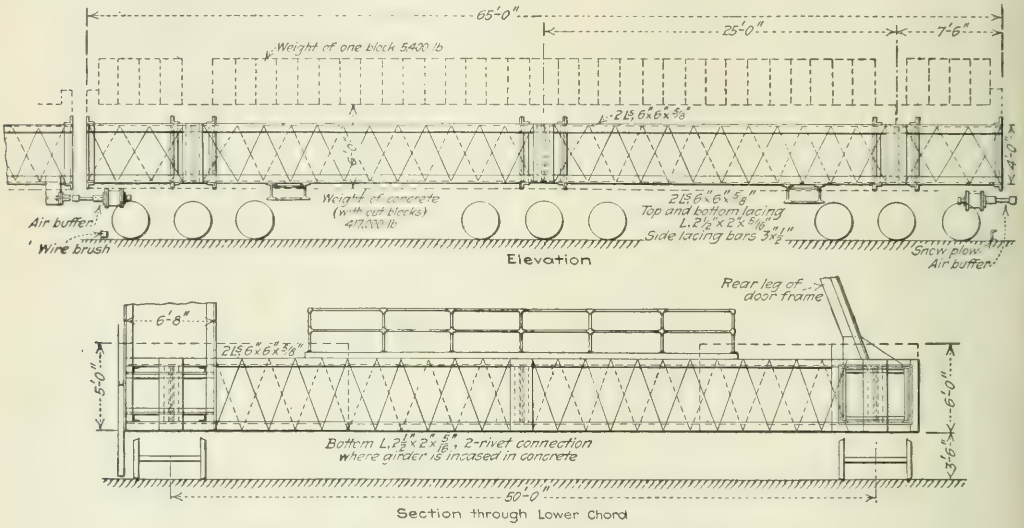

65'-0"
25'-0"
7'-6"
Weight of one block 5,400 lb
2L^s 6"x6"x5/8"
4'-0"
6'-0"
Weight of concrete (with cut blocks) 417,000 lb
2L^s 6"x6"x5/8"
Top and bottom lacing L.2½"x2"x5/16"
Side lacing bars 3"x½"
Air buffer
Wire brush
Snow plow
Air buffer
Elevation
Rear leg of door frame
6'-8"
2L^s 6"x6"x5/8"
5'-0"
6'-0"
3'-6"
Bottom L.2½"x2"x5/16", 2-rivet connection where girder is incased in concrete
50'-0"
Section through Lower Chord

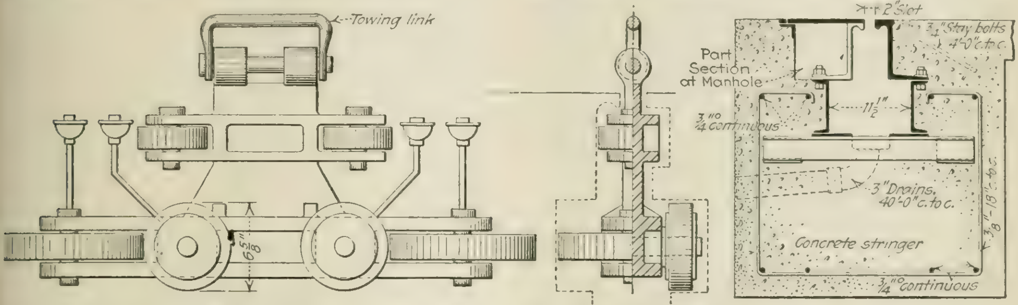
FIG. 6—BASE GIRDERS AND TRUCK ARRANGEMENT OF DOOR

End Doors—At each end of the hangar is a pair of self-supporting rolling doors which cover the entire height and width of the structure. Two of the leaves are shown in the open position in Fig. 1. Each leaf or half-door, Fig. 5, is composed of vertical and horizontal trusses, braced together and carrying a facing of corrugated asbestos. This framework is supported by tall A-frames, as shown. The entire structure of the leaf is carried by six-wheeled trucks on two standard-gage tracks spaced 50 ft. c. to c., these tracks being transverse to the center line of the hangar and laid with 80-lb. rails. The four corner trucks are fitted with electric motors and the two others are idlers.

Heavy framing is used for the base of the doors, as shown in Fig. 6. Cast steel bolsters on the trucks carry latticed box girders, the one nearer the building being 75½ ft. long and 6 x 6 ft. in cross-section, and the other girder 65½ ft. long, of similar cross-section. Each girder rests on three trucks spaced 25 ft. apart. These two girders are tied and cross-braced with built-up latticed I-girders. On the long girder is carried the structural steel door superstructure, back braced to the rear girder by the A-frames. This superstructure is similar in outline to half the end opening and carries sheathing to cover its share of the end of the building.

There are approximately 135 tons of steel in a leaf, and this weight is increased by 200 tons of concrete in each main girder, besides 100 tons of movable concrete counterweight blocks placed on top of the rear girder. This brings the total weight of a door leaf to over 600 tons. The purpose of the heavy counterweighting is to resist the overturning tendency when the leaf is open and exposed to wind pressure.

In the design of the door the following loads were used: Live load is based on 30 lb. per square foot. Dead load includes the weight of the structure and counterweights but does not include the weight of the trucks and operating mechanism.



Elevation of Trolley

Sectional End Elevation

FIG 7—DOCKING CONDUIT AND TOWING TROLLEY FOR HANGAR

1. Total vertical dead load per truck: 205,600 lb.
2. Total vertical dead and live loads on the three leeward wheels per truck; 196,900 lb.
3. Total vertical dead and live load on the three windward wheels per truck; 145,900 lb.
4. Total horizontal live load per truck; 64,000 lb., which is resisted by the flanges of the three leeward wheels in contact with the rail head.

Door Operation—The trucks carrying the doors have 2-in. armor-plate side frames and 33-in. cast-iron wheels with chilled treads, with a wheelbase of 9 ft. On each motor truck (four per leaf) the axle at one end is driven by gearing from a motor and power is transmitted to the middle axle by coupling-rods on the wheels. The 250-volt motors are rated at 27½ hp. and it is calculated that 45 hp. per motor will be required in starting and 6 hp. when running at the rate of 10 ft. per minute. All four motors are operated in parallel through a master switch located in a small control house on the door platform.

When opening, the door leaf may be stopped in three ways: (1) By a limit switch tripping the circuit breaker in the control house; (2) by pneumatic buffers on the truck frames striking the concrete bumpers; or (3) by throwing off the master switch, which releases the solenoids on the motor pulley brakes, strong springs holding the brakeshoes against the pulley. The truck buffers are plungers working in pneumatic cylinders. When closing the doors, each leaf is stopped by means of cast-steel blocks bolted to the rails. As the leaf reaches its closed position, these stops engage brakeshoes suspended from the truck frame and bring these shoes in contact with the wheels.

In emergency, the doors may be moved by means of a hand operating mechanism designed to obtain a speed of at least one foot per minute. A capstan for eight 10-ft. handles is mounted on the center of the door platform, a 4-in. reinforced-concrete floor permitting manning and operating of the capstan. The capstan head is geared to a vertical shaft whose lower end carries a bevel pinion transmitting the power through bevel gears to two cross shafts which are in line with each other and each of which carries a drum on which is coiled a 1-in. plow-steel cable.

To operate the doors by hand, the two drums of each leaf are released from their shafts to allow them to revolve freely, so that the cables can be hauled off and attached to deadmen or anchors at the end of the track. With the drums again keyed to the shaft they are driven by means of the capstan, the door being hauled on the track as the cables wind on the drums.

Where the docking-rail conduits cross the door tracks there are installed manganese steel crossovers which close the 2-in. gap in the docking rail by means of two movable rail sections. Added protection is provided by an electric switch which trips the door feeder circuit in the substation should the movable section of rail be ⅜ in. out of place. Power is brought to the door motors through an armored flexible cable suspended from a 40-ft. steep pole to an outrigger on the door (Figs. 1 and 5).

Docking Rails and Trolleys—Airships will be towed in and out of the hangar by trolleys traveling in longitudinal conduits, each trolley having a towing link which projects through a 2-in. slot in the floor of the hangar. Towing cables attached to the airship are hitched to the trolley by means of a cable-releasing device. There are eight trolleys in all and they are handled by men by means of tow ropes. In this way the airship is prevented from getting away when once secured to the underground trolley.

There are two of these conduits 137 ft. apart and 3,610 ft. long, extending 1,400 ft. beyond each end of the 810-ft. hangar. As shown in Fig. 7, the conduit is formed by a pair of 7-in. channels with base plates, tied together at the bottom by transverse angles. Upon these channels are two 8-in. 81-lb. slot rails, forming a 2-in. slot in the floor of the hangar. This whole steel structure is embedded in a reinforced-concrete stringer, the slot rails being held in position by diagonal rods with anchor plates. The trolley or towing carriage has four 6⅝-in. wheels riding on the bottom plates of the conduit and is held in upright position by horizontal guide rails riding against the sides of both the wide and narrow portions of the conduit. All these wheels have roller bearings. A manhole at each end of the docking rail provides for removal of the trolley. Manholes for oiling are spaced approximately 150 ft. apart.

Heating and Lighting—Along the sides of the building, between the A-frames, are twelve rooms 60 ft. long, 16 ft. high and 22 ft. 6 in. wide, with 2½-in. metal and plaster walls. Approximately 400 sq.ft. of ceiling type radiation is required for heating these rooms, low-pressure steam being supplied from two sectional boilers in the boiler house. For artificial lighting there are seven rows of lights running the length of the building, with a 200-watt lamp and 16-in. reflector in each bay per run. In addition, there are 250-watt projectors, 16 ft. above the floor, on all the A-frames except those at the ends, making a total of fifty-two projectors. Eight 200-watt flood lights are on the gable at either end of the roof. In addition, at each end of the peak of the roof is a lookout house, 7½ x 15 ft., surmounted by a platform carrying a 36-in. searchlight.

Gasholder—For the gas plant, the hydrogen tank is a 500,000-cu.ft. triple-lift holder, with water tank approximately 100 ft. in diameter and 26 ft. high. This water tank rests on a heavy concrete foundation, and carries a guide frame 75 ft. high on column supports riveted to the sides. Each lift is approximately 25 ft. high and, when inflated, the pressures are 5 in. of water for one lift, 6½ in. for two lifts and 9 in. for three lifts. There are approximately 400 tons of steel in this structure. A 50-hp. boiler at 100 lb. pressure furnishes steam to protect the tank in freezing weather. There is a 16-in. inlet and a 16-in. outlet, the latter reduced to 10 in. to supply hydrogen to the 10-in. pipe line extending 1,400 ft. to the hangar. On this pipe line is a meter with a capacity of 35,000 cu.ft. per hour. A concrete trench protects the 10-in. hydrogen, 2-in. air and 22-in. water lines inside the hangar.

Construction Work—The main structure is practically completed, but the 2,300-volt incoming electric line, the substation, gas plant and oil-cracking plant will probably be completed this month. Construction was done for the Air Service by the W. M. Sutherland Building & Contracting Co., St. Louis, Mo., under supervision of the Construction Service of the Quartermaster Corps, U. S. Army. Steel erection of the hangar was handled by the Strobel Steel Construction Co., Chicago. The total cost of the entire plant will be about $1,400,000, of which the hangar represents $1,250,000.

Drawbridge Pier Destroyed by Steamer

An extraordinary accident in which the rest pier of a single-leaf bascule bridge was demolished, occurred in England on Dec. 17. The bridge has ten girder spans and a bascule lift span carrying a highway and the Southeastern & Chatham Ry. over the river Swale. The clear width of waterway is 58½ ft. and as the 7,000-ton steamer "Gyp" was about 48 ft. wide the owners were warned of the risk in taking so large a vessel through the draw. In some way the steamer got beyond control and struck the rest pier with such force as to knock it over, leaving the adjacent fixed span standing as a cantilever, as shown by photographs in the *Railway Gazette*, London. The extent of damage to the ship is not reported.

New York State Highway Construction

THE following figures, which set forth the present status of New York state highway construction, were presented by John H. Gordon, president of the New York State Roadbuilders' Association at its annual banquet held recently in Albany.

Work completed in 1922 that was awarded in:	
1919	$352,000
1920	301,000
1921	8,561,000
1921 (repairs)	1,653,000
1922	4,697,000
1922 (repairs)	764,000
Total completed during 1922	$16,328,000
On Jan. 1, 1923, there remained to be completed, work awarded in:	
1919	$40,000
1921	1,787,000
1922	11,645,000
1922 (repairs)	2,020,000
Total remaining to be done, as of Jan. 1, 1923	$15,492,000
Construction contracts awarded 1922	$16,470,000
Repair contracts awarded 1922	2,784,000
	$19,254,000
Of the construction awarded in 1922, $129,000 was cancelled.	
Appropriations for work to be let during 1923:	
Construction	$18,000,000
Repairs	9,988,000
	$27,988,000
A summary of conditions now and a year ago shows the following:	
Work done in 1921	$25,105,000
Work done in 1922	16,329,000
Excess of work done in 1921	$8.776,000
Work left over from 1922	15,492,000
Work left over from 1921	12,633,000
Excess of work left over from 1922	$2,859,000

In explanation of the drop in work done and of the increase in work left over from 1922, Herbert S. Sisson, retiring commissioner of highways, who was present when these figures were announced, pointed out that the season of 1922 was unfavorable for construction work due largely to weather conditions and to the upset transportation conditions brought about by the railroad and coal strikes. He indicated also that probably 50 per cent of the contracts to be awarded this year will not be let before the middle of the construction season and that these cannot be begun before 1924.

Utilization of Blue-Stained Lumber

While it has been established that blue stain in lumber is not an early stage of decay, but merely an indication of the presence in the sapwood of a fungus which does not materially affect the strength of the wood for ordinary commercial purposes, no absolutely effective method of preventing it other than kiln drying has been found. Kiln tests at the Forest Products Laboratory, of the Forest Service, have shown that a temperature of 140 deg. F. for a period of 6 hours is sufficient to kill the blue-stain fungus in the center of test pieces up to 4 in. square. No chemical dip for green lumber has been found which is remedial in periods of continued rain during the warm months. Until a suitable method of prevention is found applicable in cases where kiln drying is not feasible, intelligent utilization of the discolored stock will remain the only means of discounting the damage done by the blue-stain fungus when the methods now available have failed to keep it out. Resurfacing will not help when the fungus has made substantial penetration. Blue stain is freely accepted in rough lumber, lath, scantling, plank and some of the larger sizes of dimensions. More could well be used in the manufacture of sash· doors, millwork and other products when the discoloration is to be painted or otherwise hidden from view.

Referendum Shows Ohio Engineers Against Registration

Engineers Club of Cincinnati Brings Out Sentiment Prior to Vote of Legislature on Proposed Legislation

By Edgar Dow Gilman
Chairman, Registration Committee, Engineers' Club of Cincinnati

The question of registration for engineers in Ohio has been raised this year by the presentation of a bill to the General Assembly by a group acting under the name "Associated Engineering Organizations of Ohio." This association was formed only a few weeks ago, and for the sole purpose of promoting a registration bill. The bill which has been presented provides for the compulsory registration of engineers employed by or doing work for the state or its subdivisions, and the optional registration of other engineers.

The Engineers' Club of Cincinnati, after carefully considering the whole question of registration, came to the conclusion that such statutory action is wholly unnecessary from the viewpoint of public welfare, and to a considerable extent is duplication of existing and functioning state boards. It was also held that no benefits would accrue to engineers therefrom, and that even if such benefits were to be derived, it is against the best public policy for a state to pass legislation based upon professional benefit. However, the Engineers' Club took the position that if a majority of practising engineers in the state really believed in the bill, the club would take no steps to oppose it.

The sentiment of the engineers of the state was secured by submitting a prepaid ballot to all Ohio members of the American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, and the American Institute of Chemical Engineers. It was, and is, believed that this will represent as true a cross-section of the opinions of practising engineers as could possibly be obtained. Two questions were printed on the post card ballot, the first asking for an opinion on the question of registration as a principle, and the second for an expression on the particular bill now before the legislature. The results are shown in the accompanying tables.

TABLE I—LETTERS SENT OUT

Society	Letters	Replies	Per Cent Replies
A. S. C. E.	444	222	50.0
A. S. M. E.	1,000	348	34.8
A. I. E. E.	530	225	42.4
A. I. Ch. E.	53	21	39 6
	2,027	816	40.2

TABLE II—GENERAL RETURNS

	Favor Principle of Registration Yes	Favor Principle of Registration No	Favor Present Bill Yes	Favor Present Bill No	No. Votes
1 Straight ballots	168	572	168	572	740
2. Favor Prin -Oppose bill	29	...	...	29	29
3. Oppose Prin.-Favor bill	...	12	12	...	12
4. Incomplete ballots	16	...	2	4	22
5. No vote	...	...	...	.	13
	213	584	182	605	816

TABLE IIIa—GEOGRAPHICAL AND SOCIETY RETURNS, PRINCIPLE OF REGISTRATION

	A.S.C.E.			A.S.M.E.			A.I.E.E.			A.I.Ch.E.			Total		
	Yes	No	Vote	Yes	No	Vote	Yes	No	Vote	Yes	No	Vote	Yes	No	Vote
Akron	7	5	12	5	11	16	2	10	12	1	1	2	15	27	42
Canton	1	..	1	1	4	5	..	5	5	.			2	9	11
Cincinnati	6	24	31	6	80	86	4	24	29	2	2	4	18	130	150
Cleveland	33	30	67	18	71	90	17	66	85		9	9	68	176	251
Columbus	23	6	29	9	18	27	4	9	14			1	36	33	71
Dayton	11	9	21	4	14	18		19	19				15	42	58
Mansfield					6	6		11	11					17	17
Toledo	14	5	19	6	22	30	4	8	12		1	1	24	36	62
Youngstown	3	3	6		5	5	3	2	5	.	..		6	10	16
Scattered	18	17	36	6	56	65	4	28	33	1	3	4	29	104	138
	116	99	222	55	287	348	38	182	225	4	16	21	213	584	816

TABLE IIIb—GEOGRAPHICAL AND SOCIETY RETURNS, PRESENT BILL

	A.S.C.E.			A.S.M.E.			A.I.E.E.			A.I.Ch.E.			Total		
	Yes	No	Vote	Yes	No	Vote	Yes	No	Vote	Yes	No	Vote	Yes	No	Vote
Akron	4	7	12	4	12	16	2	10	12	1	1	2	11	30	42
Canton	.	1	1	1	4	5	..	5	5	..			1	10	11
Cincinnati	7	24	31	5	81	86	2	26	29	1	3	4	15	134	150
Cleveland	30	33	67	20	70	90	17	65	85	..	9	9	67	177	251
Columbus	20	8	29	9	17	27	2	11	14	..		1	31	36	71
Dayton	10	10	21	3	14	18	..	19	19	..			13	43	58
Mansfield		..	..	..	6	6	..	11	11	..				17	17
Toledo	10	7	19	4	24	30	2	8	12	..	1	1	16	40	62
Youngstown	3	3	6		5	5	1	3	5	..			4	11	16
Scattered	15	19	36	4	57	65	4	28	33	1	3	4	24	107	137
	99	112	222	50	290	348	30	186	225	3	17	21	182	605	816

This shows 2.74 to 1 against any registration, and 3.33 to 1 against this particular bill. There are 59 different towns under the item "scattered."

It is interesting to note in Table II the number of ballots which are opposed to the principle of registration, but which favor the registration bill. Most of these come from Cleveland, and were accompanied by explanations that the writers did not believe registration would be of any value to the public or to the engineer, but that it was sure to come, and they were in favor of letting this bill go through because it was drawn so as to have as little effect as possible. The fear was expressed that if this bill was not adopted, some other, having greater objections, might be forced upon the engineers of the state. These ideas are so widespread in the correspondence from Cleveland, that one is led to believe it was systematically used in that city, and to wonder how many of the "yes" votes were caused by this argument. In spite of this, Cleveland goes on record as 176 to 68 against the principle, and 177 to 67 against the particular bill. The closeness of these figures is purely a coincidence, as there were many incomplete and split ballots from this city.

The vote of the electrical and mechanical engineers of the state, as compared with the civil vote brings out some interesting points. The writer does not wish to attempt an analysis of this marked divergence, but believes it may bring out some interesting discussions, and might eventually lead to rational legislation. The civil engineers have a slight majority favoring some registration, but also have a slight majority disapproving the present bill. The electrical and mechanical and chemical engineers are overwhelmingly opposed to any registration whatever.

In view of the ballots shown above, the Engineers' Club of Cincinnati is actively opposing House Bill No. 146, before the House of Representatives, providing for the registration of engineers in Ohio.

Cotton Belt R.R. to Spend $3,750,000

Expenditures totaling $3,750,000 for betterments were approved at a recent meeting of the directors of the Cotton Belt R.R. held in Tyler, Tex. Twelve hundred freight cars will be purchased, their cost to be about $2,500,000.

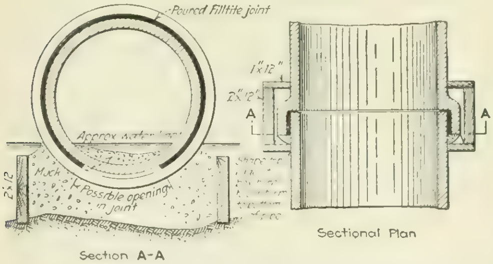
Making Sewer Joints with the Pipe Partly Under Water

Low-Lying Line Paralleling River in Fort Madison, Iowa, Successfully Laid Utilizing Both Plastic and Solid Material

By L. B. Reynolds
Member of Firm of Burns & McDonnell, Kansas City, Mo.

EXPERIENCE in making joints in unusually wet trenches in the recently completed reconstruction and extension of the Fort Madison (Iowa) $400,000 sanitary sewer system brought out the good and bad points of various kinds of joint material. The ingenuity of the contractors and engineers was also under test. Assurance of good joints as well as support for the pipe in insecure ground was finally effected by the use of a bottomless wood box and form within which the joint was made after the sand had been removed.

The new system has three gravity outlets and one pumping outlet, the latter serving a low district along the river. Some water and quicksand were encountered on the high lines but the pumping station and low lines were constructed with considerable difficulty, due to the soil conditions. The pumping station is located on the river front opposite the central portion of the city and the sewage is pumped into the river through 375 ft. of cast-iron pipe. The pumping equipment consists of three 150-gal. ejectors and is located under the same roof with the air compressing equipment.



BOTTOMLESS BOX FOR MAKING JOINTS

Combined "filtite" and concrete joint made in box filled with concrete after filtite poured to fill possible opening in bottom of joint.

At the lower end the main 24-in. line which parallels the river is 8 ft. below water level in the river and at the upper ends the two branch mains are 1 ft. below water level. Below the surface soil the formation consisted of coarse sand and gravel with pockets of quicksand and some material more nearly a slime than a quicksand. Tight sheeting was necessary on all these lines and at times the pressure became so great from the thoroughly saturated ground that it was necessary to double brace the trench for stretches of 40 to 50 ft. Settlement of sheeting into the bottom of the trench was a common occurrence, accompanied by a general subsidence of the surface near the trench and an upheaval of the bottom of the trench. Increased difficulties were encountered in the form of bubbling springs and sink holes, some of them large enough to engulf a man to the knees should he accidentally step into them. The pressure was quite often so great that it was necessary to hold the pipe down to grade with braces nailed to the sheeting. Sand was continually being washed down upon the pipe work and quite often the sand had to be shoveled back continuously while laying a joint of pipe.

The contractor was protected in this hazardous work by a clause in the specifications allowing him the extra cost of sheeting and bracing and handling water. The specifications also contained a clause allowing the use of special and plastic joints under the usual stipulations for additional work at cost plus a percentage.

Bottomless Box Method—Tests were made before starting the work with several plastic pipe compounds under conditions approximating actual trench work with the pipe partially under water, but it was decided that a good joint could not be assured with any compound poured hot. Too often openings would be found at the bottom of the joint. During the progress of the deep line work continual pumping was necessary, but even then the trench could not be kept entirely clear of water and the pipe had to be laid in water covering one-third to one-half of the pipe. The bottomless box scheme was then devised. The sides were of 1 x 12-in. boards cut down half way on each side to fit the pipe. The ends were of 2 x 10-in. blocks and the length of the box was 12 in. greater than the maximum outside diameter of the pipe. The boxes were placed in the trench so that the bell came inside the box and were then adjusted to bring the pipe to line and grade. The runner was then placed and "filtite" furnished by the Pacific Flush Tank Co., was poured. The form was then cleaned out, filled with concrete and any opening in the bottom of the joint was thus sealed. The contractor favored this method at first, but his pipe-laying gang did not fully co-operate. Difficulties arose. Crooked and narrow places in the trench required sawing off the end of the box which filled with quicksand. The box was held on line and grade with difficulty.

After using the above method for 200 ft. during which time the speed of the entire work had been discouragingly slow due mostly to the inability to complete the excavation fast enough, the contractor and city desired that a new kind of joint be used. A demonstration of the Weston gasket and form, made by L. A. Weston of Adams, Mass., was arranged. The gasket is of galvanized iron, the inner flange being drawn tight on the pipe by means of a small bolt. Though the outer flange is notched to make it pliable it is still sufficiently stiff to form a support for the pipe and to hold it to the flow-line level. The form is of galvanized iron, extends two-thirds of the way around the pipe and is attached firmly by two wires to provide a form for the mortar. Every effort was used to clean out any sand deposited in the form by blowing it out with a steam or air hose passed around inside the form to the bottom. Rich grout was then poured quickly into the form, a laborer forcing it down with some pressure in an attempt to compact the mass, care being taken not to force it through the gasket. A stiffer mortar was used for the upper part of the joint. With 8-in. pipe a packing of clay was used around the mortar when available. Excavated material was thrown back over the joint just laid, but this method was not deemed advisable with large pipe or where there was considerable water. In many places where the foundation was soft, dry-mixed concrete of Class "B" quality was dumped in the bottom of the trench without any form or spading, although an effort was made to keep it from being disturbed. In soft places this dry material was pushed into the bottom to provide a foundation for the pipe, as much as a yard being used under one joint in some cases. Pumping was continued for at least two hours after the last pipe was laid to prevent undue pressure on the green joint and then the water was allowed to rise over the pipe during the night. The Weston joint was used on the remainder of the 24-in. pipe.

On 18-in. and smaller pipe "filtite" and Weston joints were alternated, the former being poured on the bank where a perfect joint could be obtained. The two sections of pipe were then lowered into the trench and the Weston joint made. This was believed to be the best method of construction, as it was certain that at least every other joint would be watertight and also flexible enough to allow some settlement without breaking the pipe or the joints.

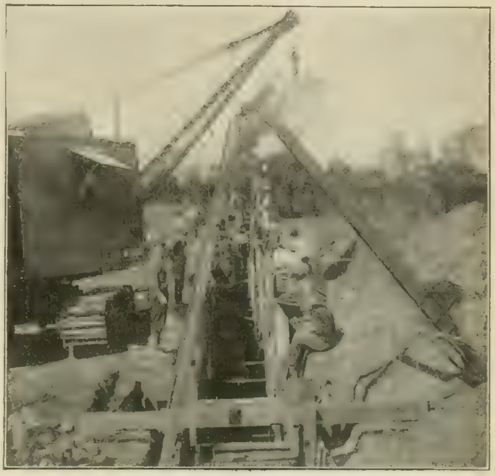
Inspection—After the low lines were completed an interior inspection of the 24 and 18-in. pipe was made, which revealed the results of the pipelaying methods. The only failure found with the combined form of joint (using filtite with the concrete box beneath) was when the filtite did not reach down to the concrete, thus leaving an opening. In these cases the box had been cut off on one side due to a crooked trench, thus bringing the pipe so close to the sheeting that there was no chance of inspection before backfilling.

Actual cost records showed that no more labor was required with the filtite joints than with the Weston joints. If properly laid the percentage of failures would be small and the danger of rupture by settlement would be slight. However, the possibility of filtite running through the oakum somewhere seems to be against its use for pipe too small to allow an interior inspection.

The joint failures with the Weston gasket and form occurred in a number of different ways. Where the joint was used in water there was almost always a slight current flowing through the slit openings of the form or through openings where the form did not fit tightly around the spigot or bell. In a fine sand formation this continuous flow of water tended to carry sand into the form in the interval between the blowing out of the joint with steam and the pouring of the grout. When the water in the trench was half-way up on the pipe, or more, this deposit of sand often took place without being noted. The accumulation of sand in the bottom of the form, due to its not being completely blown out or to its being subsequently washed in or to a settling out of the sand from the joint mortar, was sometimes washed out later leaving an opening in the joint which was not discovered until the interior inspection was made.

Grout Difficulties—Sometimes at the time of pouring the joint, or subsequently, some of the grout found its way into the interior of the pipe. Oakum was tried, but without great success, in connection with the Weston gasket to prevent this entry of grout. When the grout ran directly into the pipe at the time of pouring, the loss was usually noticed by the amount of grout required or by a subsidence in the form. Sometimes, however, the grout would settle after the stiffer top mortar was partly set and the subsidence of the grout would not be noticed, thus leaving an opening on the side. In some cases the pressure of bubbling springs may have set up currents of water which gradually carried away the grouting from the bottom of the form until an opening was produced through the joint. An inspection of all uncovered joints was made frequently to detect such defects. Whenever the grout ran into the interior of the pipe there was the probability of a considerable deposit of mortar on the inside which later had to be chipped out or dragged out in the case of pipe too small for interior work.

When the interior inspection of the larger pipe was made accumulations of mortar and filtite were found in several places and removed. All openings greater than ¾ in. wide were filled with mortar or with strips of lead molded to fit the opening if the leaks did not allow mortar to be placed. On the smaller lines only such leaks were repaired as could be seen from manholes or Y's by the use of mirrors.



DEEP MAIN SEWER LINE EXCAVATED WITH TRENCHING MACHINE AND BACKFILLED WITH CLAM SHELL

Leakage—The total leakage of more than 200 gal. per minute before any repair work was done was reduced to 87 gal. after the leakage elimination work was completed. Of the 4.3 miles of pipe in the pumping system sections totaling 3.4 miles were laid in wet trenches. The leakage per mile of main per day on the pumping system is 29,700 gal., which was considered to be the minimum obtainable at reasonable cost under the existing conditions. The total cost of the low lines exclusive of the ejector station was $128,000, of which $34,500 was allowed above the bid prices, to cover the cost of handling water and the extra cost of sheeting, bracing and special joints made necessary by the water and quicksand.

The contractor was the National Construction Co., of Davenport, Iowa. The supervising engineer in charge of the work was M. H. Walser, of Burrs & McDonnell Engineering Co.

Statistics of Some Leading British Railways

Railway	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	£		£			
Gt. Eastern	54,144,330	1,133	[illegible]	1,284	5,748	[illegible]
Gt. Central	[illegible]	[illegible]	[illegible]	[illegible]	2,698	34,433
Gt. Northern	54,592,525	[illegible]	[illegible]	1,359	3,399	[illegible]
Gt. Western	[illegible]	[illegible]	[illegible]	[illegible]	8,604	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4,414	34,431
[illegible]	[illegible]	[illegible]	[illegible]	3,051	9,371	75,739
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6,742	[illegible]
North Eastern	86,374,564	[illegible]	[illegible]	[illegible]	[illegible]	116,655

Pumping Assists Reclamation of Alkali Lands

Experiments on Land Spoiled by Irrigation—Drainage Accelerated by Pumping Is Better Than Gravity Flow

TO RESTORE LAND to a cultivable condition after it has been rendered alkaline by excessive irrigation or seepage from irrigated areas a combination of drainage to lower the water table and flooding to wash out the salts has been employed in several cases, but this process can be accelerated by pumping. This is the main point of a paper presented before the National Drainage Congress by W. W. Weir, assistant professor of soil technology at the University of California. Further, he suggests that the cost of pumping may be reduced by using the water elsewhere for irrigation. He points out, however, that the first consideration should be to prevent the waterlogging of land by excess irrigation or by seepage water, since it is almost impossible to restore the land to its original productivity. A brief abstract of Mr. Weir's paper, dealing with developments in this land reclamation problem in California is given below.

Some forty years ago Dr. Hilgard began studying soil alkali in relation to irrigation and he predicted the increase in drainage that would result from the continued use of excessive amounts of water. He recommended draining the land to reduce the water table and flooding the land after drainage to leach out the alkali and redistribute it throughout the soil. He also advocated the use of gypsum on black alkali land in order to change it over to the more leachable sulphate form.

Flooding land after drainage, in order to wash the surface accumulations of alkali back into the soil and out through the drains, is being practiced today about as advocated forty years ago. But the lowering of the water table by drainage is not sufficient to bring a highly alkaline tract back into productiveness. It is necessary next to remove the alkali which has already accumulated. The process is to prepare the land so that it can be flooded to a depth of six to twelve inches and kept under water for a period. The depth of water and the period of submergence are dependent upon the soil and the amount of alkali.

Engineers too often think they are through with drainage when they have accepted the drains from the contractor, but the work is not finished until the land is brought back to productiveness. Engineering advice and assistance are just as necessary in this last step as in the design of the drainage system.

A drainage district in California that was fine alfalfa, vineyard and truck land became waterlogged and alkaline, and the entire area was used as salt grass pasture. A tile drainage system was installed at a cost of about $75 per acre, and the water table was lowered to about 8 ft. At this point the officials of the district thought that they had finished with the services of their engineer, and he was discharged. Three years afterward the land was not producing as much as it did before it was drained, as the salt grass had died because of the removal of the moisture. The trouble was that the land now had to be irrigated, reclaimed from alkali and put back into alfalfa. This was an engineering job.

In regard to the black alkali or sodium carbonate problem, Dr. Hilgard probably was partly right when he advocated the use of gypsum on black alkali land. But, he failed to appreciate the importance of black alkali, or the practical difficulties in handling it. It is substantially true that there never has been a black alkali area successfully reclaimed. There have been numerous attempts, but for one reason or another they have not been successful.

Experience with Black Alkali—In 1912 the University of California took a bad piece of black alkali land, 160 acres, in which it was thought possible to eliminate all of the reasons that had been assigned for failures in other sections, such as insufficient depth of drainage, feeble attempts at flooding, lack of interest, etc. It was drained with tile, flooded, and everything else done that was thought necessary. Furthermore, we had almost complete control of the operations. But the tract is not yet producing as good crops as it did before it became alkaline. After five or six years the University started more complete investigations, with the result that we discovered that we were tackling something that had never been done, namely, the complete reclamation of black alkali land. I do not say it cannot be done, but so far as we have been able to learn, it never has been done.

We then took a small area of about seven acres, divided into nine plots, in the worst land that had been tile drained, and proceeded to treat it intensively. The tract was carefully leveled, plowed and prepared as a seed bed. The soil was sampled and tested for alkali. Gypsum was then applied at the rate of three tons and six tons per acre to three plots each, the other three plots remaining as checks. The nine plots were then flooded to a depth of about one foot. When the water had disappeared, which required a couple of weeks, the plots were cultivated and flooded again. This was repeated a third time. Barley was then planted, and the yield plotted and compared with the yield that had been grown and plotted previous to the treatment. This process has been repeated with the addition of more gypsum to three of the plots, and sulphur added to additional plots. The soil sampling, crop yields and all other data have now been obtained for three years.

Briefly, we have very greatly improved all of the plots; those to which only water was added, as well as those to which gypsum was added. The balance, however, is in favor of the gypsum when only yields of barley are considered. But when cost is considered, the whole thing has not been a success. Even those plots upon which the most gypsum was applied are not yet 100 per cent perfect. The result indicates that we do not know how to treat black alkali land commercially in order to reclaim it.

This work may seem beyond the realm of the engineer, but in fact it is an engineering problem just as much as the building of a bridge. The engineer might as well say: "I've built a bridge, what do I care whether it is fit to travel over or not." The engineer is vitally concerned as to whether a piece of land upon which he has placed tile drains will grow anything. We are certain of this one thing regarding alkali; that it is necessary, as the first step, to lower the water table or to keep it beyond capillary reach of the surface.

Pumping appears to me to be a logical and entirely feasible method of reducing the water table over many areas which have poor drainage as a result of irrigation. The essential points are to find a well or series of wells capable of delivering a good supply, put on pumps of sufficient size to take it out, and to find a continuous use for the water. The advantages are: (1) Possibility of lowering the water table below any depth feasible by a gravity system, thus assuring the success of alkali prevention; (2) it makes more available the water developed than would be possible by a gravity system where it would be necessary in most cases to pump it on to higher lands; (3) the first cost is considerably less than gravity drainage; (4) it is applicable where gravity outlets are unavailable. The disadvantages are: (1) The dependence of pumps on human beings for their continued operation; (2) the operating costs.

In closing, let me repeat that the only true remedy for alkali and waterlogging conditions is to prevent its occurring. This brings us again to the pumping idea. Every sound irrigation development in the future will be based on obtaining at least a portion of its water from underground sources. New developments that have no present prospect of gravity water can succeed if the older waterlogged areas will permit pumping. And the older waterlogged areas are doomed to failure unless they do pump from their ever-increasing underground supply. Thus irrigation and drainage will work hand in hand.

Lining a Power Ditch While in Service

Precast Semi-Circular Frames Made of Gunite Dropped Into Flowing Stream and Joined When Sections Are Laid Dry—Concrete Materials Floated to Place in Welded Steel Tubs

IN THE development of the El Dorado hydro-electric project of the Western States Gas and Electric Co., in the Sierra mountains near Placerville, Calif., an old unlined power ditch is being lined with concrete by a novel application of precast sections built up by the cement gun and sunk into place in the flowing ditch.

This old ditch, in the American River canyon, dates back to gold rush days and now is subject to claims of the city of Placerville for its water supply. The water rights were purchased by the power company, still subject to the city's claim, and the ditch made a part of the new power plant which will develop 26,000 hp. from a series of reservoirs. Incident to the improvement it was necessary to enlarge the capacity of the ditch, at the same time not shutting off its flow for any length of time. The method here described was adopted as an alternative to bypassing, which it was felt would be unduly expensive.

Determination was made to take advantage of the high strength of gunite and the ease of placing and of handling within a few hours after it is shot. Heavy steel forms fully braced across the top, as will be seen in Fig. 1, were built and fitted along the edges with a slotted shoulder, so arranged with thumb screws at each slot that each strand of the 2x2 in. reinforcing mesh will be firmly held in place against the form. These are stood vertically on the berme of the ditch as shown in Fig. 1 and the gunite shot on to a thickness of two inches. Different methods, such as covering the forms with paper, or greasing, were tried to obtain a coating for the steel form that would insure prompt release of the gunite slab, but it was finally decided to adopt a heavy coat of shellac after the forms are cleaned and prior to placing the reinforcing mesh.

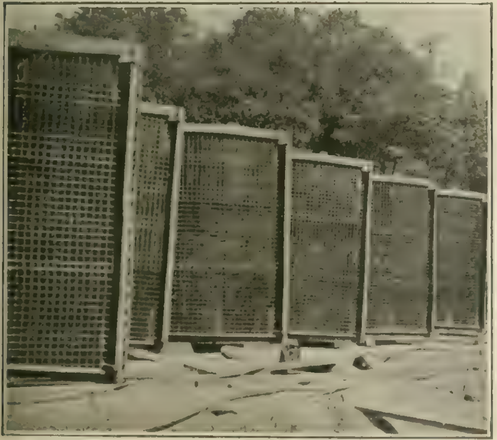


FIG. 1—FORMS READY FOR GUNITE

These frames are set up alongside the ditch and are then covered on each side with gunite and then lifted into place as shown in Fig. 3.

Fig. 1 shows a number of forms in place for guniting. Fig. 2 shows a form being lowered into the ditch. This is done by a traveling derrick which moves on rollers along the outer berme. To insure against overturning, this derrick is designed with an outrigger which spans the ditch, and is weighted down on the opposite berme. In placing the form is held firmly in its definite position of line and grade by the derrick slings while backfill is being placed behind the slab. After the backfill is completed the wires are released at the thumb screws and the form is easily lifted out of the completed slab.

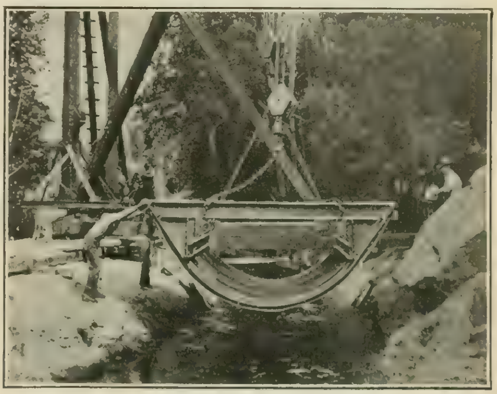


FIG. 2—LOWERING A GUNITE SECTION INTO PLACE

In addition to the derrick described above, which has its boom pointing downstream, there is, in advance of this traveler, and two or three hundred feet further downstream, a similar traveler with the derrick boom pointing upstream. The function of this traveler is to handle the forms which are floated downstream from the setting derrick on a small barge as shown in Fig. 4 and also to handle the sand and cement for the cement-gun equipment immediately adjacent. The forms after being lifted from the scow are stood on end, cleaned and shellaced and are again ready for the reinforcing mesh and gunite covering, thus insuring a continuity of operation with the same set of forms.

Each section is spaced by a spacer block at a fixed distance from the previously placed section, and after several hundred feet of lining have been completed, the water is shut off for a short time and the spaces filled with gunite shot directly in place. Inasmuch as the

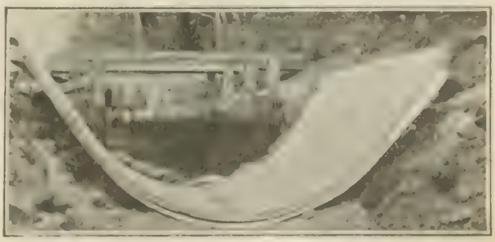


FIG. 3—A COMPLETED LINING SECTION IN DRY DITCH

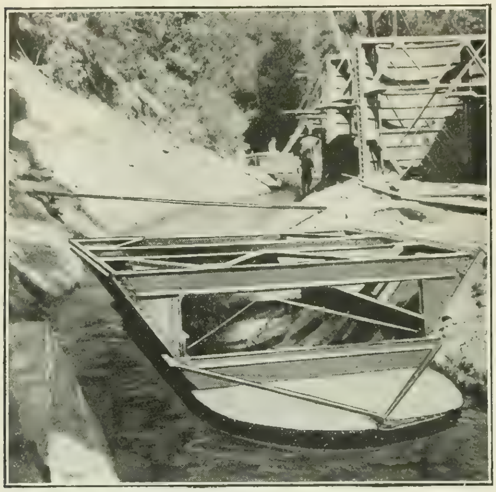


FIG. 4—CARRYING A STEEL FORM BACK TO BE GUNITED

wire mesh extends beyond the end of each section, to provide a reinforcement connection for possible future enlargement of the section, ample reinforcement is provided for these joints.

On account of the roughness of the country, transportation by road is impossible so the water in the ditch itself is made use of to carry the material. At the upstream end of the ditch a granite quarry of superior quality has been opened and a crushing plant installed for making sand. This sand is then loaded into steel tubs (Fig. 5) which are floated to the point of working. The specifications required that the tubs should be built of ⅛-in. black annealed steel sheet, 6½ ft. in diameter, with sides 3 ft. high, sloping inward to a dished bottom 10 in. deep; that the tubs float 8 in. out of water when carrying a 3,000-lb. load, and that they be leak-proof and free from projections on the outside. Two hundred such tubs were ordered.

After the materials are dumped into the bins the tubs are placed in the stream, and floated to a fixed derrick located at one of the two or three places where the ditch is crossed by the main highway. They are lifted out by this derrick, nested and carried on auto trucks back to the quarry. Cement which is brought by train to a station near the lower end of the ditch is handled by trucks to a convenient road crossing, and handled in the tubs in a similar manner.

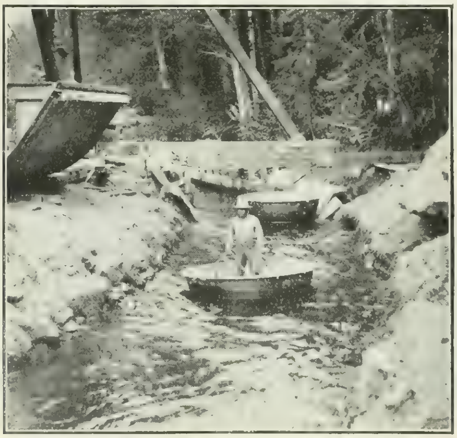


FIG. 5—TUB CARRIES MATERIAL TO CEMENT GUN

Four cement-gun equipments with accompanying derricks have been provided. Each equipment consists of one cement-gun with a 13x8 in. horizontal type double acting portable compressor. One of these compressors is driven by a gasoline motor, but the other three, as well as the derrick hoists, are driven by electricity supplied from a small unit at the dam site.

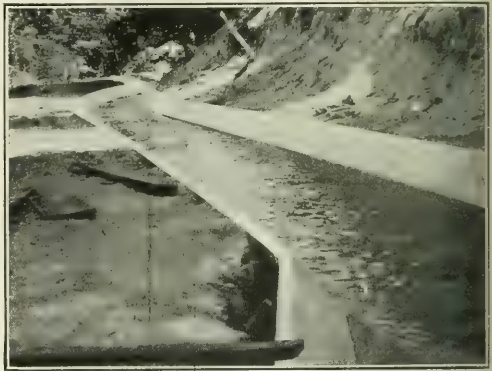


FIG. 6—COMPLETED DITCH WITH CONCRETE LINING

H. M. Byllesby & Co. are the engineers on the work, which is in direct charge of H. H. Fisher as general superintendent and W. B. Rittenhouse as chief field and designing engineer.

Effect of Gatun Lake on Local Rainfall

It has been suggested that the creation of an inland body of water as large as Gatun Lake (165 square miles) might possibly result in a slight increase in precipitation, especially during the dry season, at stations on the leeward side of the lake. A study in 1918 of the records then available, to determine whether there had been such a result, was inconclusive. It appeared then that the creation of Gatun Lake had had no appreciable effect on Isthmian rainfall, or that the effect had been so slight that records extending over a much longer period would be required to disclose even slight local increases of precipitation, resulting from the increase in atmospheric humidity due to evaporation from the lake surface. A further study of the records available to the close of the year 1921 also fails to disclose an increase in rainfall. In fact, the average annual precipitation at seven stations from Gamboa to Balboa during the years from 1913 to 1921 was less in every instance than the annual average at the same stations during the years of record prior to 1913. Even when the excessive rainfall of 1909 and 1910 is omitted from the calculation the result is the same except at one station. However, it is generally conceded that rainfall increases or decreases over long periods in indefinite cycles, and it is possible that the slight effect of the lake on precipitation was obscured by factors operating to make 1919 and 1920 years of minimum rainfall.—*Panama Canal Record.*

Stream-Flow Measurements Under Tidal Influence

Methods Applied on Sacramento River Provide for Reversal of Current and Seasonal Variations in Ocean Level

By E. A. Bailey
Flood Control Engineer
Department of Engineering, State of California

During the low water season of 1920 it was desired to determine the total flow of fresh water into the Delta of the Sacramento and San Joaquin Rivers upon which salt water from San Francisco Bay was encroaching. This necessitated measuring the discharge and establishing rating curves for these streams within the tidal influence in order to eliminate the irrigation diversions and tributaries of the valleys above. The Sacramento River was measured at Sacramento City, 60 miles above the mouth of the river, where the mean daily elevation of the water surface averaged only about a foot above mean sea level for a month, the minimum being 0.63 on July 22, with an extreme low tide that day reaching 0.5 below mean sea level and a minimum mean discharge of 440 sec.-ft. There was a tidal range of from 2 to 3 ft., with a reverse current actually carrying the water upstream past the gaging station from five to nine hours each day. To complicate the matter still further it was found that the mean tide level of the ocean varies from day to day, with a maximum range during the season of about three-fourths of a foot.

To meet these varying conditions, a system was developed whereby the mean discharge was determined with the use of special equipment during a complete tidal-cycle period about once every ten days or two weeks during the season, from which a rating curve was established after applying a correction for the variation of mean tide level, from which the mean daily discharge was determined by application of this curve to the corrected mean daily gage heights. The results obtained are believed to be within the usual limits of accuracy.

Tidal Cycle Measurements—The period of time between two successive, corresponding tides, called a "tidal cycle," is approximately 24 hr. 50 min. The effect of the tide was to produce a heavy run out during ebb tide and a slackening of the flow, and even an upstream current, during flood tide. It was necessary, therefore, to obtain practically continuous discharge measurements over the entire tidal-cycle period.

At the first of the season the velocity of the water at a fixed point in the stream, having as near as possible the mean velocity of the entire section, as determined by a complete metering of the section, was recorded by anchoring a mast in the stream with a projecting arm from which was suspended a cable passing through a pulley attached to a current meter. (See Fig. 1.) The other end of the cable was fastened to a float which was free to rise and fall with the tide, the mast acting as a guide to hold the float in a fixed position. By this means the current meter, being set at 0.6 depth of the stream at mean tide, was automatically kept very close to that depth at all times, as the tide rose and fell. The revolutions of the current meter were recorded on a chronograph stationed on the bank of the stream, and connected with the meter by an electric cable.

In this way a continuous measurement of the velocity near the mean point was obtained for the entire tidal cycle period. In addition to this, several discharge measurements with observations taken at intervals of 10 or 20 ft. across the stream were made from which the mean velocity of the stream was determined, and a curve plotted through these mean velocity points and parallel with, or similar to, the continuously measured velocity curve, where it did not coincide with the mean velocity points.

A continuous discharge curve was then constructed from the mean velocity curve and the areas of cross-section at short intervals of time, and the mean of this discharge curve obtained by a planimeter for a tidal-cycle period. (Fig. 2.) The period was so chosen that the elevation of the water surface was as nearly as possible the same at the beginning and end of the period, so as to eliminate any effect of difference in storage in the channel above the gaging station.

As the season advanced and the direction of the flow began to reverse (the maximum upstream flow at Sacramento amounting to 9 hr. 20 min. during a tidal-cycle period), too much variation in the location of the point of mean velocity of the stream was found so that the method of recording the velocity at one point continuously was abandoned and the following method pursued: One or two careful measurements of discharge were made with velocity measurements taken at close intervals, and at the time of the tide when the velocity was changing the least. From these measurements a curve was plotted showing the velocity across the stream, and certain points in the cross-section of the stream were then chosen for the regular velocity observations, as few in number as possible and yet giving a true mean velocity for each section. Velocity measurements were then taken at these chosen points in each section once each hour during the tidal-cycle period, the object being to obtain these measurements across the entire section as quickly as possible before the velocity should change materially.

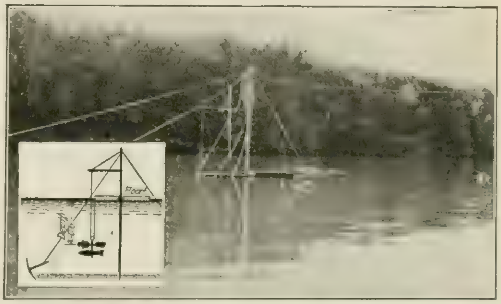


FIG. 1—ANCHORED CURRENT METER WITH FLOAT AND PULLEY TO KEEP METER AT 0.6 DEPTH

Careful soundings were taken at close intervals across the stream at high and low tides, the object being to obtain these soundings during a time when there was little or no change in the elevation of the water surface. The various soundings were plotted and their mean used, together with the mean elevation of the water surface during the periods of velocity measurements, in determining the areas for computing the discharge for such hourly measurements. A temporary

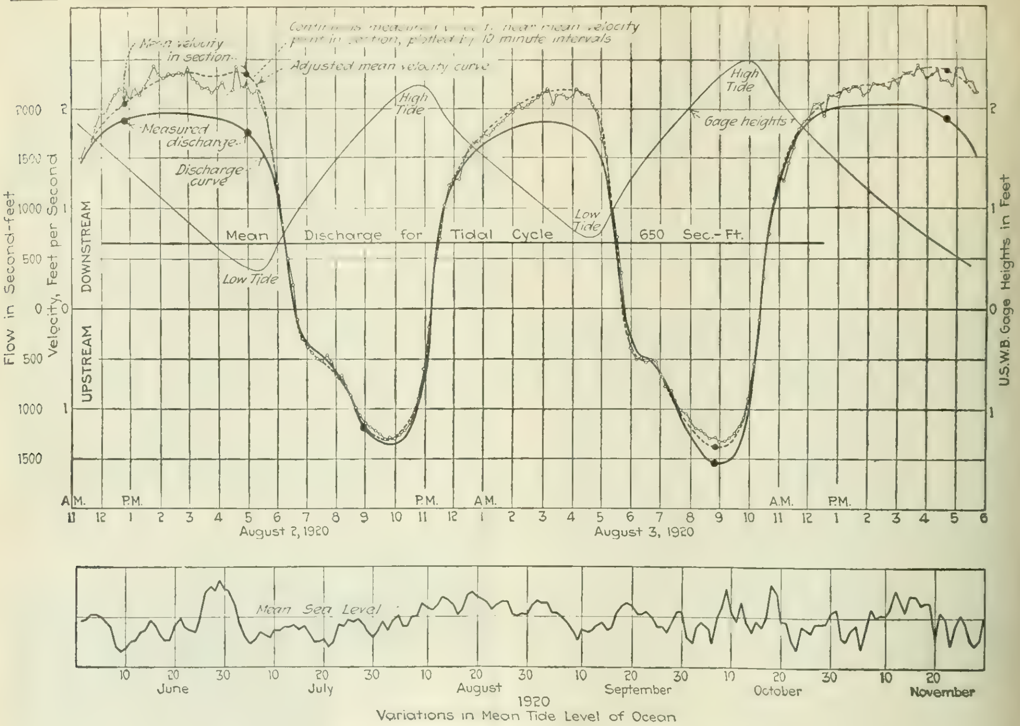


FIG. 2—TIDAL-CYCLE MEASUREMENT, SACRAMENTO RIVER

gage set at the gaging station was read as often as necessary to show a complete curve of the tidal variation. A discharge curve was then drawn through these hourly discharge measurements and the mean discharge determined as before. Velocity measurements were omitted near the time of reversal, which was determined as nearly as possible by observation of a long float, reaching nearly to the bed of the stream, and held by a long cord, from drifting too far from the observation boat.

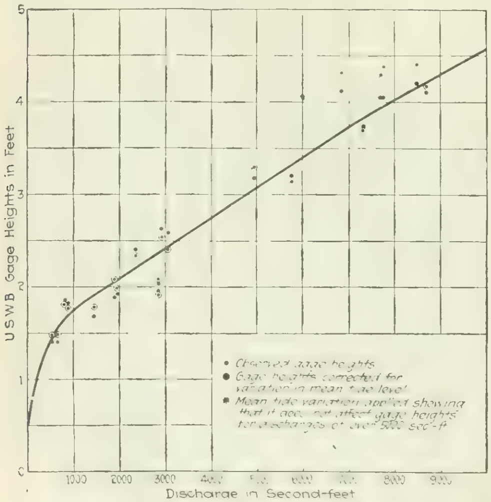


FIG. 3—RATING CURVE OF SACRAMENTO RIVER
Based on measurements at Sacramento in 1920

Variation in Mean Tide Level—During the season of 1920 the elevation of mean tide varied from 0.38 ft. above to 0.35 ft. below mean sea level. During the extreme low water period, when the elevation of the water surface at the gaging stations was but little above mean sea level, this variation in the level of the ocean was transmitted with the tidal waves up the streams and affected the gage readings at these stations.

In order to construct a rating curve from the discharge measurements for such stations it was necessary to determine this variation in mean tide level of the ocean and apply a corresponding correction to the observed gage heights. The mean tide variation was obtained from the records of the tide gage at Fort Point near the entrance of San Francisco Bay, which is maintained by the United States Coast and Geodetic Survey. This gage is well constructed, well housed, and is visited at least every two days by the attendant. It is the only gage either on the bay or in the valley, which was to be found, from which a continuous and correct record could be obtained.

Rating Curves—The discharge measurements were plotted with both the observed gage heights and the adjusted gage heights; the adjusted heights being obtained by applying the variation in mean tide level of the ocean so as to reduce the gage heights to what they would have been had there been no variation from mean sea level. The result (Fig. 3) showed very strikingly the effect of this variation upon the gage heights below certain stages.

On the Sacramento River rating curve, the application of the mean tide correction brought all except one of the plotted discharge measurements closer to a mean curve, for mean discharges of less than 3,050 sec.-ft., while for discharges over 4,950 sec.-ft. the application of this correction moved all points except one farther from the mean curve. It happens that no discharge measurements were taken between these limits. In applying the rating curve to the daily mean gage heights to obtain the daily mean discharge, the mean tide correction was tapered off, from the use of the full correction up to 4,000 sec.-ft. discharge to zero correction for 5,000 sec.-ft. On the San Joaquin River rating curve the mean tide variation was shown to be effective up to a discharge of 1,000 sec.-ft. and was tapered to zero correction at a discharge of 1,500 sec.-ft. The difference in the limiting discharge in the two streams is due to the difference in the average cross-section of the two channels below the gaging stations, that of the Sacramento being about 6,000 sq.ft. and the San Joaquin about 2,000 sq.ft. These rating curves could only be used for the low stages after obtaining the mean tidal variation correction from the Fort Point Gage.

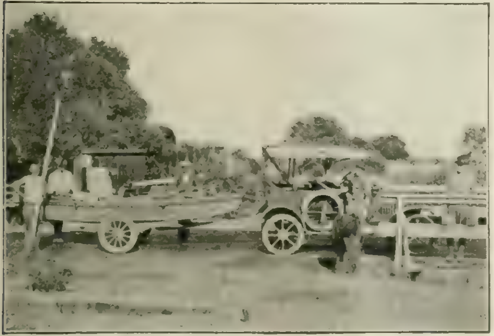


FIG. 4—PORTABLE EQUIPMENT FOR GAGING
Special skiff and gaging party moved from station to station by Ford car and trailer.

Equipment and Staff—A 16-ft. double transom skiff, especially constructed for the purpose, was carried on a trailer behind a Ford, from one gaging station to another for use in taking the measurements. The skiff was held in position by a ¾-in. wire cable stretched across the stream. The work was done by a four-man party—8-hr. shifts of two men each. A fifth man as chief of party, to see that gage heights are obtained with sufficient accuracy.

A Stevens water-stage register, type E, with an elevation scale of 1 in. equals 0.2 ft., was used for recording the water level. The greatest emphasis had to be placed upon the instructions to the field party to obtain sufficiently accurate observations of the gage heights, and to accurately connect their observations at the Gaging Station with readings on the U. S. Weather Bureau gage, to which the rating curve was referred. The gage height observations should be accurate within 0.01 ft. This accuracy may be obtained, even in choppy weather, by the use of a glass tube, corked at both ends, with a small hole through each cork, and a wooden ball colored with red ink floating on the water surface within the glass tube, the tube being held in position upon the scale of a staff gage by screw-eyes.

Fixed Value and Variable Return as a Rate Base

Annual Revision of Fair Rate of Return Simpler and Less Wasteful than Periodical Revaluation of Properties

BY LEO HUDSON
of Hudson & Myron, Engineers, Pittsburgh, Pa.

JUST at this time of greatly fluctuating prices, naturally the basis upon which inventories are priced for the purpose of evaluating public utility properties is of great interest. Generally speaking, there are three bases used, and in some cases a combination of the three. These are: (1) the actual known prudent investment, or, in case of this investment not being actually known, the reproduction cost as of the dates of actual construction; (2) the reproduction cost as of the time at which the evaluation is being made; (3) the reproduction cost in terms of some average of prices.

There are advocates of the original prudent investment, as indicated by Edward Flad's paper in *Engineering News-Record*, of Nov. 2, 1922, p. 736. These advocates can produce, and do produce, copious court decisions to substantiate their position. The advocates of the reproduction cost at the time of the appraisal also produce copious and authoritative court decisions, the leading decision perhaps being that of Justice Clark in the case of City of Houston vs. Southwestern Bell Telephone Co. as decided May 29, 1922, and as reported in the Supreme Court Recorder, Advance Sheets, issued under date of July 2, 1922. The advocates supporting the reproduction cost in terms of a fair average of prices offer, in support, a stability of procedure not experienced in taking either the actual cost nor the reproduction cost as of any certain date, but an average set of figures which will, if extended into the future, most probably represent a plateau of prices over the time for which the rates are being made. These advocates also offer copious court decisions: the procedure under the Galveston Electric Co. vs. City of Galveston, et al., as decided by Justice Brandies, April 10, 1922, and as reported in the Supreme Court Recorder, Advance Sheets, issued May 15, 1922. Also, these advocates offer the exact specification of the act in Pennsylvania and perhaps in other states. Then, there are advocates who would combine these different elements according to the conditions surrounding each specific case, for the purpose of arriving at a figure to represent "fair value" for rate-making purposes.

Variable Valuations and Fixed Rate—All of these advocates seem to hold to bases which will produce variable valuations and the most of them consider the valuations in terms of a fixed rate of return. Mr. Flad, however, does offer to give consideration to the variation of the rate of return in so far as it may be influenced by variation in the interest rate.

It seems to the writer that there is some danger of inconsistency in the method selected from time to time, in that the advocate of the high-priced periods will "find the shoe on the other foot" in case of a sharp future drop in prices, and the advocate of the high-priced peak of 1920 perhaps would not have used the same argument in the year 1914. In like manner, an investor actually putting his money into the property during the time of high prices would perhaps have his investment embarrassed at the time of low prices in case a reproduction cost method of procedure were followed.

Fixed Valuation and Variable Rate—The author feels that the assuming of these different processes has taken place not as a result of the dictates of the fundamental common law, nor of the exact language of the statutory law. The varying court decisions indicate clearly that we stand, even today, on a foundation of shifting sand, in so far as evaluation is concerned. It is for this reason, with others, that it appears that many of the difficulties encountered in the evaluation of public utilities properties and the fixing and changing of rates could be simplified greatly and at the same time in terms of greater justice to both the investor and the public, if more attention would be placed upon fixing the "fair valuation" of the property as a constant and upon taking up the variation in the rate of return. When we speak of valuation as a constant, we, of course, mean that this should change naturally as the changes actually take place, in that retirements, depletions and depreciation should be written off and additions to capital written on, as these things actually take place. These deductions and additions, however, to be made in terms of a fixed original cost, which fixed cost would not be subject to change at the end of each period stipulated by the Act creating the Public Service Commission of each state. In order to arrive at this fixed base, the author believes that, unquestionably, the most logical basis is that of the actual prudent investment.

The varying purchasing power of a dollar can be quite accurately secured in terms of general commodities, and the federal government is at this time issuing from time to time a general commodity index figure which shows what the varying purchasing power of a dollar is.

Not Inconsistent With Court Decisions—The author believes that this solution is not inconsistent with the court decisions clearly in favor of the actual investment as the basis of valuation. We also feel that this suggestion is not inconsistent with the court decisions which say that the cost as of the time of the valuation is the proper basis, and we believe that the argument in favor of average prices can be automatically worked out through consideration of the variable rate of return. A determination could readily be made on the books of the company at the end of each year under this specification and the rates for the preceding year could be readily adjusted by the giving of a rebate, or the placing of a surcharge which would accomplish the purpose. The entire fighting ground of such a proposition would be in the determination of what was the purchasing value of a dollar as of that date, or what it had been over the year just passed. The difficulties here do not seem to the author to be anywhere comparable to the difficulties experienced by the revaluation of a property. We believe also that there is nothing in this proposition inconsistent with the statutory laws of the several states creating the Public Service Commissions, and that this method can be readily interpreted to be within the authority of the several commissions.

Method Just to All Parties—The present tendency to make valuation a variable and the rate of return a constant can be strongly supported through the argument that the valuation of anything does, as a matter of fact, change from time to time and that the fixed rate of return is more favorable to the parties holding the securities of the corporation. We believe that the valuation of a thing does change from time to time, and it is to produce the ever-changing value of the dollars invested in a thing that we are trying to solve in terms of a variable rate of return and not in terms of the variable number of money units. As to the security holders, the bondholders receive a constant rate of return on their securities and it is the stockholder who benefits or who suffers by the fluctuation in the basis of valuation. This method might possibly produce a return on certain portions of the investment below the rate of interest which the bonds call for for certain years, but, on the other hand, it would create a higher rate of return during other years, and this method would call upon the stockholder to make the bonds absolutely secure, as he does under the present methods.

We believe that the application of this method would be beneficial not only to the investors, but also to the public, in that it would discontinue to a great extent at least the constant state of warfare which now exists between the public and their utilities. Valuations which were established two years ago will have to be reviewed again within a year or so, this time, perhaps, on the application of the public, due to the drop in the cost of commodities. This is because the valuation two years ago was fixed in terms of the same rate of return as the valuation of the next year will be fixed.

The present methods are expensive to the corporation, are expensive to the public, and are expensive to the state, all of which means that it is three-fold expensive to the people, because it is the people who will pay the entire bill in the end. It burdens up work to be done by Public Service Commissions, which takes their valuable time from work of a more valuable nature. The present method is actually producing a cost of government which will ultimately result in the government supporting the people instead of the people supporting the government. The solution of one case under the present condition will necessarily call for a reconsideration and another solution within a short period to follow, the corporations taking the initiative in the years of high prices, and the people taking the initiative in the years of low prices. Ultimately, the bridge will become so heavy that it will fail of its own weight.

Cost of Submerged Outlet Sewers

The accompanying table of the cost of submerged outlet sewers is taken from a brief report of the Committee of the Boston Society of Civil Engineers on Methods of Design and Construction and Results of Operation of Submerged Pipe Lines for Outfall Sewers, printed in the Journal of the society for January. The report states that "under extreme circumstances, the costs were in a few instances 100 per cent in excess of and 50 per cent less than those" given in the table; also that the cost figures were for average pre-war conditions. The committee was composed of Hiram A. Miller, chairman, Edgar S. Dorr and George A. Sampson.

COST OF SUBMERGED OUTFALL SEWERS

Size In	Price per Foot Including Outlet	Size In.	Price per Foot Including Outlet
8	$5.00	48	20.00
12	6.25	60	26.00
16	7.50	72	32.50
24	10.25	84	39.50
36	14.75		

Automobile Control, City Planning and Traffic Regulation

Limits of Car Operation in Relation to Speed and Road Capacity Demand Better Street Plans and Traffic Rules

By Herbert S. Swan
City Planner, New York City

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HOW fast can a motor vehicle go without endangering the safety of its slower neighbor? How long a time does it take a machine traveling at different rates of speed to stop? What relationship does the speed of a car bear to its stopping distance on a dry road? On a wet road? When going downhill? Going uphill? How much ground does a car cover in a second if it is traveling 20 miles an hour? Forty miles an hour? Sixty miles an hour? How fast can a car run and yet be stopped within a second? What effect has a load upon the stopping time and distance of a car? These appear to be elementary problems in the operation of an automobile. They confront every driver every minute of the day and yet they are questions concerning which not even the average manufacturer of automobiles has precise and accurate data.

Braking—The time required to stop cars going at different speeds is in exact proportion to the speed of the car. The rate of deceleration which can ordinarily be attained is in the neighborhood of 8 ft. per sec. per sec.; that is, the velocity can be reduced 8 ft. per sec. or at the rate of 5.4 miles per hour each second until the car stops. In emergencies this deceleration may be as high as 10 ft. per sec. per sec., although this increased deceleration is not obtained without discomfort being experienced by the occupants of the cars.

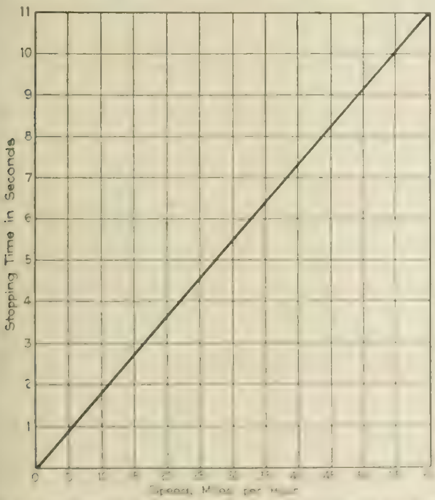


FIG. 1—STOPPING TIME AT DIFFERENT RATES OF SPEED

Relative Efficiency of Brakes on Dry and Wet Roads—The grip of the wheels upon the road surface is quite as important as the ability of the brakes to lock the wheels. A good grip on the road as well as sufficient brake power is required to bring a car to a prompt stop. The grip depends upon the nature of the road surface and not upon the brakes. On a dry asphalt or concrete pavement the coefficient of adhesion is about 0.64. When the pavement is wet it is reduced to about 0.38 and when greasy to as low as 0.06. On a wet asphalt or concrete pavement it would require about twice as much distance to stop a car as would ordinarily be the case if it were dry and if the pavement were greasy about ten times the distance. A severe application of the brakes when the pavement is greasy would result in a skid. Safety is assured when the pavement is in this condition only by operating the car at not over one-third its normal speed. If a greasy roadway is sanded, then, of course, adhesion is increased and a greater speed than this is permissible.

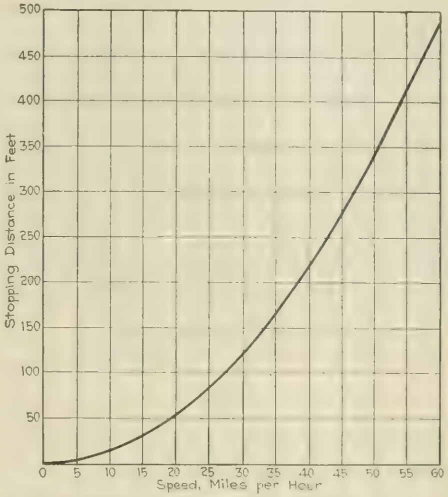


FIG. 2—STOPPING DISTANCES AT DIFFERENT SPEEDS

Stopping Time—The fastest speed a car can go and yet be stopped within one second with a deceleration of eight feet per sec. per sec. is 5.4 miles per hour. In other words, if a car is traveling faster than this, it will take longer than one second to stop it. Thus a car going 30 miles an hour upon the application of the brakes is still after one second of their application traveling at the rate of 24.6 miles per hour. After two seconds' application, its speed is retarded to 19.2 miles per hour; after three seconds, to 13.8 miles per hour; and after four seconds to 8.4 miles per hour. The car is not brought to a dead stop until the brakes have been applied 5½ seconds. A car with an initial speed of 40 miles is still running seven seconds after the application of its brakes; one with an initial speed of 50 miles, nine seconds; and one with 60 miles, eleven seconds. A car with an original speed of 60 miles an hour is still forging ahead at 30 miles an hour after a car running 30 miles an hour has been brought to a complete halt.

Speed and Stopping Distance.—The time within which a machine can be stopped varies directly as its speed; the distance within which it can be stopped as the square of its speed. Twenty miles an hour is a pleasant speed, yet a car traveling at this rate covers 29 ft. every second. A car running 40 miles an hour covers 58 ft. every second, one 60 miles an hour, 88 ft. It takes almost four seconds to stop a car traveling 20 miles and eleven seconds one traveling 60 miles an hour.

Before a car moving 20 miles an hour can be stopped, it has covered a distance of 54 ft. If the speed is increased to 40 miles an hour, the distance demanded for stopping is increased to 215 ft. A car racing along at 60 miles an hour cannot be stopped until it has covered 484 ft. Every time the speed is doubled, the distance required for stopping is quadrupled.

Fig. 1 shows the time and Fig. 2 the distance in which a car going at different speeds can be stopped.

Effect of Grades on Stopping Distance—The effect of grades on stopping distance with dry pavements is to increase that distance by about 36 per cent when going down a 10 per cent grade and when going up a 10 per cent grade to shorten the stopping distance by about 21 per cent. On 5 per cent down grades the distance required to stop increases 15 per cent and on 5 per cent up grades diminishes 12 per cent. When the street is wet or greasy the increased distance required to stop in going down hill is very much more. When the grade exceeds 5½ per cent on an asphalt, concrete or wood block pavement, and the pavement itself is wet and greasy, a situation is created where the brakes cannot hold against the force of gravity. The importance of a satisfactory coefficient of adhesion in the case of wet and greasy pavements on steep grades is therefore apparent. The grip of the wheels on a slippery pavement may be considerably augmented by sanding the roadway.

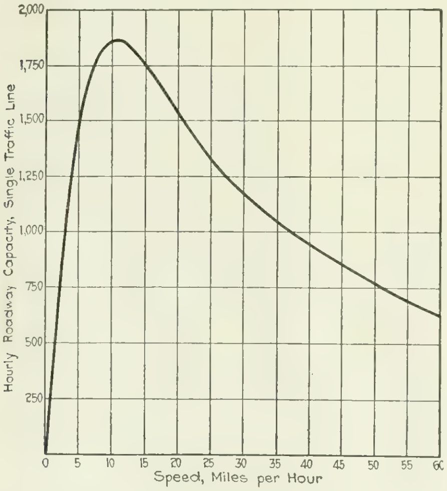


FIG. 3—AUTOMOBILE SPEED AND ROADWAY CAPACITY

Effect of Load Upon Stopping Distance—The load on a vehicle has but little to do with its ability to stop. The retarding effect of the brakes increases with the load. So much of the load on trucks bears on the rear axle (to which the brakes are exclusively applied as a rule) that they can usually be stopped in less distance with a load than without one. This is true whether the pavement is dry, wet or greasy. If a machine with a load, however, gets out of control it will, owing to the greater mass in motion, do much more damage than a machine without a load.

TABLE I—SPEED AFTER APPLICATION OF BRAKES FOR DIFFERENT PERIODS.

(Deceleration 8 ft. per second per second)

Original Speed, M.P.H.	Remaining Speed, Miles per Hour After— 1 Sec.	2 Sec.	3 Sec.	4 Sec.	5 Sec.	6 Sec.	7 Sec.	8 Sec.	9 Sec.	10 Sec.
5										
10	4.6									
15	9.6	4.2								
20	14.6	9.2	3.8							
25	19.6	14.2	8.8	3.4						
30	24.6	19.2	13.8	8.4	3.0					
40	34.6	29.2	23.8	18.4	13.0	7.6	2.2			
50	44.6	39.2	33.8	28.4	23.0	17.6	12.2	6.8	1.4	
60	54.6	49.2	43.8	38.4	33.0	27.6	22.2	16.8	11.4	6.0

TABLE II—TIME AND DISTANCE REQUIRED IN WHICH TO STOP CAR AS WELL AS ROADWAY CAPACITY FOR DIFFERENT SPEEDS

Miles Per Hour	Feet Covered Per Second	Seconds Consumed Stopping*	Feet Covered Stopping	Spacing of Feet	Roadway Capacity Single Line Vehicles Per Hr.
5	7.3	.92	3.3	18	1,438
10	14.6	1.83	13.4	28	1,856
15	22.9	2.75	30.2	45	1.750
20	29.3	3.67	53.8	69	1,530
25	36.6	4.58	84.0	99	1,333
30	44.0	5.50	121.0	136	1,166
40	58.6	7.33	215.1	230	918
50	73.3	9.17	336.1	361	755
60	88.0	11.00	484.0	499	635

* No interval allowed for application of brake — it is presumed to have been applied instantly.

Speed and Roadway Capacity—An increase in speed by no means increases the capacity of a roadway. Paradoxical as it may seem, the direct opposite is true, for though a fast car may travel between two points more quickly than a slow one, it does so when the roadway is used to capacity only by driving other cars off the highway.

The speed that will pass the maximum number of cars with equal safety is not one of 50 miles an hour, nor one of 40 miles an hour, nor even one of 30 or 20 miles an hour. It is the prosaic gait of 10 miles an hour. A uniform speed of 10 miles an hour will pass a third more vehicles than one of 25 miles; and half again as many as one of 30 miles. A speed of 60 miles will pass scarcely more than a third as many vehicles as one of 10 miles. Even a speed of 5 miles an hour will pass more vehicles than one of 30 and twice as many as one of 60. Fig. 3 gives the roadway capacity for different speeds.

The common impression is that the faster the speed the greater is the number of vehicles which can pass a point in a given length of time. This is true for quite low speeds. Each increase in speed up to a certain point does increase the capacity of a roadway but after a certain speed has been attained, each unit of increased speed requires such an increased spacing of machines that the roadway capacity is diminished.

If accidents are to be avoided, machines should certainly not follow each other any closer than the distance it takes to stop. So great a headway between cars is, however, very indifferently observed among drivers who commonly act upon the theory that they can stop, even at the higher speeds, as quickly as the car ahead. This may be true if they instantly observe when the forward car applies its brake and also apply their own brakes instantly, provided no accident or sudden obstruction bars the progress of the car ahead. Motorists, however, should always be able to stop in season to avoid any obstruction or danger that may suddenly confront them in place of the car ahead.

Not until thoroughfares are planned and traffic regulated with reference to the fundamental characteristics of the motor vehicle will our streets become efficient and safe for both pedestrians and vehicles. We must also consider thoroughfare design and control of traffic in its relations to the variety, number and speed of vehicles which the street is to carry. To utilize a street to capacity we must, of course, know what its capacity is. Before building new streets we must be sure that the existing ones cannot, through improvement in the regulations affecting traffic, be made to serve the ultimate volume of traffic for which provision must be made.

The frequency of major streets, their width and grade, the sharpness of street angles and curves, the radii for rounding corners, should be determined with reference to the physical characteristics of the automobile, to the anticipated volume of traffic and to the particular requirements of the ground. Acceleration, deceleration, necessary clearance for different speeds, engine power, gear ratio and turning radius, although comparatively new, are nevertheless fundamental considerations in successful thoroughfare planning. And when it comes to regulating traffic, separating fast from slow vehicles, imposing maximum and minimum speed limits, obliging traffic to round central standards at corners, stopping and starting traffic at intersections, are controlling factors which, if ignored, will prove disastrous to the most mobile condition of traffic.

The street and vehicle using the street must be adapted to one another. The city planner must recognize the mechanical limitations of the automobile in laying out and regulating traffic in his streets; the automobile engineer must adapt the mechanism of his machine to the physical limitations of the thoroughfare plan. The automobile engineer is rapidly solving his part of the problem but not the city planner, although a street designed without reference to the machines using it is no less absurd a thing than an automobile built without reference to the streets it is to use.

An All-Steel Grand Stand at Iowa State University

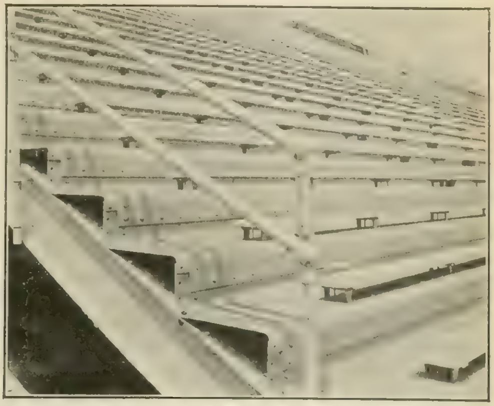
By B. J. Lambert
Professor of Civil Engineering, Iowa State University, Iowa City

Extract of a paper presented at the Iowa Engineering Society annual meeting Jan. 23 to 25 in Des Moines

THE first so-called permanent stands on the Iowa athletic field were built about 1910, of reinforced concrete supported on concrete walls 17 ft. apart. No great care seems to have been used in securing adequate foundations nor in using a high-grade concrete, nor in getting good lines and surfaces. In consequence today there are a number of cracks and breaks and the concrete is in fair shape only. Though it is perfectly safe, yet it is not prepossessing in appearance and cannot be made so by any reasonable expenditure. The great fault with reinforced concrete on small jobs, seems to be the difficulty of securing a competent contractor, one who not only has good intentions but also the experience necessary to do first-class work. Up to 1920 some 6,400 reinforced-concrete seats had been built on Iowa Field, the last section of 1,600 costing about $8 per seat.

On one side of the field is the Iowa River, on the other the Cedar Rapids-Iowa City Electric Ry. tracks. The old concrete stand is twenty rows deep and extends back practically to the river and also to within 10 ft. of the railway. On account of the increasingly great demand for seats at football games, it became necessary to widen our seating space in spite of these obstacles or else move to a new location.

Widening the seating space required building out over the river and also over the electric railway. It was during a study of this proposition that the writer, as chairman of the board in control of athletics, worked out a design for a comparatively light and inexpensive steel structure that was eventually used. It has proved admirably adapted for the purpose.

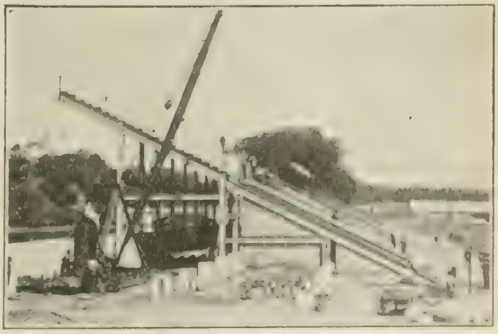


ALL-STEEL GRAND STAND AT IOWA FIELD
Main seat plates are $\frac{3}{8}$-in. sheets with $11\frac{1}{2}$-in. risers and 24-in. treads having $\frac{1}{8}$-in. grade. Rivet pitch is 6 in. Cast-iron stools support cypress seats.

The structure, cantilevered out over the river, is supported on a river wall by steel columns designed with sufficient strength to carry a second deck in addition to the present loading. The main 24-in. supporting I-beams and the main seat plates are all built with an adequate factor of safety. Wind bracing is provided in all directions.

Over the electric railway the structure has 18-in. I-beams and 8-in. H-columns, the latter as well as the foundations being designed for a double deck. The main seat plates are of $\frac{3}{8}$-in. steel. They are bent Z-shaped with 24-in. tread, and are riveted together at the center of the riser, the upper plate overlapping the lower, thus making this detail waterproof. The supporting I-beams are spaced 17 ft. on centers, and the seat plates are butt-spliced over this beam and also bolted to its upper flange.

The contract for about 10,000 seats was let for slightly less than $50,000. This included fabrication, erection and two coats of paint. The whole work was completed in three months. Foundations of sufficient size to carry a second deck cost about 50c. per seat. The cypress plank forming the seat proper is supported by cast-iron stools spaced 4 ft. on centers. These stools stand about 4 in. high and are fastened to the main plates by [illegible] bolts screwed into tapped holes. The cost of this plank seat construction in place and painted two coats was about [illegible] per seat. The total cost of the structure complete was therefore about $6 per seat. The design has been patented.

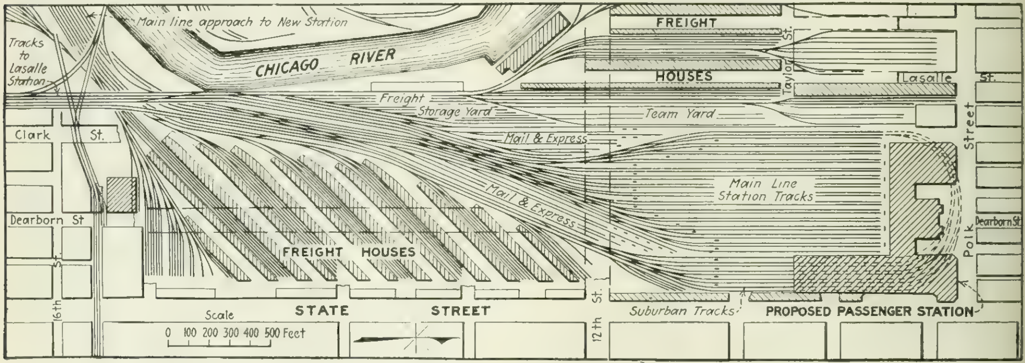


ERECTING CANTILEVER OVER RIVER AND RAILWAY
Stand is [illegible] ft. wide and has [illegible] rows of seats plus a distributing aisle.

Proposed State St. Terminal Station at Chicago

Passenger Station with 37 Tracks and Through Loop for Suburban Trains—Extensive Freighthouse Facilities

A PROJECT for the reconstruction of the Dearborn Station of the Chicago & Western Indiana R.R. at Chicago, with provision for 37 station tracks and extensive freighthouse facilities, is the latest development in the numerous plans for railway terminal improvement in Chicago. This station, which faces and thus closes Dearborn St. at Polk St., lies between Federal St. and Plymouth Court, with an annex on the east side of the latter, giving a present total of thirteen passenger tracks. Combined heavy main line and suburban service of the owning road and several tenant lines results in such congestion of traffic that increased facilities have been under consideration for several years. In view of the central location it was held desirable to provide these facilities on an enlargement of the present site.



PLAN OF PROPOSED CHICAGO TERMINAL FOR CHICAGO & WESTERN INDIANA R.R.

From the accompanying plan it will be seen that the proposed station is to extend east and west across the two blocks between State and Clark Sts. Its headhouse will consist of three buildings, about 260 ft. high, separated by inclined driveways which will carry Dearborn St. past the central building, behind which they will unite in a boulevard viaduct 120 ft. wide passing above the tracks and intersecting streets and coming down to street level again at 15th St. This arrangement will not only avoid the intersection of north and south boulevard traffic with the very heavy traffic on Roosevelt Road (12th St.) but will also provide a new north and south artery, since Dearborn St. is not now a continuous thoroughfare. The city is widening Polk St. to 90 ft. and the headhouse is to be set back from the street line so as to provide a plaza in front of the station.

A four-track main line which passes under the railways using the La Salle station farther north is developed into an eight-track approach which fans out into 28 station stub tracks. A two-track suburban line diverging from the east side of the main approach fans out into nine depressed tracks. These suburban platform tracks on a grade of 0.69 to 0.4 per cent unite beyond the platforms in a double track line looping under the headhouse and rising on a 1 per cent grade to pass out along the west side of the station. It is estimated that with this loop arrangement the capacity of the station will be equivalent to that of forty-six stub tracks. The ratio of approach tracks to station tracks is 1:3½ for the 28 stub tracks and 1 to 2¼ for the suburban tracks, taking the latter as equivalent to 18 tracks in view of the loop connection.

From the undercrossing already mentioned the approach tracks will rise on a 1 per cent grade to El. 12 and then descend on the same grade to the station tracks. The suburban lines entering on the east side will have descending grades of 0.69 and 0.4 per cent to the loop and will then rise on a 1 per cent grade along the west side. From a concourse at street level, or El. 14, easy ramps will lead down to platforms about 3 ft. below that level, the rails of the stub tracks being at El. 10. The suburban platforms will be a little lower, but also reached by ramps instead of stairways. The loop tracks will be 13½ ft. below the main station tracks, or at El. —3.5 (3½ ft. below mean water level in the river).

Electrification will be necessary for the full execution of the project, since the suburban loop and the air-right developments over freight tracks cannot be carried out with steam operation. Mail and express facilities are arranged on both sides of the main approach, and freight facilities are located in the area between the approach and State St. The freight tracks would be at El. 5, or about 9 ft. below street level. For the initial stage it is proposed to have single-story freighthouses and driveways at track level, the driveways opening from a wide space parallel with State St. For future development, however, the foundations and substructure provide for high buildings over the freight tracks. In view of the possibility that the railways now using the La Salle Station might use the new State St. Station a track connection with the main line approach of the latter has been provided, together with a tentative layout of freighthouses in the space between the new station and the river.

A study of this project for an immense Chicago passenger and freight terminal was suggested by H. G. Hetzler, president of the Chicago & Western Indiana R.R. The present plans were prepared by Alfred Fellheimer, architect and engineer, New York, with Steward Wagner and O. S. Payzant as his associates, assisted by E. H. Lee, vice-president and chief engineer of the railroad, and his engineering staff.

Concrete Arch Rib Fails Due to Laitance at Joint

A.A.E. Committee at Tacoma, Wash., Reports on Curious Failures of Part of Highway Bridge in That City

PARTIAL failure of one of three ribs of a skew concrete arch bridge at Tacoma, Wash., last fall caused the closing of the bridge until repairs could be made. The situation was investigated by a committee of the local chapters of the American Association of Engineers, composed of G. W. Osgood, *chairman*, L. A. Nicholson, F. J. Walsh and L. D. Jenson. The main features of the report are as follows:

The committee as individuals and as a committee visited the arch several times. The final examination was made in company of J. C. Manly, city engineer, who furnished the committee with plans of the arch and offered every facility for our examination.

The arch is of the elliptical skew type built on the center line of Tacoma Ave., and spans the Northern Pacific R.R. tracks which intersect the center line of Tacoma Ave. at an angle of about 45 deg. The arch supports an earth fill extending from the abutments to about 6 ft. deep over the crown and carrying the street car and roadway traffic on Tacoma Ave.

The span of the ellipse is about 85 ft. and the rise 30 ft. The width of the arch is 60 ft., divided into three sections 18, 16 and 18 ft. wide (see drawing), with their sides parallel to Tacoma Ave. The abutments of the arch are parallel with the Northern Pacific tracks or 45 deg. to the center line of the arch. As no bond was provided between the three sections, the arch was really three separate arches and was so designed.

The west sections failed at about the third-point on the south end. All other sections are in good condition so far as can be determined by superficial examination. The failure developed a crack entirely across the rib section. From the inside of the arch the crack showed an opening of a couple of inches at the east end, ending in a myriad of cracks and spalling of the concrete under the spandrel wall at the west end.

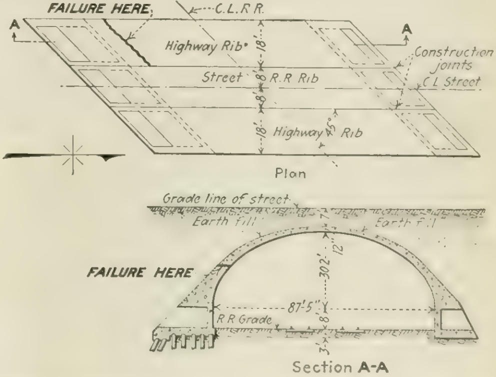
At the east end of the crack the wall crowded in an inch or more, probably due to the pressure of the earth back of the arch. On the back of the arch the crack was equally well defined, though the concrete showed close contact at some points. However, along most of the way there is a more or less regular opening of one or two inches. A number of the vertical reinforcing bars had been wholly fractured and some were partially fractured. The remaining vertical steel was greatly elongated and twisted, showing the arch ring to be approaching a complete failure and collapse.

Examination showed that the crack followed an emergency joint in the concrete. The joint was not normal to the ellipse, but horizontal, and naturally offered no resistance to shearing stresses set up by the thrust of the arch ring along the plant of the joint, which were augmented by the thrust of the earth fill behind. Laitance from ½ to 1 in. in thickness was found in various parts of the crack together with a few scraps of wood and rubbish. As water had been seeping through the crack for several years, it is probable that the laitance had been partially washed away and jarred out due to vibration of trains and street cars. From this it is assumed that the original laitance plane was greater than was found on examination.

In general, the concrete on the entire arch was hard and dense and of good quality.

On examination of emergency or day's work joints in other sections of the structure numerous layers of laitance were found from ½ to 3 in. thick. It is the opinion of the committee that no importance was attached to the formation of laitance on any part of the job, and that no attempt was made to prevent or to remove it. It is understood that during construction the concrete was brought up to about the point of failure when the forms were found to be giving. Concreting was suspended until the top of the arch forms had been loaded sufficiently to counteract the weight of the concrete. Concreting on this side was not resumed until the entire opposite half of the arch ring had been concreted, a period of about ten hours. Apparently a thick layer of laitance which formed on top of the original concrete was not removed and naturally resulted in a joint with practically no bond. In time, with water continually seeping through together with vibration from trains and street cars, the laitance in the joint washed and jarred out, leaving an open crack which increased in size as the wall below moved in.

A theory of the cause of the failure has been advanced by the superintendent of construction for the contractor building the arch to the effect that the concrete at the joint had received its initial set before resumption of pouring, and that workmen sent down into the forms to clean out debris broke up the green concrete by walking on it and destroyed its bond value. This is not the opinion of your committee. It is the conclusion of the committee that the cause of the failure of the arch was due primarily to lack of bond due to laitance left in the emergency joint, augmented by the fact that the joint was not made normal to the thrust of the arch ring.



SKETCH SHOWING CRACK IN TACOMA, WASH., BRIDGE

The benefit to be derived by the members of this association from this failure and the subsequent examination will be to impress on them the danger of and the cause of laitance. No further discussion is needed regarding the danger. The cause and the cure may be covered under one heading: Too much water or too wet a mixture.

Death Rates in 19 Large European Cities

The 1921 death rates per 1,000 in 19 large European cities (see table) ranged from 21.88 for Rouen to 10.34 for Amsterdam, according to figures compiled by the New York City Health Department. The corresponding rate for New York City was 11.17, but it is not strictly comparable with the figures for France, Belgium and Holland, given in the accompanying table, since in those countries deaths of newly born children occurring before the registration of their births are not included, whereas the New York records include deaths of all infants born alive.

DEATH RATES IN 19 CITIES OF EUROPE, 1921

Rouen	*21.88	[illegible]	14.27	[illegible]	*12.29
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12.13
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11.21
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11.27
[illegible]	*14.43	[illegible]	[illegible]	[illegible]	11.07
Milan........	14.39	London......	12.46	Amsterdam...	*10.34
		[illegible]	[illegible]		

* Deaths of infants before registration of birth not included. See text.—EDITOR.

From Job and Office

Hints That Cut Costs and Time For the Contractor and the Engineer

Determining Pile Locations Under L-Shaped Column Section

By Jacob Feld
Brooklyn, N. Y.

A SIMPLE method for determining the center of gravity of an L-shaped column requiring no computation and no scaling outside of drawing the column section to scale is as follows:

Referring to Fig. 1, consider *ABCDEF* as made up of the two rectangles *ABCa* and *aDEF*, by drawing diagonals find the center of each, *d* and *c*, and connect these two points. Similarly from *AFEb* and *bBCD* obtain line *fe*. The intersection of these two lines, *g*, is the center of gravity of the entire section.

The proof is based on the theorem that the center of gravity of two bodies is on the line joining their centers of gravity. The footing for the column may be either L-shaped or rectangular. In either case, the center of gravity of the pile cluster, where piles are used, must be under the center of gravity of the column section. Otherwise, the piles will be unequally loaded and nonuniform settlement will follow. The pile locations are usually governed by the property lines. Figs. 2a, 2b, and 2c show the cases of 3, 4 and 5-pile clusters located by a simple graphical method. Draw the axes parallel to the external faces of the column at the minimum allowable distance of the center of pile from the building line. Through the center of gravity of the section, *G*, draw a line parallel to one axis, obtaining point *a*. In Fig. 2a, the case of three piles is shown, *ab* is twice *oa*, and *c* is the intersection of *bG* (produced) and the other axis. The proper location of the piles is then, one at point *b* and the other two spaced symmetrically about *c*. Since the distance of the center of a pile from the building line cannot be less than *oe*, the two piles must be on the axis *ox*, and at equal distances from *c*.

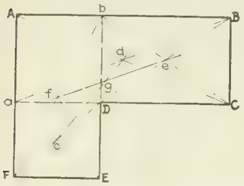


FIG. 1—FINDING CENTER OF GRAVITY OF L-SHAPED COLUMN SECTION

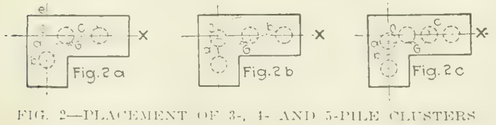


FIG. 2—PLACEMENT OF 3-, 4- AND 5-PILE CLUSTERS UNDER L-SHAPED COLUMN SECTION

In Fig. 2c, we have the case of five piles by the same method, *oa: ab* as 2 : 3. The three piles are spaced symmetrically about *c*. This method is not dependent upon the angle formed by the two axes. The proof is as follows: *b* and *c* are the centers of gravity of the 2- and 3-pile clusters. *G* is the center of gravity of the five piles since it is on the line *bc* and since *bG: Gc* as *ba: ao* as 3 : 2.

For the special case of perpendicular column faces and equal number of piles under each leg of the L, the very simple method of Fig. 2b may be used. With *G* as center and *Go* as radius, draw the arc cutting the axis at *a* and *b*. Since *aob* is a right triangle, and *G* is equidistant from *a*, *o* and *b*, *G* is on the line *ab*, which is also the diameter of the arc. If two piles are required, they must be placed at *a* and *b*. If any other number is used, half must be spaced symmetrically about each of these two points. Where there are no building line restrictions, the same methods may be used, and the piles are spaced in symmetrical clusters about the points *a* and *b*, with the center to center spacing decided upon.

Diagrams drawn to a 1-in. scale will give results which are more accurate than are the best field methods of pile driving.

Brass Plugs Set in Concrete Mark Survey Points in Timber Tract

By George F. Paul
Chicago, Illinois

CONCRETE markers to show the intersection of important survey lines are being used to advantage in plotting a large tract of timber land near Laurel, Mississippi. These markers have been made 4½ in. square and 17 in. long. In the center is a brass or aluminum plug which is screwed on an iron rod and sunk into the concrete; on this plug the numbers are stamped. In the illustration, the township and range figures are the small ones on the outside. The large figures are section numbers.

In this region are many angle lines, some of which date back to the old Choctaw Indian purchase boundaries, and the result is that there is much confusion. In the early days the government would buy and survey a slice of Indian territory running, it might be, from the wigwam of the Big Chief out to some large rock, oak tree, spring, or other landmark. Later, other sales would be made, with the result that there would be great confusion of demarcation lines. In one exceptional instance four concrete posts were needed to establish what should have been one corner.

CONCRETE ENCASED PLUGS FOR SURVEY POINTS

Small figures are township and range figures; large figures are for sections.

Contractor Puts Pay Office and Toolhouse on Wagon Trucks

By B. S. Bascome
Huntington Water Corp., Huntington, W. Va.

THE accompanying illustration shows a portable toolhouse and pay office built upon a set of ordinary wagon wheels and used in connection with the construction of a 24-in. cast-iron pipe line. Owing to bad weather conditions, it was necessary to build some sort of protection for the watchman. Inasmuch as this had to be done, the structure was extended to provide other uses than for housing the watchman.

PORTABLE TOOLHOUSE AND FIELD OFFICE

The wagon is divided into an office and toolroom, the office containing two desks for the timekeeper and superintendent, as well as a drafting table. The toolroom contains a rack for the tools and the walls are pegged for the purpose of hanging up rubber boots, slickers, etc., which are therefore always kept dry and ready for use. The wagon is equipped with hinged supports carried on four screw jacks. Thus the dead-weight of the house can be transmitted to the ground when the wagon is not actually in motion. The house is provided with removable steps which are set up as soon as the wagon is parked and the team removed.

The overall length of the house is 20 ft. and the overall width 8 ft. Of this space 8x11 ft. is occupied by the office, and a space 8x9 ft. by the toolroom.

The writer suggests that this outfit might be valuable to contractors involved in road construction or other work wherein daily moves are necessary to keep up with construction.

False Bents Jacked in Place Strengthen Timber Bridge as Shovel Crosses

By R. T. Brown
General Manager, Piedmont Construction Co., Asheville, N. C.

RECENTLY one of our superintendents used considerable ingenuity in carrying a ¾-yd. shovel across a timber bridge. There was so little clearance between the railings of the bridge that the cab could not be swung to either side to steer the shovel. The superintendent, therefore, had the steering clutch disengaged, leaving the road wheels free. He and one assistant then took two large timber wedges and kept closely in front of the shovel as it proceeded. When it began to crawl too close to one side of the bridge a wedge was thrown in front of the opposite wheel. This held the wheel back until the other gained the necessary advantage and the crossing was made without mishap.

To support the panels between caps, he placed a false cap on struts which in turn rested on jacks. When the load came on the panel the jacks were raised to take care of the deflection. When the shovel rested over the regular bridge cap the false cap and jacks were moved forward to the next panel.

The crossing was made in less than two hours, whereas it would have taken more than a day to place false bents under all panels and to remove and replace the railing.

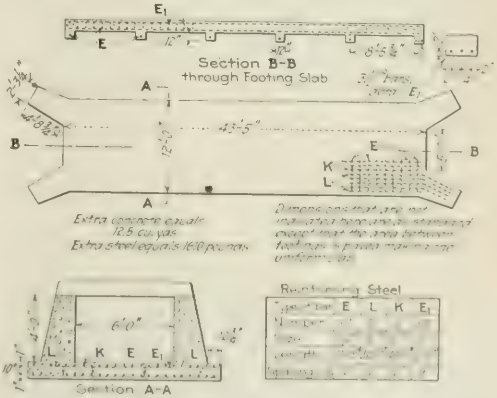
Special Footing for a Culvert

By Paul L. Fetherston
Resident Engineer, Michigan State Highway Department

THE SPECIAL footing shown in the sketch was designed for a standard culvert which was placed on a muck foundation. This soil was water soaked and so soft that a man would sink to his knees when walking in it. A 30-ft. rod was shoved down full length and no suitable footing for piles was discovered.

The size and disposition of the reinforcing steel is shown in the sketch in detail. It is probable that an excess of steel was used but it was thought best to be on the safe side and make sure that a failure would not occur for the lack of a few dollars worth of steel.

In placing this culvert the excavation was carried to a depth of 1 ft. beyond that required for the concrete, then backfilled with coarse gravel. A sloppy 1:3 mix of cement and sand was spread over this to a depth of ½ in. and allowed to set for 24 hours before the footing was poured. This was done in order to make sure that the muck would not mix with the concrete while it was being poured.



HEAVILY-REINFORCED CONCRETE CULVERT FOOTING

In placing the footing a rigid inspection was maintained to make sure that all water was removed from the excavation and that the concrete was properly mixed and the steel placed as specified. A 1:3:6 mix was employed.

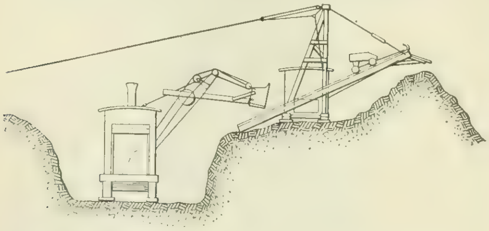
This culvert has now been in place for a season and levels taken on the headwalls from time to time indicate that there has been no settlement to date. The structure appears to be sound throughout.

From Job and Office

Hints that Cut Cost and Time

Skip on Portable Incline Supplements Steam Shovel in Excavation

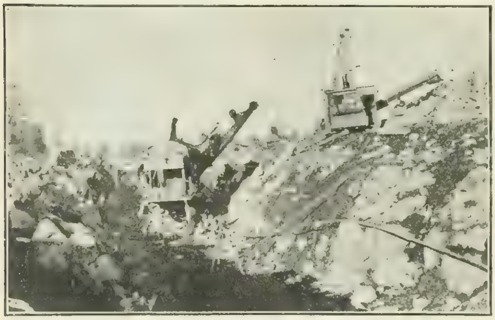
A PORTABLE, inclined track with a power-operated skip used in the excavation of the canal for the Hat Creek No. 1 hydro-electric plant recently built by the Pacific Gas & Electric Co. in northern California, made it possible to use a steam shovel of ordinary size for excavating a canal 10 ft. deep and still maintain a wide berme along the edge of the canal. The canal is 17 ft. wide at the bottom, has side slopes of ¾ to 1 and in its length of 2,600 ft. required the removal of about 24,000 cu.yd. of rock and earth.



SKETCH SHOWING RELATION OF SHOVEL AND INCLINE

This yardage did not warrant taking a special, large-sized shovel onto the job, which is in a remote district, and the plan worked out called for only such equipment as was conveniently available. A 2-in. compressed-air line was already laid along the canal for serving rock drills and this line was tapped at intervals for power to operate the skip. Under the plan devised the shovel dipper delivered to a skip operating on an inclined track built upon a heavy skid frame, which also carried a double-drum air-driven hoist. The incline was braced and guyed with the aid of a tower, as shown in the accompanying illustration, and material dumped from its upper end was delivered 20 to 25 ft. from the edge of the canal.

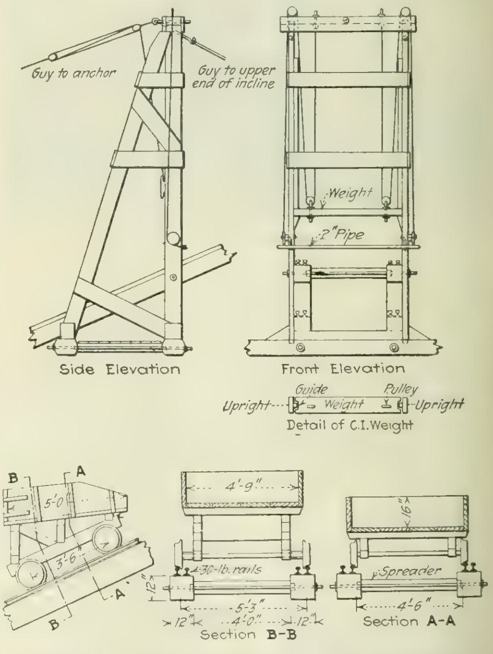
The incline was made of 12x12-in. timbers with 6x6-in. braces and 1-in. iron tie-rods. Two pairs of rails were used, the front wheels fitting the inner pair and the rear wheels the outer pair, so that automatic dumping at the upper end of the incline could be accomplished in the usual way. At the top of the incline the outer rails were bent up to form a bumper, while the inner rails were bent down at an angle of 45 deg.



STEAM SHOVEL IN CANAL SERVING CONVEYOR ON BERME

At the outset the empty car did not readily start back down the incline. This was overcome by arranging a weight, as shown in the illustration, so that when the loaded car was pulled up in the last few feet of its travel it raised a counterweight. This counterweight in turn started the skip back down the incline when tension on the hauling line was slacked off.

When it was desired to move ahead the guy across the canal was released and a line was carried to a deadman some distance ahead. Power for moving the entire outfit on its skids was provided by the same hoisting engine which operated the skip.



DETAILS OF INCLINE, SKIP AND COUNTERWEIGHT

The work was done under the direction of O. W. Peterson, construction engineer for the Pacific Gas & Electric Co. and James Martin, superintendent of construction.

Why City Engineers Go Crazy

In reporting the difficulties of a contractor who ran into 10 ft. of wet quicksand at the bottom of a 50-ft. pit under heavy surcharge, a contemporary remarks that the contractor's organization proceeded to *punch holes* into a 10-ft. sewer under the cut. Through this sewer the troublesome quicksand was speedily drained enabling the contractor to complete retaining walls and abutments without the extraordinary expense and delay that otherwise would have been necessary.

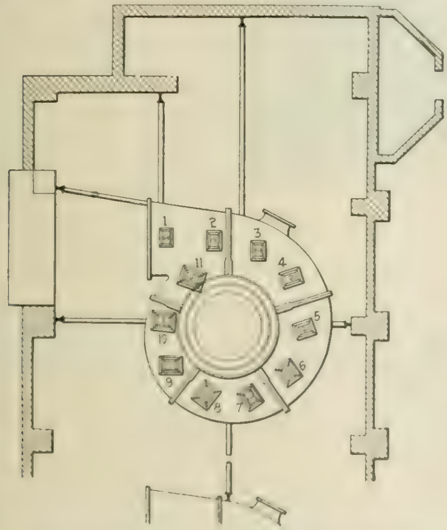
From Job and Office

For Contractor and Engineer

Time Saved in Aligning Turbine Casings by Leaving Jacks in Concrete

SCROLL casings for the two hydraulic turbines in the Pit River power house No. 1, recently installed by the Pacific Gas & Electric Co. in northern California, were aligned, leveled up and held in position by jacks, most of which were left in place when the concrete was poured. The loss of the jacks embedded in the concrete was negligible as compared with the time and labor saved in adjusting to exact position the casings which weighed about 105 tons each.

The assembled casing, ready to be embedded in concrete, was lowered to place and rested on eleven jacks, each supported on a concrete pier. These piers ranged from 3 ft. 3 in. to 5 ft. 7 in. in height and all four sides had a batter of 9 in. in 5½ ft. The piers were reinforced with six ½-in. square bars extending 2 ft. 6 in. into the supporting slab and braced by ¼-in. stirrups placed 1 ft. apart vertically. The tops of all piers were made 12x18 in. in size. Piers 9 and 10 were portable as they came in the opening for removing the turbine runner. These two piers were cast with handles made of ¾-in. reinforcing steel to allow them to be safely and readily moved with a derrick.



PLAN SHOWING LOCATION OF JACK PIERS AND PIPE BRACES

All but 9 and 10 were concreted in, these two being in an opening left for the removal of runner.

By turning up the jacks to take the weight of the scroll casing the exact level desired was secured. At the same time, to secure the desired alignment in a horizontal plane, jacks were turned up on six horizontal braces of 4 and 6 in. pipe placed between the casing and the walls of the pit, with jacks at the wall ends.

Where the jacks could be salvaged the hydraulic type was used, elsewhere 2-in. screw jacks, with a capacity of 20 tons and costing about $5 each, were used. When the concrete had set the horizontal pipe braces projecting from the walls were cut off with an oxy-acetylene torch.

One of the concrete piers started to fail at the top, due to the concentrated load imposed on it by the jack. This was remedied by putting ¼x4-in. iron straps around the pier at the top. Where jacks with small bases are used it is therefore recommended that steel base-plates be provided.

LINING UP SCROLL CASING WITH JACKS ON PIERS AND PIPES

The installation was made by the Pacific Gas & Electric Co. under the direction of O. W. Peterson, construction engineer, and James Martin, superintendent.

Tractor Hauls Industrial Trains on Heavy Grade in Road Work

By Crosby Tappan

Superintendent of Construction, Pennsylvania Highway Department

IN THE highway recently completed by the construction bureau of the state highway department in the vicinity of Franklin, Venango County, Pennsylvania, there was a grade 1¼ miles long ascending from the railroad siding where the unloading of materials was done. The gradient at certain points ran as high as 9 per cent. Beyond the top of this grade approximately 3½ miles of road were to be built. The problem to be

5-TON TRACTOR HAULING TRAIN ON 9 PER CENT GRADE solved was to devise some efficient and economical method for hauling the materials up this grade for concrete.

After careful consideration of the use of gear-driven locomotives, trucks, and a combination of trucks and industrial railroad, it was decided to grade the hill first, to lay a 24-in. railway track on each side of the finished grade and then haul trains of cars loaded with filled batch boxes up one track and empties down the other, using as motive power ten-ton caterpillar tractors, which occupied the space between the two railroad tracks. The cars were attached to the tractor by means of a ¾-in. cable about 40 ft. long.

To prevent runaways a piece of heavy iron was placed with one end in the rear knuckle of the rear car, the other end dragging on the ground. This iron was about 3 ft. long and was flattened to a rough cutting edge at the lower end. If for any reason, such as breaking of the cable, the cars started to slide downhill, this "stop" thrust itself into the ground and held the train. To send empty cars down the hill the train was kept attached to the tractor and dropped down with the tractor holding the train back. It was found that the best results were obtained with a tractor speed of four miles an hour. This enabled the tractor to haul as high as six loaded cars up the grade.

From Job and Office

Hints that Cut Cost and Time

Instrument "Speaks" Reservoir Water Level to Distant Engineer by Telephone

By Major R. Johnstone-Taylor

Underdale, Shrewsbury, England

THROUGH combined use of the telephone and the gramophone a recorder has been set up at the Delta Barrage, Egypt, whereby an engineer removed several miles from the reservoir is told the water level therein. The system which thus does away with the services of an attendant at the reservoir has recently been installed by Kents of London.

The recorder can be switched into an existing telephone circuit when information is wanted. One transmitter is used, the ordinary standard telephone acting as the receiver. The calling is done exactly as in any ordinary 'phone call. Two methods of producing audible signals have been employed: One is by means of a gramophone which states the depth; the other is by means of contacts which give a certain number of clicks to correspond to a certain depth of water in the tank or reservoir.

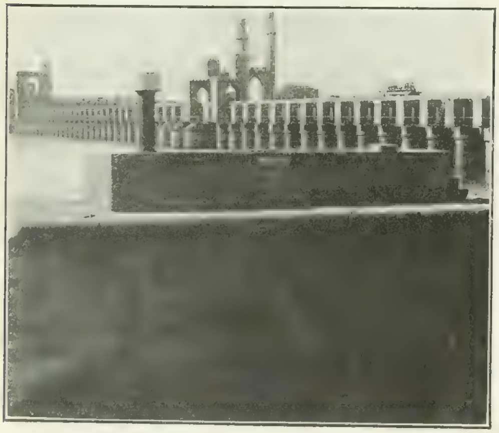


FIG. 1—WATER LEVEL RECORDER AT DELTA BARRAGE, EGYPT

The instrument is seen at the left of the picture with the metallic cover upon it.

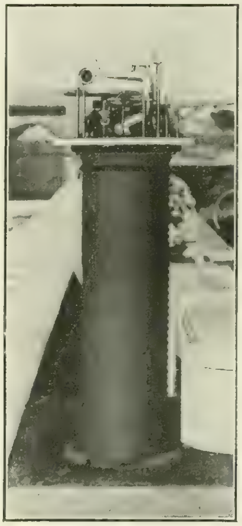


FIG. 2—CLOSE UP OF RECORDER

If the gramophone system be used the apparatus consists essentially of the gramophone clockwork mechanism working in conjunction with a level recorder gear, the mechanism being inclosed in a locked iron case. By a movement of a float resting on the water, the tone arm, sound box and needle of the apparatus are moved laterally into a position with the disk to give the correct reading when the needle is brought into contact therewith. To make the contact a sprocket wheel is geared with the disk spindle of the clockwork mechanism. This sprocket is fitted with a platform and from it a runner travels down a small ramp and by a system of levers and a cord the sound box, with the needle attached, is lowered upon the disk when the mechanism is in rotation with the disk, and raised when the mechanism stops.

The instrument is fixed at the reservoir and connected up in the usual way to the nearest telephone exchange. It is allocated a subscriber's number, which, when asked for, puts the inquirer into communication with the instrument which then speaks to him. Signals are given eight times to avoid any possibility of error through mishearing.

The recording disk is vocalized in 200 concentric circles spread over a distance of 3½ in., the gear reduction between float and tone arm being designed especially for each machine. The disk reads from "empty" to "one double naught," enunciating each digit, that is "seven-two," "seven-two-half," etc.

In the instrument which records by clicks a contact arm is moved parallel to the axis of the drum by the movement of the float. When the 'phone exchange rings the instrument the clockwork is set in motion and the drum rotated. The contact arm makes electrical contact with the drum during its revolution, thus causing a series of sounds to be imparted to the circuit. Signals are sent in groups of three with a longer pause between each set of digits. This is to facilitate reading so that the clicks can readily be heard. Signals are repeated three times, the line is then automatically cleared and is ready to be called again.

From Job and Office

For Contractor and Engineer

Reservoir Spillway Discharge Studies

By F. H. Macy
Assistant Engineer, Bureau of Water Power, Office
New York State Engineer and Surveyor

The writer has used the well-known mass curve of runoff to solve many stream-flow and control problems and finds it convenient when applied to the study of reservoir spillway discharges herein described.

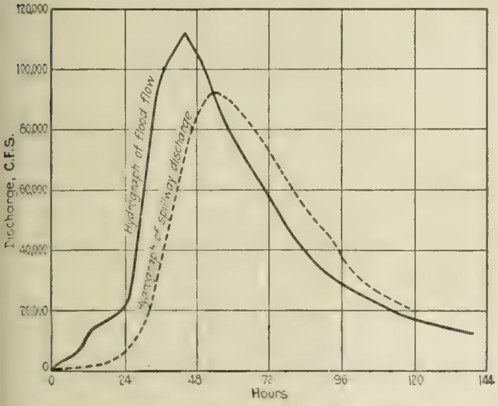


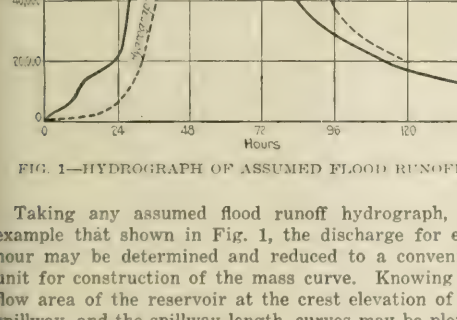
FIG. 1—HYDROGRAPH OF ASSUMED FLOOD RUNOFF

Taking any assumed flood runoff hydrograph, for example that shown in Fig. 1, the discharge for each hour may be determined and reduced to a convenient unit for construction of the mass curve. Knowing the flow area of the reservoir at the crest elevation of the spillway, and the spillway length, curves may be plotted showing the relation between:

(1) Spillway discharge in billion cubic feet per hour and height of water on the crest:

(2) Spillway discharge in billion cubic feet per hour and storage on the crest in billion cubic feet. (Fig. 3).

The problem may be solved graphically or in tabular form as follows:



IG. 3—SPILLWAY DISCHARGE AND STORAGE ON CREST

TABLE I

I Hour	II Flood Discharge Billion Cu Ft. Per Hr.	III Integrated Flood Discharge Billion Cu.Ft.	IV Discharge Over Spillway Billion Cu.Ft. Per Hr.	V Integrated Spillway Discharge Billion Cu.Ft.	VI Storage on Crest Billion Cu.Ft.
1	.007	.007	0	0	.007
2	.008	.015	.0001	.0001	.0149
3	.008	.023	.0001	.0002	.0228
4	.009	.032	00015	.00035	.0316
	etc. to				
54	.336	9 615	324	5.392	4 223 Max

The flows from the hydrograph, Fig. 1, are reduced to billion cubic feet per hour for each hour and placed in Column II. This column is integrated to form Column III, which is the mass curve data for the flood inflow. The assumption is made that the flow for the first hour is all stored on the spillway crest, i.e., no overflow, making Columns IV and V for the first hour equal to 0, Column VI for the first hour being equal to Column III.

The next assumption is that the amount of storage on the crest at the end of each hour, or more strictly the equivalent head, determines the discharge during the succeeding hour. This spillway discharge is derived directly from Fig. 3. (It is advisable to plot the lower portion of Fig. 3 on a large scale as the quantities involved are small.) The spillway discharge having been determined, this is integrated, giving Column V, which is the mass curve of the spillway discharge. Column VI is Column III less Column V. The computation is carried on until the maximum value of spillway discharge is obtained.

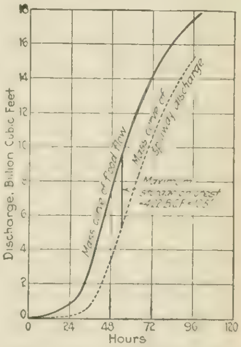


FIG. 2—MASS CURVE OF FLOOD FLOW, SPILLWAY DISCHARGE

The process may also be solved by plotting the mass curve data to some convenient scale. (Fig. 2.)

A somewhat similar method as described above, written by C. C. Jacob, appeared in *Engineering News* June 13, 1912, p. 1134.

Track Inspection Instrument

A simple track recording instrument which is actuated by the oscillations of the train so as to indicate irregularities of line and surface, and which may be mounted in an ordinary car, is being used on the Great Northern Ry., of England. A box about 12x18 in. and 24 in. high contains the mechanism for four recording pens and a continuous strip of paper for the chart. One pen is operated by a bulb held by an observer who thus indicates mile posts, stations, junctions and other points. The others are operated by counterweights and pendulums controlled by oil and pneumatic dashpots. Of these three pens, one records longitudinal oscillations due to braking and acceleration and to rolling motion caused by low rail joints; the second records lateral movements due to bad line or wide gage; the third records vertical motion due to irregular surface of track. From the chart the engineers can locate spots or stretches of track that need attention for proper maintenance.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

More on Mississippi Spillways

Sir—Your issue of Jan. 4, 1923, devoted considerable space to the flood problem on the Mississippi River. The importance of the problem, now that the condition of the lower river has become so critical, appeals to publicity, in order that the real situation may be better understood.

The writer of this letter, who is a member of the Engineering sub-committee of the Safe River committee of New Orleans, and who appeared before the Flood Control committee of the House of Representatives, during December, advocating a spillway in the vicinity of New Orleans as a supplement to the present levee system, wishes to call your attention to what he considers misleading deductions in your presentation of the case.

In your editorial comment you say: "It may be pointed out that each side avoids extensive reference to the main criticism of the other. The spillway advocates are little concerned with the structural stability of a spillway or weir. Col. Townsend dismisses rather lightly the long held contention that the main argument against a spillway is a possible silting up of the river below the spillway. Of the two omissions, Col. Townsend has the better of it in that he is arguing about something that is tangible and assured, the tremendous force of 250,000 sec.-ft. of water and the difficulty of building in the Louisiana alluvium any dam or weir that could withstand it. This is an engineering problem of gigantic proportions and while it is by no means inherently insoluble, its solution involves courage and huge expenditure."

It is true that our committee laid its greatest stress upon the question of the old trite bugaboo of channel impairment below the spillway, and furnished an abundance of good evidence to disprove it, not only in the report from which you quote but also in arguments before the Flood Control committee of the House of Representatives. We did this because the Mississippi River Commission's argument has always been that checking the velocity in the slighest degree by any form of outlet or waste weir would cause impairment by sedimentary deposit greater than the benefit derived from the opening. We had never heard of structural difficulties being offered as argument against the practicability of a spillway.

The Mississippi River Commission in 1895 made an elaborate survey of many cross-sections above, opposite and below the present outlet through Old River, at Red River Landing, into the Atchafalaya. In 1910, they resurveyed those same cross-sections and found, in absolute refutation of their theory, that instead of impairment during the intervening fifteen years, there had been a channel improvement of 7.4 per cent.

By order of Congress, the Mississippi River Commission, in 1914, had Col. Clarke L. Smith, U. S. A., make a survey to determine the advisability of a spillway, or spillways, in the vicinity of New Orleans. His report was most gratifying and showed that a spillway 6,000 ft. wide, into Lake Borgne, below New Orleans, would have held the 1922 flood to more than 3 ft. lower stage than was reached. The plan was rejected by the commission on the grounds that it would not be used very often, that the relief was not very great and that it was hazardous and expensive. The first argument is as untenable as would be an argument against fire insurance; the second argument is unsound because that relief, though apparently small would have meant in 1922 the difference between the crevasse and no crevasse. Three feet more relief would have averted the Poydras crevasse. The argument of expense is not sound because the Poydras crevasse was more expensive than the cost of a spillway and we are still liable to other crevasses in the near future. The argument of hazard is a decided reflection on American engineers. Furthermore, if the whole works blow out we would only have a crevasse and we are accustomed to crevasses.

There has been neither improvement from scouring nor impairment from sedimentary deposit in outlets. Insofar as the writer has been able to ascertain the river responds to the calls of cross-section and slope just as if it were a clear stream, the velocity being at all times adequate to carry all the sediment in suspension. The reason the river gets higher than formerly is that confinement by levees forces into it water that formerly rested in natural storage basins until the crest had passed.

The contention of our committee is that the reasonable limits of levee heights will have been reached when the present commission grade and cross-section is attained and the floods will be still far from provided for. We know that additional means of flood control must be provided and see in a spillway the greatest measure of relief at the least expense.

It is inconceivable that engineers who can build the Panama canal, the Roosevelt dam, the Keokuk dam and numerous other similar works would fail on so simple a project as a spillway into Lake Borgne, below New Orleans. A flow of 250,000 cu.ft. per sec. is considerable water, but the weir is 6,000 ft. long, two and a half times the width of the Mississippi River. The maximum flow through it will be 6 ft. deep, and the maximum velocity over the weir less than 7 ft. per sec., just about the same as that in the river past the spillway.

The elevation of the crest of the spillway will be 12.7 ft. above mean gulf level; add 6 ft. for the maximum depth of water over the weir and we have a crest of 18.7 ft. for the water at the spillway. The natural elevation of the ground 600 ft. back of the spillway is just about 7 ft. above mean gulf level and drops practically all of this 7 ft. in the first half mile towards Lake Borgne, when it enters a timbered swamp which is practically gulf level. It is about four miles across this swamp to Lake Borgne.

The spillway plans provide a flexible apron for 600 ft. from the spillway, made of concrete blocks held together by cables, on which apron the force of the water coming over the weir can expend itself.

There will probably be something of a hole dug by the water at the extremity of the apron but, as it tends to dig back towards the spillway, the flexible apron will adjust itself to the configurations of the hole and the digging will cease when a sufficient water cushion is obtained to consume the force of the sudden fall.

The resistance of the stumps and vegetation in the swamp portion of the spillway will be great enough to slow the water down to probably no more than the current in the river; this will mean a depth of 6 ft. through the spillway, which will back up against the weir a sufficient height of water to materially modify the force of the fall. If this is not sufficient it would be no great engineering feat to install retarders to accomplish the desired purpose.

Instead of thinking of this proposition in terms of 250,000 sec.-ft. of water, which carries the terrors of huge volume with it, let us think of it as a flow of water 6 ft. deep over a dam 5 ft. high. It then sounds less formidable.

The structure will be on a pile foundation similar to those used in New Orleans, in the identical soil upon which rest buildings more than twenty stories high.

Col. Townsend says "The committee invites attention to a fact long known to river engineers that the amount of sediment carried by the river in suspension at New Orleans bears an obscure relation to flood heights, but they appear to be ignorant of the cause of the phenomenon." He then proceeds to explain the greater turbidity of Missouri water over that of the Ohio, a matter quite thoroughly gone into by the writer before the Flood Control committee of the House. Our committee was not ignorant of the cause of this turbidity condition but the cause was not at issue. We were refuting the contention heretofore expressed of the

Mississippi River Commission that a spillway would cause dangerous deposit due to diminishing velocity.

Col. Townsend also says "They also emphasize another well known fact that the river discharge, at a given stage, constantly varies. A river's discharge is dependent not only on the area of its cross-section but also on its slope." He then goes on to show that the discharge in 1916 was greater for a given stage than was the case in 1912 or 1922, because the flood of 1916 was of short duration and the storage reservoirs at the mouths of the tributaries were not all filled up and the slope consequently was greater than in 1912 and much greater than in 1922.

The committee appreciated these facts and the writer concurs entirely with Col. Townsend in his deductions. What we were endeavoring to show, and what we complain of, is that the closing of the natural storage basins has brought about the condition which has diminished the capacity of the river at New Orleans, for a given stage, twenty per cent since 1851. The choking of the river, particularly in the lower reaches, prolongs the floods until practically all of the storage area becomes filled and the slope becomes more nearly uniform and consequently gentler, which means less discharge for a given stage. We are not a little surprised to note that while Col. Townsend admits this he still persists in a policy which can mean nothing but failure and ruin, for it is obvious that the capacity of the river has been diminished beyond any reasonable hope that levee heights can compensate in cross-section for the loss in slope due to the closing of the natural storage basins.

[Mr. Kemper here included in his original letter a criticism of Col. Townsend's flood figures based on the reference in the Townsed paper to the Vicksburg stage "on April 18." As this was a typographical error in the original paper, the the intention being to refer to "April 28," Mr. Kemper's criticism does not seem valid and is therefore not included.—EDITOR.]

Col. Townsend was again mistaken when he says that the Cairo stage exceeded 50 ft. for 55 days during the flood of 1922. It reached 50 ft. on March 20 and passed under the 50 ft. mark on May 2, remaining 50 ft. or more for 44 days. That this is long enough is admitted, but it caused no alarming stages between Cairo and Memphis. The Memphis gage did not get within 4.5 ft. of the 1913 record while the Arkansas City gage, 200 miles below Memphis, showed 2.9 ft. higher than it did in 1913. This variation of 7.4 ft. was caused wholly by the closing of the Cypress Creek gap, referred to by Col. Townsend, which shut water out of the Tensas basin at the mouth of the Arkansas and forced it into the Mississippi River. It can not be accounted for by the high condition at Cairo, however much the Mississippi River Commission would like to use that route for an alibi, for the reasonably low stage at Memphis was between to disprove it.

There is just one ray of hope in Col. Townsend's most interesting paper and that is contained in these words—"The principal lesson to be derived from the flood of 1922 is the vital importance of maintaining the existing spillway at the mouth of the Red River." The commission periodically votes on closing this opening into the Atchafalaya. At their last vote on the subject the engineers were divided three to three and the lay member saved the situation by voting, as he told me, his common sense. He saw that great volume of water leaving the Mississippi into the Atchafalaya, with the tops of the levees barely out of water, and his common sense told him if that additional burden was placed on the river the levees would be overtopped. It is the writer's opinion that they would be overtopped about 6 ft., just as the Arkansas City stage was raised 7.4 ft. by closing the Tensas opening.

Our committee believes that the only hope for flood relief is thoroughly intelligent information. The public in general and our legislators in particular have been deceived by false theories. We think the Mississippi River Commission should either defend its actions on their merits or acknowledge their error. They seem disinclined to do either. We feel gratified, however, over the progress made in Col. Townsend's admission that the opposition to spillways is now based only on structural difficulties and not upon channel impairment, as the commission has falsely preached for forty-three years.

We know that a spillway will cost no more than a very mediocre crevasse and we know if the spillway were to blow out it would only be a crevasse and we are accustomed to crevasses. We also know that, if the Mississippi River Commission has no engineers competent to build a spillway there are private concerns that for a reasonable consideration will build it and bond it against blowing out.

The commission has the authority to build spillways and it is our purpose to so bombard it with truth that it will be unable to stand the pressure of a righteous opposition and rescind from its present arbitrary and not entirely consistent position.

J. P. KEMPER,
Civil Engineer.

New Orleans, La.,
Jan. 18.

Sir—In your issue of Jan. 4 you state "Col. Townsend dismisses rather lightly the long held contention that the main argument against a spillway is the possible silting up of the river below the spillway." It is unfortunate that he has done so for that is the crux of the whole matter.

The organic law creating the Mississippi River Commission in 1879 provided that "the commission shall report in full upon the practicability, feasibility and probable cost of the various plans known as the jetty system, the levee system and the outlet system as well as upon such others as they deem necessary." In obedience to these instructions the commission began the collection of data from all available sources, including the experiences in foreign lands, and the studies extended through a period of several years. In fact the study of the effect of outlets and crevasses on the bed of the river has been continuous up to the present time. And the conclusion was reached that any outflow of material volume from the main stream reduces the capacity of the main stream below, through deposits of sediment, whether the outflow is an outlet, a spillway or a crevasse. It is merely a question of the extent of the reduction of section and not a question of fact.

The data gathered from the early experiences of crevasses in Louisiana and data gathered since by actual surveys made by the commission before and after many crevasses, all bear out the correctness of the conclusions above cited. There have been many attempts to explain away the results, but actual facts and figures to disprove them are still lacking. Furthermore, experiences of many years in other lands where great sedimentary rivers have been bled by numerous irrigation canals, show that the rivers have silted up to such extent that they are no longer able to carry anything like their former volume.

Neither is it important to differentiate between outlets and spillways or crevasses. Assume a spillway connecting the Mississippi River and Lake Borgne in operation during the flood of 1922. As soon as the outflow begins, the deposit of sediment in the river below follows and continues until the bankful stage or top of weir is reached on the recession of the flood. There is found a decided reduction in the section of the river below and a material loss in its carrying capacity, depending in a measure on the volume and duration of the outflow. In the case of the Polydras crevasse of 1922 the measured decrease in section amounted to about 7 per cent. In one case measured the decrease amounted to 24 per cent. The danger lies in the loss of carrying capacity.

Assume an overflow of 250,000 cu.ft. per sec., what will be the actual reduction in flood stage? A study of the actual discharge measurements at Carrollton would indicate that the abstraction of so large a volume from the river should reduce the stage about 4 ft. The actual reduction according to gage readings is however only 1.6 ft. There is only one way to account for this and that is, the reduction of the channel capacity below the weir formed by the deposits has required that much increase in stage in order to carry off the volume put upon it. That is why the reduction in stage looked for from a spillway can never be realized and will always be disappointing.

It is not now and never has been a question of navigation below Baton Rouge where the navigable depth of water is ample at all stages of the river. As the river carries a maximum of over 1,500,000 cu.yd. of sediment per day past the spillway site, is it any wonder that the channel capacity is reduced, a part of the sediment dropped, due to the depleted volume? The outflow through the spillway is from the surface where if anything the percentage of sediment is the lowest.

In every case where the effect of crevasses on the bed of the river has been measured a reduction of section has been noted and the lowering of the stage of river due to the crevasse has not been commensurate with outflow volume.

The river again within its banks or below the crest of the weir, the assumed spillway has no further influence until the next flood comes, and this may be an interval of several years. When it first became effective, the channel conditions were the resultant of several succeeding confined flood stages and the usual low stages. It seems probable that like conditions would be required to restore the channel to the conditions which existed when the spillway outflow began. That is to say a channel developed by a flow of 1,500,000 sec.-ft. once depleted by a crevasse or spillway outflow, could only be fully restored by a volume equal to that which created it.

The length of river covered by the reduction in section has never been determined but is not important as the reduction in volume of flow is measured by the area of the cross-section and the velocity due to the local slope. The extent to which the deposits may be cumulative has not been determined. That there will be some removal of the deposits due to scour between bankful stage and low water seems inevitable.

Rivers in foreign lands which have been under observation for many years definitely show a cumulative deterioration of the lower reaches where the volume higher up has been largely depleted.

After an extended series of observations before and after crevasses, of crevasses open and closed, the commission stated its conclusions: "That the loss of volume through high water outlets caused both a diminution of velocity and a deflection of the thread of movement of the stream towards the outlet, accompanied by loss of power necessary to transport the material with which it is loaded. The excess of load is dropped in the bed, decreasing the section below the outlet. When these conditions occur frequently * * * the injury inflicted on the river as a channel or as a drain is cumulative, leading to general deterioration."

All later observations have confirmed these conclusions and nothing has been developed which seriously questions their validity.

In 1913 the commission directed that surveys be made of possible spillway sites below Baton Rouge and after consideration of the results, reached the following conclusions, in November, 1914: "Exhaustive surveys and examinations have been made of six possible sites for spillways below Baton Rouge, and while such spillways of adequate dimensions might reduce flood heights locally to a limited extent, their introduction into the adopted scheme of flood control would add new and serious dangers to the integrity of the levees themselves, and to the lands and improvements in the vicinity of the controlling works. Then too the first cost and the maintenance of such controlling works would be very great and far in excess of the benefits that might be derived therefrom. It is therefore the opinion of the commission that the use of spillways for the purpose of reducing flood heights is impracticable."

The writer has not deemed it necessary to burden these statements with definite figures as they are to be found in abundance in the reports and files of the commission.

J. A. OCKERSON,
Past President, American Society of Civil Engineers.
St. Louis, Mo., Jan. 25.

[The two letters above were referred to Col. Townsend, who has replied as follows:—EDITOR.]

Sir—The letters of Mr. Ockerson and Mr. Kemper instead of refuting the deductions in my paper on spillways, rely confirm them.

eduction in carrying capacity of 7 per cent to 24 per cent as stated by Mr. Ockerson would be detrimental to navigation between Cairo and the mouth of the Red River where channel depths varying from 4½ to 10 ft. are found on bars at lower water, but below New Orleans, where depths exceeding 60 ft. exist on crossings, a reduction to 50 ft. would be of no practical importance to seagoing vessels so long as the depth on the bar at the mouth of the river does not exceed the 35 ft. of the existing project.

Mr. Kemper relies on the resistance afforded by four miles of "stumps and vegetation," to prevent a concentrated flow of 250,000 sec.-ft. on a slope of four feet to the mile, from scouring Louisiana alluvium after "something of a hole has been dug" at the weir. Those "who built the Panama Canal, the Keokuk dam and the Roosevelt dam" used larger coefficients of safety.

Mr. Kemper utilizes a typographical error to controvert my computations of flood heights. The crest of the flood culminated at Vicksburg on April 28 instead of April 18 erroneously stated in the paper. This could have been inferred from the allusion to the propagation of the flood to the mouth of Red River in 17 days. Even the hydrographs published by the committee show two distinct flood waves down to Donaldsonville.

C. McD. TOWNSEND,
Col. (ret'd), Corps of Engineers, U. S. A.
Brooklyn, N. Y.
Feb. 7, 1923.

A $15,000 Water Bond Issue Will Cost City $39,750

Sir—The $15,000 of water improvement bonds issued in 1892 by Mt. Pleasant, Mich., will cost the city of Mt. Pleasant $39,750. This is a condition that one might find in a good many other cities in the United States. Long-term bonds have been quite generally used in the past, but improved city finance make use of serial bonds.

The Mount Pleasant water bonds of 1892 were to run for fifteen years and bear 5 per cent interest. No sinking fund was provided. When the bonds were due in 1907 there was no money available to retire them. To raise the whole $15,000 by taxation in one year when the entire tax would otherwise be only $17,400 was out of the question. So the $15,000 bond issue was refunded for twenty years, but at 4½ instead of the original 5 per cent.

Not a dollar was put into a sinking fund to relieve this bond until June 1922, when $2,500 was appropriated by the commission and it was recommended that the same amount should be appropriated yearly for the next five years, so as to retire these bonds on July 15, 1927.

Interest on the original bonds for fifteen years at 5 per cent was $11,250 and on the re-issue for twenty years at 4½ per cent is $13,500, making a total of $24,750 interest. If 5 per cent 1-15-year serial bonds has been issued the total interest charge would have been $6,000 instead of $24,750 or a saving of $18,750. This is not all, for the water-works bond issue is only one of several of the sort that this city has had to shoulder. We are now paying city debts that should have been paid fifteen years ago. No wonder that taxes are high.

C. H. PETERSON,
City Manager.
Mt. Pleasant, Mich., Feb. 7.

River Improvement Costs on Ton-Mile Basis

In a special report now before the Joint Waterways Committee of the Western Society of Engineers the following estimates are offered as to the costs of several river improvements reduced to a ton-mile basis. The figures are not to be considered accurate but are submitted as approximations or indications of actual costs:

Waterway	Ton-Miles Per Year (Millions)	Total Annual Cost (Includes Annual Maintenance Plus 5 Per Cent of First Cost)	Cost of Improvement Per Ton-Mile Per Year Including Maintenance
Monongahela	782	$1,700,000	$ .00216
Ohio	4,220	4,500,000	.0011
Mississippi (Vicksburg to New Orleans)	750	1,600,000	.00215
Allegheny	10.2	288,000	.016
Sacramento	96	132,750	.00138
Warrior System	173	775,000	.00447
Mississippi (Mouth of Missouri to Cairo)	175	989,000	.00565
Total	6,209	10,084,750	.00162

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevitics

An injunction suit against a bond issue of $2,000,000 for municipal improvements at Beaumont, Tex., authorized two years ago, has been dismissed by the Texas Supreme Court. It is expected that steps will be taken at once to expend the money for municipal improvements.

By the terms of a law passed recently by the Government of Panama a loan of $4,500,000 is to be floated so that the national program of highway construction started in 1921 may be carried on. R. W. Hebard & Co., Inc., of New York and Panama, are the engineers and contractors for work.

On Feb. 27 Champaign County, Ill., is to vote on a bond issue for $2,500,000, the proceeds of which will go to the building of hard surfaced roads. The system is approved by the State Highway Department and comprises 173 miles of 9-ft. concrete road which can be widened to an 18-ft. width as traffic demands.

The senate committee on education and labor has reported favorably and without amendment the Frelinghuysen bill to create a commission on unemployment to study public works which may be undertaken advantageously in periods of depression when abnormal numbers of men are without work.

The East Jersey Water Co., a corporation interested in the water supplies of various New Jersey cities and towns, has been declared a public utility and thus subject to state regulation by the New Jersey Court of Errors and Appeals. The decision has a bearing upon a number of controverted water-supply and rate questions in northern New Jersey.

An engineering committee to report on the design of the army semi-rigid dirigible RS1 has been named by the National Advisory Committee for Aeronautics. It consists of Henry Goldmark, chairman; W. W. Pagon, Prof. Wm. Hovgaard, Dr. L. B. Tuckerman, and Dr. Max Munk. The first meeting is to be held Feb. 23. A committee of the same membership was appointed last summer to investigate the naval rigid airship built at Lakehurst, and recently reported.

Hearings on the application of the New York Port Authority to require the railroads entering the port to co-operate with it in the carrying out of its comprehensive plan has been set by the Interstate Commerce Commission for March 15. It will be held at the office of the Port Authority, 11 Broadway, New York City, concurrently with a hearing on the same subject to be held by the Port of New York Authority.

Fire in New York Hospital for Insane Cost 25 Lives

Twenty-two patients and three attendants were burned to death in a fire which destroyed the west wing of the east main building of the Manhattan State Hospital for the Insane on Ward's Island, New York City, early Sunday morning. The fire occurred in the hospital wing of one of the buildings which was erected more than half a century ago, and which had not been made fireproof. Due to the fact that during the early part of the fire only the hospital's own fighting equipment—two steamers, one truck, one utility wagon and one horse-drawn hose cart—was available, damage to life and property was doubtless greater than it otherwise would have been.

The fire started around five o'clock and was not out until six hours later. As soon as the gravity of the situation was realized alarms brought to the East River from New York apparatus, but only two pieces of apparatus even then were ferried over. To the island's equipment working through a 12-in. pressure main, were added two of the New York fireboats, which, however, before they could operate, had to stretch lines of hose 1,500 ft.

The fire of Sunday is the sixth that has occurred at the island in the past 26 years. Each time emphasis has been placed by the press upon the lack of fire fighting equipment at the institution.

Several investigations have been ordered. Governor Smith, of New York, has deputized Dr. Floyd C. Haviland, head of the state hospital commission, to represent him in the state investigation.

Consider Electrification for Ontario Railway

A report recommending electrification of the Timiskaming & Northern Ontario Ry. by F. B. Clement, chief engineer, and J. G. G. Kerry, consulting engineer of the T. & N. O. Ry., is now under consideration by the commission operating the line and the Ontario government. Electrification is recommended for the main line from North Bay to Cochrane, a distance of 252.3 miles; for the Iroquois Falls subdivision, 17 miles; and for the Porcupine subdivision, 33 miles, the commission to take immediate steps to secure control of water power on the Amable du Fond, Blanche and Frederickhouse rivers. It is also recommended that opportunities be given to companies operating power plants in the district to bid for the supply of electric power. The estimated cost of electrifying the line to give it capacity to handle the traffic expected by 1925, estimated at 25 per cent greater than that handled in 1921, is $11,814,778. The T. & N. O. commission, in presenting the report to the provincial government, recommended that electrification be postponed for the present, as its success will depend upon the volume of future traffic.

Harding Submits Government Reorganization Plan

Interior Department To Control Public Works Construction and Maintenance

Co-ordination of the military and naval establishments under a single cabinet officer, transfer of all non-military functions from the War and Navy Departments to civilian departments, elimination of all non-fiscal functions from the Treasury Department, establishment of one new cabinet office, renaming the Post Office Department the Department of Communications, and the attachment to the several departments of all independent establishments except those performing quasi-judicial functions or acting as service agencies for all departments, are main recommendations made by President Harding and the cabinet in the reorganization plan sent to the Joint Committee on Reorganization of Government Departments last week.

Of chief engineering interest is the inclusion in one department—Department of Interior—of principal agencies for the construction and maintenance of public works. The Department of Interior is given, under the reorganization plan, but two major functions: the administration of the public domain and of the construction and maintenance of public works. An assistant secretary is provided for to perform each of these two functions. Under the assistant secretary for public domain would be administration of Hawaii and Alaska, Indian lands and reservations, the General Land Office, War Minerals Relief Commission, the Geological Survey, National Park Service, National Military Park Commissions (transferred from the War Department) and the Federal Power Section, which would include the Federal Power Commission.

The assistant secretary for public works would have jurisdiction over the following: Bureau of Public Roads (which is transferred from the Department of Agriculture), the Supervising Architects Office from the Treasury Department), the Alaskan Engineering Commission, the Reclamation Service, the Board of Engineers for Rivers and Harbors (from the War Department), the Board of Road Commissioners for Alaska (from the War Department), and the Bureau of District of Columbia Building and Grounds.

The Board of Engineers for Rivers and Harbors would contain the following bodies: Board of Engineers, New York City; U. S. Engineer offices; the Mississippi River Commission and the California Debris Commission. These are now in the War Department.

The Bureau of District of Columbia Buildings and Grounds would contain. Office of Public Buildings and Grounds, the Commission of Fine Arts, the Superintendent of State, War and Navy Buildings, the architect of the Capitol and the Rock Creek and Potomac Parkway Commission.

The new government department recommended in the President's plan would be called the Department of Education and Welfare. An assistant secretary in this new department would be charged with administration of various agencies concerned with public health. The public health bureau would therefore be transferred from the Treasury Department, and with hospitalization included in the enlarged bureau, several hospitals now under the War and Interior Departments would be transferred thereto.

Commerce Reorganization

Under the reorganization plan the Department of Commerce is given three major functions: the promotion of industry; the promotion of trade; and the development, regulation and protection of the merchant marine. The subdivisions are accordingly organized under three assistant secretaries. Under this plan the Bureau of Patents would be transferred from the War Department and given to the assistant secretary for industry, as would the Bureau of Mines, transferred from the Interior Department, and the Bureau of Standards, already included in the Department of Commerce. A new bureau—that of transportation — would be created to be supervised by the assistant secretary for trade in the Department of Commerce. This would include supervision over airways, waterways (federal canals except Panama), and highways. To the third of the three assistant secretaries in the Department of Commerce would be given supervision over the merchant marine, and to his department would be transferred: from the War Department, the Lake Survey, and from the Navy Department the Hydrographic Office, both to be included in the Coast and Geodetic Survey; and from the War Department Inland and Coastwise Waterways Service and the supervisor for New York harbor. Bureaus now in the Department of Commerce which the assistant secretary for merchant marine would supervise include the Bureau of Lighthouses and the Bureau of Navigation.

The Forest Service over which there has been considerable discussion, remains in the Department of Agriculture.

Independent Establishments

In the President's reorganization plan existing independent establishments have been placed under the supervision of some department, insofar as has been deemed expedient. Only those remain as independent organization which are quasi-judicial in character. These include: Civil Service Commission, Shipping Board with the Emergency Fleet Corp., Tariff Commission, Interstate Commerce Commission, Federal Trade Commission, Federal Reserve Board, War Finance Corp., Coal Commission, Railroad Administration, Railroad Labor Board, World War Foreign Debt Commission, Bureau of the Budget, the Government Printing Office, Bureau of Efficiency, and the Bureau of Purchase and Supply.

In transmitting his recommended reorganization plan the President asserted that in a few instances, "believed to be of minor importance, the principle of major purpose was not followed out to the letter, in order to avoid contro- rsies which might jeopardize re- nization as a whole."

Albany Society Adopt Resolutions on State Engineer

At a recent annual meeting of the Albany Society of Engineers a resolution was adopted approving the principle of a proposed amendment to the constitution of New York State authorizing the consolidation of the offices of state engineer and surveyor and superintendent of public works but disapproving the amendment in its present form or in any other form that does not provide that the holder of the new office having "control of engineering works shall be an engineer of not less than fifteen years' experience and training in engineering work." A copy of the resolution may be secured from John W. Henry, secretary, 89 Morris St., Albany, N. Y.

A year ago, Governor Miller said in his annual message that economy would result from the consolidation of the two offices named above, possibly including also the departments of highways, buildings and state architect. The legislature of 1922 adopted a concurrent resolution (which if passed by the 1923 legislature and endorsed by a state-wide referendum vote would become a constitutional amendment) authorizing legislation, which, in effect, would consolidate the offices of state engineer and of superintendent of works (see *Engineering News-Record,* April 6, 1922, p. 584.)

Governor Smith, in his inaugural message as successor to Governor Miller (a message delivered after the action of the Albany Society of Engineers, already cited), recommended more sweeping action along the lines of a plan worked out in 1920 for consolidation of state administrative departments that would reduce the number of these from 180 to 19. Pending the final passage of the constitutional amendments Governor Smith advises the legislature to make such consolidations as can be effected by statute. These consolidations, which are to be outlined in a special message, would enlarge the powers of the present Departments of Conservation, Health, Education, Farms and Markets and Adjutant General.

Road Oiling in Illinois Calls for $2,000,000 Expenditure

Results of a summation made by the Illinois state highway department shows that oiling of roads has become an industry second only in importance to the construction of hard roads in that state. The oiling programs by the various counties have called for an expenditure of over $2,000,000 for 1922, approximately $1,500,000 for 1921 and indications are that the expenditures will be materially increased during 1923. The laboratory inspected over 35,000,000 gal. of oil during 1922—3,000,000 gal. for one county alone.

The laboratory made many field inspections which brought out the following considerations: "The first requisite to a good job of oiling is a road surface free from pits, ruts and dust. There was noticed a tendency to spread the oil over too great a mileage in two ways—first by oiling a narrow strip in the center of the road and second by using thin oil having low viscosity and low asphaltic content. Either of these practices defeats the purpose of oiling."

Committee to Study Pollution of Curtis Bay, Baltimore

A committee to study the pollution of Curtis Bay, Baltimore Harbor, has been appointed by Dr. John S. Fulton, director, Maryland Board of Health, as follows: Dr. M. C. Whitaker, vice-president of the United States Industrial Alcohol Co.; E. B. Miller, vice-president of the Davison Chemical Co.; Dr. Wade H. Frost, professor of epidemiology, School of Hygiene and Public Health, Johns Hopkins University; Abel Wolman, chief engineer of the State Department of Health, and Swepson Earle, of the State Conservation Commission. Industrial wastes seem to be the chief source of trouble and to be threatening fish life and the steel and wood of ships. The dissolved oxygen parts of the area has fallen from 19 per cent of normal in 1915 to zero at present, according to Mr. Wolman.

Gift of $4,200,000 to California Institute of Technology

The Board of Trustees of the California Institute of Technology at Pasadena, Calif., have announced an additional gift from Arthur H. Fleming, amounting to $4,200,000, which is to be kept intact as a perpetual trust fund and the income from which is to be used for endowment uses and research purposes.

In presenting the gift the donor made certain recommendations as to the future policy of the Institute. He suggested that the enrollment be limited to 2,000 students, that the present engineering work be continued, and special attention be given to research in chemistry and physics, and that endeavor be made to invite the superior student and help encourage those disposed to research.

Denver to Vote Again in Spring Election for Water Bonds

At the regular May election in Denver, Colo., a charter amendment will be voted upon providing for the issuance of about $7,000,000 water-works improvements bonds, as recommended by the Engineering Board of Review. In a bulletin issued Feb. 1 by the Board of Water Commissioners the statement is made that it is not possible to delay the beginning of construction beyond the summer of 1923 as work on all units must proceed together—conduit system, filters, distribution system and enlarged pumping plants.

Because of urgent necessity for more water this season expenditures from current revenues have been authorized which will give three of the pumping stations an additional capacity of 10,000,000 gal.

Following the war water was furnished free for thrift-gardens. During the season of 1922 so much water was wasted that the board has decided that no free water will be furnished this year. Another saving measure will be the restriction of the irrigation of lawns to four days per week. Properties bearing even numbers may irrigate on Mondays, Wednesdays and Fridays and Sundays, while those having odd numbers may use water the other days in the week.

Indiana Sanitarians Discuss Water, Sewage and Fire

Fire prevention, water-works operating difficulties, softening problems and the relation of sewage to water at the lower end of Lake Michigan were the main topics discussed Feb. 14 and 15 at Indianapolis, at the Annual Meeting of the Indiana Water Supply and Sanitary Association. About 125 sanitary engineers, water-works operators and health officials registered.

Frank C. Jordan, secretary, Indianapolis Water Co., has been assisting the local fire officials in a campaign of fire prevention in the city and now proposed to make the co-operation and educational features state wide giving service outside the city limits, which is made possible because of the increasing network of good roads. The nucleus of a state fire protection association has been formed whose aim is to effect better co-operation between water and fire departments.

Charles P. Hoover, chemist in charge of the water purification plant at Columbus, Ohio, in discussing water softening, stated that water was so much cheaper than gas, electricity and local transportation that the public would soon demand water in Middle West states be brought down to approximately 100 p.p.m. of hardness. Time and temperature factors in chemical reactions are far more important than they have been credited with. In the Columbus mixing tanks where the water remains only 2 hours 90 per cent of the work is done, only 3 per cent is done in the 15 hours in the settling basins and 7 per cent in the filters. He deduced that large basins are unnecessary and described a carbonator costing $900 per million gallons which will do much of the same work. In answering Mr. Hoover's contention that hard waters like the Indianapolis supply would soon require softening, H. E. Jordan of the local company stated there were several needs preceding a softening program that the public were clamoring for.

Selling water to contractors by meter is the best practice according to a round-table discussion on the subject, though few cities do it that way, thereby incurring much difficulty with flat rate wasters and yearly permits because of fly-by-the-night contractors who failed to pay for water used.

L. R. Howson, consulting engineer, Chicago, repeated the startling effects of water waste in Chicago given at the Midwinter Convocation of the Western Society of Engineers. Paul Hansen, consulting engineer, Chicago, gave a history of the Bloomington (Ind.) water situation, on the solution of which several consulting engineers are in substantial agreement but which the officials as often have rejected, until last year water had to be hauled into the town by train at price of $1 a barrel.

A committee on rules and standards of service for water utilities reporting to the State Public Service Commission has prepared a set of rules and standards more elaborate than yet adopted by any of the states. Carl Wilde, secretary of the committee, discussed those referring to water. The reports will be sent to members as well as to the commission.

Officers elected for the ensuing year are as follows: H. E. Jordan, president; C. K. Calvert, secretary-treasurer.

Syracuse Leases Its Garbage Works for Five Years

A five-year contract for the disposal of the garbage of Syracuse, N. Y., by means of the garbage-reduction works owned by the city, has been let to the C. O. Bartlett & Snow Co., Cleveland, Ohio. The company will install additional machinery at a cost to itself of $35,000. The city will deliver the garbage to the plant and will pay the company $30,000 a year for its services

The garbage-reduction plant, which is of the Cobwell type, was installed by the company named. It was put in operation March 1, 1921. On Jan. 1, following, the city administration changed and there were soon allegations against the way the plant had been operated by the preceding administration, besides complaints of an excessive net operating cost and claims of a reduction of the net cost under the new administration. Soon after the middle of the year the city invited bids for the disposal of its garbage. Among the resulting offers was one from the C. O. Bartlett & Snow Co., substantially as outlined above. The mayor advised acceptance of this bid but the council voted against it. On Dec. 10 the plant was shut down on the ground of the high cost of operation and burial of the garbage begun (see *Engineering News-Record*, Jan. 11, p. 89). Finally the council approved the lease already outlined, but owing to illness in the legal department the contract had not been executed up to Feb. 16.

It is expected that the plant will be taken over under the contract by March 1, but that the additional equipment will not be installed and the plant in full working order until two or three months later.

I.C.C. Approves Southern Pacific Control of Central Pacific

The Interstate Commerce Commission has approved the acquisition by the Southern Pacific Co. of control of the Central Pacific Ry. by stock purchase and by lease. The order authorizing this step provides conditions designed to prevent discrimination against the Ogden route and to permit other disposition of the Central Pacific should the commission find it desirable in carrying out its consolidation program.

Michigan Road and Bridge Builders Organize

Organization of the Michigan Road Contractors Association composed of road and bridge contractors operating throughout the state was effected at a dinner meeting held recently. Practically all contractors present became charter members. The temporary officers who were appointed at a preliminary meeting held in Grand Rapids in November were made permanent. The officers are: President, L. D. Townsend, Lansing; William H. Ryan, Jackson, vice-president; C. A. Handyside, Detroit, treasurer.

The association will lend its energies to encouraging and promoting public highway improvement and harmonizing the interests of the contractor, the public, and public departments. The headquarters of the association have been established in the Capital National Bank Building, Lansing, Mich.

Congress Inaction Hampers Coal Commission

Legislative Zeal Wanes with Passing of Emergency—Necessary Bills Go Over from Week to Week

Washington Correspondence

Congress has failed to hold up the hands of the coal commission which it created. Because of its dilatoriness, the services of Judge Alschuler, one of the commission's most valuable members, were lost. Early in its term, the commission asked also for legislation to make compulsory and provide penalties covering the returns submitted on questionnaires. As this is written, there still is much uncertainty as to when that legislation will be forthcoming. It still remains to be seen whether or not the same policy will prevail in the handling of the legislation carrying $400,000 for the expenses of administering the commission.

COMMISSION HANDICAPPED

The procrastination and the lack of interest on the part of Congress is handicapping the commission in its work and lessening its possibilities for usefulness. The attitude of the legislative bodies toward the coal commission can not be attributed to any displeasure with the work the commission has done. On the contrary, opinion on Capitol Hill is generally favorable to the commission. When the commission bill was passed, the country was face to face with an emergency with coal. Public opinion was inflamed. Under those conditions, Congress was prompt to pass the bill and apply the counter irritant. In the meantime, the emergency has passed. The strike danger has been postponed for a year. The price of coal is falling and the full requirements of the country are in a fair way to be met. Public interest no longer is focussed on coal. As a result, the legislation held to be necessary to the commission's maximum accomplishment goes over from day to day and week to week. Even Chairman Winslow, of the Committee on Interstate and Foreign Commerce, coming as he does from New England where the fuel situation has been most acute, ranks the coal bill as eighth in importance among the measures that his committee will bring before the House. When his committee has its day, under House rules, seven other pieces of legislation must be disposed of before the coal bill is laid before the House.

STOCK REPORT FIGURES

The stock report, issued under the authority of the federal fuel distributor, showing only 36,000,000 tons of coal in storage on Jan. 1, reveals how unprepared the country would have been to withstand a strike this year. With stocks at that level and with demand much increased over that of a year ago, it is apparent that the country could not have built up to [illegible] of April 1, 1922, when 6[illegible],000,000 tons were in storage. The stock report explains clearly why prices are 50 per cent higher than they were about a year ago.

The increase in the demand, however, cannot be attributed entirely to enlarged industrial activity, since no small portion of the demand is for the purpose of replacing anthracite.

Indiana City Planning Engineers Hold Conference

City planning engineers of Indiana in a conference Feb. 14 and 15 at Lafayette, under the auspices of the civil engineering department of Purdue University, held a conference on city planning programs and legislation. Attorneys, members of city plan commissions, real estate operators, as well as engineers were in attendance. R. H. Whitten, city planning engineer for Cleveland, spoke on "Zoning Problems." Harland Bartholomew, St. Louis, and Prof. L. S. Smith, University of Wisconsin, were also on the program for the engineers.

Allegheny River Bridge Not to Have Stone-Faced Piers

On Feb. 6 the county commissioners of Allegheny County (Pittsburgh), Pa. (V. R. Covell, county engineer), awarded a contract for the construction of the piers of the new 40th St. bridge over the Allegheny River between Pittsburgh and the Borough of Millvale to H. P. Converse & Co. for $854,692. The contract is for concrete piers carried to rock, without stone facing. The award ends an active controversy as between concrete and stone-faced piers. Alternate designs were submitted by the architect and engineer, Benno Janssen and C. S. Davis, with the recommendation that stone facing be used. The low bids on the two types of construction were $600,000 higher for the stone-faced piers. The stone facing was urged because of the likelihood of surface deterioration of the concrete, and action of acid river water upon it. The difference of cost was affected by the fact that the arcaded piers of the long approach on the Pittsburgh side are relatively thin and in the stone-faced designed were therefore planned to be of stone throughout (without concrete core), and the fact that they are skewed and would therefore involve relatively high stonecutting costs.

Canadian Land Surveyors Hold Annual Meeting

The practical value of the tabulated information gathered by land classification surveys in solving the problems confronting land settlement; the extension of topographic mapping in Canada; the vast mineral resources of the western provinces, and the operations of the Geodetic Survey of Canada, were among the matters discussed at the sixteenth annual meeting of the Dominion Land Surveyors' Association in Ottawa, Ontario, recently. Delegates were in attendance from every part of the Dominion. Major Douglas H. Nelles of Ottawa was elected president for the ensuing year.

In his annual report the retiring president, C. H. Herriott, stressed the fact that since 1918 not less than 20,500,000 acres of land had been examined and classified as to suitability for settlement, and reconnaissance made of 8,117,000 acres, as a preliminary to a more detailed examination.

How the federal government, through the agency of detail maps prepared by the Geological Survey of Canada, was making the work of the prospector much less difficult, than in the past, was explained in a paper by F. J. Alcock.

Indiana Court Orders License Issued to Practising Engineer

By a county court decision in Marion Co., Ind., the Board of Engineering Examiners has been mandamused to issue a license to an engineer practising professional engineering within the state for a year or more and complying with the other requirements of the engineer's license laws. The ruling held that the board had no discretionary powers to construe the law as meaning that the applicant for a license should have been in responsible charge of work, this being the defense of the board. On this point the judge ruled as follows:

"While I may commend the motives of the defendant board and approve the standard of efficiency they are endeavoring to set in this case, I am constrained to feel that no matter how laudable their motives may be, and no matter what their conception concerning their duty to a public trust might be, they cannot enlarge or restrict the plain and clear meaning of the language used by the legislature."

Engineering Societies

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 13-15.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

The Association of Professional Engineers of Manitoba held its annual meeting in Winnipeg Jan. 18 and elected as president, Alexander Young; vice-president, E. V. Caton; registrar, George L. Guy.

The Northeastern Section of the American Society of Civil Engineers held its annual meeting Jan. 27 in Boston. The officers elected for 1923 are: chairman, Lewis E. Moore; vice-chairman, Arthur D. Weston; secretary-treasurer, Charles W. Banks.

The Engineers' Club of Minneapolis has elected as its new president Prof. W. T. Ryan of the department of electrical engineering of the University of Minnesota; and as secretary A. F. Mellen, assistant superintendent of the Minneapolis filtration plant.

The Illinois Section, American Society of Civil Engineers, Jan. 4 at its annual meeting elected H. R. Safford, vice-president, Chicago, Burlington & Quincy R.R., as president, and C. B. Ball, chief sanitary inspector, City of Chicago, as vice-president for the coming year. An invitation was given to the parent society to hold the summer meeting (June) in Chicago. All of the fifty members present contributed to the $150 quota of the Illinois Section for the balance necessary to insure the erection of a bust over the tablet of James Buchanan Eads in the Hall of Fame.

The Associated Engineers of Spokane, Wash., at their recent annual meeting, elected J. C. Carpenter, mechanical engineer, as president and A. D. Butler, city engineer, as secretary and treasurer. Vice-presidents and members of the executive committee were also elected.

The Highway Engineers' Association of Missouri at its recent annual meeting at Columbia, Mo., elected as president F. B. Newton, division engineer of the state highway department; as vice-president, J. W. Wilson, county engineer of Johnson County; and re-elected as secretary and treasurer Carl W. Brown, assistant state engineer.

The Illinois Section of the American Water Works Association will hold its annual meeting March 21 and 22 at Decatur. Subjects scheduled are impounded water supplies, softening, financing public utilities, customer ownership, increased use of water, supervision of filters, consolidation of small plants, the fuel problem and the advisability of small utilities owning or controlling coal mines.

Personal Notes

H. R. DAVENPORT, until recently assistant engineer with the Mountain Water Supply Co., has become associated with the Missouri State Highway Commission as a designer in the bridge department.

O. H. STREHLOW, construction engineer with James O. Heyworth, Chicago, has been made a member of the firm of Walsh & Masterson, contractors, succeeding Herbert S. Walsh, who recently died. Mr. Strehlow, a graduate civil engineer of the University of Illinois, has had wide experience in general engineering and has had special training in river and harbor work.

J. L. STANNARD, formerly with Grant Smith & Co., contractors, of San Francisco and elsewhere, has been appointed chief engineer of the Lake Cushman power project which is being undertaken by the City of Tacoma, Wash.

CHARLES W. STANIFORD was appointed consulting engineer on the construction of the Wilmington marine terminal, now nearing completion, at a recent meeting of Board of Harbor Commissioners, Wilmington, Del. Mr. Staniford has for the past year and a half been associated with the late B. F. Cresson, Jr., consulting engineer.

HON. E. H. ARMSTRONG, minister of public works in Nova Scotia since 1911, has been appointed premier of the province of Nova Scotia.

D. C. MORROW, for 11 years borough engineer of Washington, Pa., will resign this position to become superintendent of the Citizens' Water Co. of that city. Mr. Morrow has had charge of construction of numerous sewer extensions, new paving, a garbage incinerating plant and sewage purification works.

JAMES H. GRIER is now superintendent of construction for Siems, Helmers & Shaffner, general contractors of St. Paul, Minn. Mr. Grier was formerly connected with the Michie Construction Co. as construction superintendent.

GEORGE F. KIDD, designer and constructor of power plants, mills and factories, of East Orange, N. J., has recently become eligible to appointment as assistant bridge engineer of the New Jersey State Highway Department. Mr. Kidd finished first in a recent civil service examination held for the position.

WILLIAM J. ROBERTS, of Tacoma, Wash, has resigned as chief engineer of the Intercounty River Improvement, a flood control project comprising channel changes in the White - Stuck and Puyallup Rivers, costing about $1,900,000. **HAMILTON F. GRONEN**, formerly commissioner of light and water, of Tacoma, has been appointed chief engineer of the project.

A. B. ROBERTS, who has been director of public utilities for the City of Cleveland for the past thirteen months, has resumed his position as vice-president of the Withington-Roberts-Wright Co., consulting engineers, Cleveland, Ohio. During the war Mr. Roberts was in charge of the designing and construction of the Aberdeen Proving Ground, Maryland, with the rank of major under Col. W. A. Phillips. He is a director of the Cleveland Engineering Society.

CAPT. F. A. MCCOMBER has been appointed assistant city engineer of Duluth, Minn., to succeed **A. U. SHIPMAN**, who has retired to enter business in Duluth as a contractor. Capt. McComber is president of the Duluth branch of the Society of American Military Engineers. He was for several years employed in the Duluth city engineer's office.

LUPFER & REMICK, consulting and contracting engineers of Buffalo, New York, was dissolved on Feb. 1, upon the withdrawal of Mr. Remick from the firm. Mr. Lupfer has organized the Edward P. Lupfer Corp., with offices in the Ellicott Square, Buffalo, and has associated A. J. Dillenbeck with him.

DAVID A. WATT has joined the staff of the Roger Black Company, Inc., engineering and construction, New York City, to take charge of the company's engineering work. Mr. Watt has been engaged in bridge and building work, and on lock and dam construction in different parts of the country for many years. The latter work was done under the Corps of Engineers, U. S. Army. As major of Engineers during the war Mr. Watt was placed in charge of the Wilson Dam, at Muscle Shoals, where he laid out a complete construction plant and carried on the general construction until the completion of the first cofferdam, turning the work over at that time to Col. J. B. Cavanaugh, Corps of Engineers, and remaining as assistant engineer until Hugh L. Cooper & Co. became consulting engineers for the project, when he joined Colonel Cooper's field staff.

J. W. PAXTON, has tendered his resignation to Director Caven as assistant engineer of the Division of Street Cleaning, Philadelphia, which position he has held since November 1, 1921. Mr. Paxton's resignation is made necessary by ill-health.

H. W. FLEMING, assistant engineer, stationed at Ottawa, has been appointed district engineer, Nipigon Division, of the Canadian National Ry., with headquarters at Hornepagne, Ont.

T. B. BALLANTYNE, division engineer, stationed at Schreiber, Ont., has been appointed division engineer of the Farnham Division of the Canadian Pacific R.R. His office is at Farnham, Quebec. **M. KELLY**, division engineer of the Farnham Division, has been appointed division engineer of the Toronto terminals, with headququarters at Toronto.

HERBERT NUNN, for the past several years state highway engineer of Oregon, has tendered his resignation to the highway commission. Though the resignation was handed in some time ago to become effective Feb. 6, the commission as yet has taken no action.

A. T. NORTH, engineer and architect of Chicago, has accepted a position as engineering editor of the *American Architect*. Mr. North has had a wide engineering and construction experience in various parts of the country. He is a former chief engineer of the National Fireproofing Co. (Western department) of Chicago, contracting engineer with Wells Bros. Construction Co. of Chicago, and consulting engineer for the Yellow Pine Manufacturers Association, also of Chicago.

ERNEST MCCULLOUGH, associate editor of the *American Architect*, has resigned to become associated with Dwight P. Robinson & Co., New York, in their engineering department. Mr. McCullough, prior to his connection with the *American Architect*, was in the army. He spent twenty-seven months in France, first in charge of construction work for the American Red Cross and later with the Chemical Warfare Service. Besides having done consulting work in various parts of the country, he has contributed much to technical literature and has had rather a wide experience in technical journalism.

JAMES A. FRENCH has been appointed state engineer of New Mexico, his appointment to become effective March 1. He replaces Charles A. May, the present incumbent. Mr. French's early professional experience was gained in the U. S. Coast and Geodetic Survey and with the Union Pacific and the Chicago, Burlington & Quincy Rys. Later he was employed in the engineering department of the District of Columbia and still later as an assistant engineer in the U. S. Reclamation Service. During that latter employment he was identified with the construction of the Shoshone dam outlet tunnel, and on the Sun River project, in Montana. He was also engineer-in-charge for the Reclamation Service of the Rio Grande project, New Mexico and Texas. Mr. French is a resident of santa Fe and held the office of state engineer under a previous administration.

W. J. CORBETT has been engaged as industrial engineer to be associated with R. A. Bull, research director, in the increased activities of the Electric Steel Founders Research Group.

FRANK A. RANDALL, consulting engineer, formerly of Berlin, Swern & Randall, announces that he will continue the independent practice of structural engineering at the address of the former company, 19 South La Salle St., Chicago.

W. H. WARNOCK has been appointed, effective Feb. 19, town engineer of Montclair, N. J., succeeding William F. Bates, who died Jan. 10. Mr. Warnock is a graduate of the Massachusetts Institute of Technology, class of 1905, and after about a year of service with the Holyoke (Mass.) Water Power Co. and with Westinghouse, Church, Kerr & Co., on the construction of the Pennsylvania railway terminal in New York City, he joined the engineering staff of the New York Board of Water Supply, which was then beginning the construction of the Catskill Aqueduct As assistant engineer and later as section engineer in charge of a portion of the 18-mile city tunnel in Manhattan he remained on the Catskill work eleven years. In 1917 he was engaged on investigation and research with the New York City Bureau of Fire Prevention until the United States entered the war, when he was commissioned captain in the Construction Division of the Army, serving as field officer at Camp Stuart, Newport News, Va., and later as construction quartermaster and disbursing officer at Lee Hall, Va., where the army was constructing an additional water supply system for Newport News. Prior to his present connection Mr. Warnock was engaged, for a time, on industrial development investigations for Cross & Brown, real estate operators of New York City.

Obituary

THOMAS W. COTHRAN, prominent in civil engineering and construction circles in Greenwood, S. C., for the past fifteen years, died at his home in that city Feb. 9. Previous to his entering private engineering practice he had been principal assistant engineer of the South & Western Ry., now the Carolina, Clinchfield & Ohio. Prior to that time he was assistant engineer in the chief engineer's office of the Seaboard Air Line Ry. He was a member of the first graduating class of Clemson College, S. C., and for a time was an instructor in that institution. Later he was with the U. S. Geological Survey.

EDWARD J. FARRELL, retired construction engineer and tunnel builder, died Feb. 13 at his home in New York City, aged 72 years. He was born in Capagne, New Brunswick, Canada, and educated there. He was a member of the Am. Soc. C. E. Some of his earlier construction work was on the Hoosack tunnel from North Adams to Springfield, Mass.; and the Lacine canal in Canada. He also worked on the old Croton Aqueduct, the Lenox Avenue Subway from 135th St. to the yards at 155th St., Sections 2 and 3 of the I. R. T. from 104th St. and Broadway under Central Park to 110th St. and Lenox Avenue. The last big job in which Mr. Farrell was interested was the construction of the New York Speedway running from 155th St. to Dyckman St. along the Harlem River.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Crawler Mountings for Railroad-Type Power Shovels

Operating Economies Made Possible by Recent Change in Design—Use Extending to Many Fields

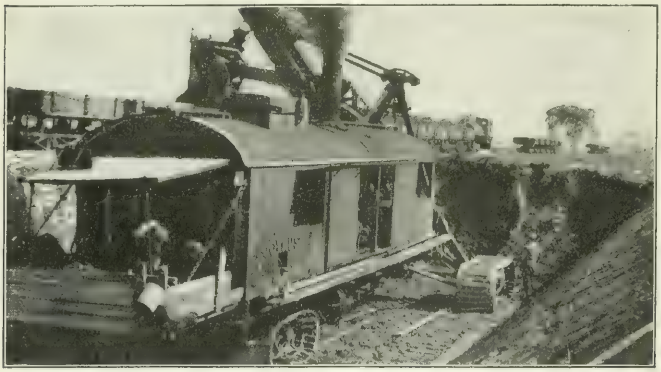
By Bradlee Van Brunt
Bucyrus Co., South Milwaukee, Wis.

TIME honored methods of steam-shovel operation are undergoing radical revision as the result of the introduction last year of crawler mountings for the large, railroad-type shovels. Translated into terms of operation, this innovation eliminates the necessity of hifting track sections, releasing jacks, setting rail clamps, and resetting the acks after the shovel has been moved up preparatory to the resumption of ligging. The first set of crawlers under a railroad-type shovel was supplied by the Bucyrus Co. in February, 1922, for a Marion (Model 91) shovel owned by the Kelly Island Lime & Transport Co. at its quarry in Marblehead, Ohio. This installation was immediately successful and was followed by a number of others built by the same company. The accompanying list indicates the extent of use of crawler mountings for railroad-type shovels at the present time.

RAILROAD TYPE POWER SHOVELS WITH CRAWLER MOUNTINGS

Owner	No. of Crawler Sets	Type of Shovel on Which Installed
Kelly Island Lime & Transport Co.	1	Marion 91
S. A Smith	1	Bucyrus 70C
Oliver Iron Mining Co.	11	Marion Model 91
Palmer & McBryde	1	Bucyrus 60C (Elec.)
Utah Copper Co.	7	Bucyrus 95C and Marion 91
Atlas Portland Cement Co	1	Bucyrus 88C
A. E. Dick	1	Bucyrus 70C
Trafikaktiebolaget Grangesburg Oxelosund, Stockholm, Sweden	1	Bucyrus 100C
Central Pa. Quarry Stripping & Const. Co.	1	Marion Model 61
Locust Mt. Coal Co.	1	Bucyrus 70C
France Stone Co.	2	Marion Moeel 92
Chile Exploration Co., Chile	1	Bucyrus 103C(Elec.)
Michigan Limestone & Chemical Co	1	Marion 100
Sandusky Portland Cement Co.	1	Bucyrus 68C (Elec.)
Kandos Portland Cement Co., Australia	1	Bucyrus 68C (Elec.)
Duquesne Slag Co.	1	Bucyrus 103C
Total	33	

For railroad-type shovels the crawler mounting consists of four units. Two forward units replace the jack arms and are so designed that they can swivel and adjust themselves to unevenness of the ground. Two rear units are mounted on one frame under the end of the shovel. The power is sufficient to enable the shovel to climb a 20-per cent grade. The treads are of cast steel of heavy construction, different sizes being offered to suit the character of the ground on which the shovel operates.



Railroad Type Steam Shovel on Crawler Mounting
On construction of Hudson River bridge and connecting railway south of Albany, N. Y.

Substantial economies in operation are possible with this type of mounting. The track sections, of course, are discarded and since there are no jacks to release and set, the need of a large pit crew is eliminated. The time required to move up is greatly reduced, as the shovel can travel forward while the dipper is swinging back from the car. This is an item of saving which, in the aggregate, mounts up at the end of a day's work.

With the crawler mounting the shovel can always be kept at the most effective digging distance from the face of the cut. There is no need of reaching out to get a full dipper, and consequently there is less strain on the boom and handle, and increased output. In rock excavation the shovel is not obliged to face blasts with the likelihood of damage, because it takes but a few minutes' time to move back out of the way and up again when the shot is fired. With the crawler mounting it has been noticed that there is considerably less vibration during digging operations, resulting in an increased life of the piping of the shovel.

The mounting of heavy excavating machinery on crawlers is not a new development. The Bucyrus Co. has for the past nine years equipped more than 100 dragline excavators, revolving shovels and tower excavators in this way. The adaptation of the crawlers to the heavy railroad-type shovel is, therefore, an added step in the improvement of excavating machinery that has been in progress during recent years. It is significant that the two largest users of railroad-type steam shovels in the world today, the Oliver Iron Mining Co. and the Utah Copper Co., after purchase and test of crawler mountings, ordered, respectively, 10 and 6 additional sets.

Machinery Export Plans for 1923—Latin America

Conditions Changed Since War—Exports to Latin American Group Totaled $92,000,000 in 1920

By W. H. Rastall
Chief, Industrial Machinery Division, U. S. Department of Commerce

This is the second of a series of articles on Foreign Machinery Markets. The first one appeared in "Engineering News-Record," Feb. 8, 1922, p. 279.—Editor.

AN ARTICLE published in *Engineering News-Record,* Feb. 8, p. 279, outlined the foreign-sales problem for the current year in its more general aspects. With that article was published a table showing the comparative value of the more important machinery markets of the world, as indicated by American export statistics for 1921, 1919, and 1910, and attention was drawn to the fact that of the 20 leading countries 17 were largely free from reconstruction problems and similar troubles resulting from the war. The present article is devoted to the countries in Latin America that were shown by the previous table to rank high as markets for American industrial machine.

Transportation routes, as at present developed, make it desirable to divide the entire Latin American territory into three groups; namely, Mexico and Central America, the West Indies and the countries bordering on the Caribbean, and other countries in South America proper. The comparative importance of these markets has changed since before the war. The nature of these changes is indicated in Table I, from which it will be noted that the machinery exports from the United States to the entire Latin American group expanded from about $15,000,000 in 1910 to $105,000,000 in 1920, falling to $92,000,000 in 1921. The percentage of the total exports of American industrial machinery absorbed by the markets of Latin America fell from about 30 per cent in 1910 to 15 per cent in 1915, but expanded to 37.4 per cent in 1921, at which time the trade was very evenly divided among the three groups of countries.

German and British Trade

Unfortunately the statistics published by the different Latin American governments do not provide a great deal of assistance to the American exporter in solving his problem, as in many cases the classifications employed scarcely meet his needs. In pre-war days German manufacturers secured better returns from the markets of Latin America than from any other part of the world, and British manufacturers have secured important business from these markets for many years. Because of the earlier entry of European interests into this trade, due in part to financial affiliations, these interests secured an exceptional position, largely because American manufacturers had not given the market the necessary attention.

During the war, when many of the Latin American countries were more or less cut off from their accustomed sources of supply, new industries were established. In a number of instances these industries have flourished, thus creating a field for the sale of American machinery.

TRADE CONDITIONS

Cuba—Although the table published in this journal, Feb. 8, p. 280, indicates that among our foreign markets throughout the entire world Mexico ranked 1, 9, 4, 2, in the years 1921, 1919, 1913, and 1910, respectively while, in the same years, Cuba ranked 3, 5, 6 and 5, the chart accompanying that article shows that since 1915 Cuba has been our best Latin American market, except during unfavorable sugar market years, such as during the last two or three years. However, the price of sugar is now in the neighborhood of 3¾ cents, or perhaps 35 per cent above the 1913 level, so that it would appear that Cuba is well started on the road to recovery. Furthermore, there seems to be reason to discount somewhat the press reports that large quantities of American machinery still remain undelivered at Cuban ports. It has been estimated that the glut of merchandise, which at one time had accumulated in the bonded warehouses of Cuba, has been reduced from the highest total (perhaps $60,000,000 to $80,000,000) to a present total not exceeding $10,000,000 to $15,000,000, and it is, of course, recognized that machinery is only one item of the many classes of merchandise that accumulated there. Conditions in the machinery markets of Cuba well deserve careful attention at this time. In this connection it is interesting to remember that, in spite of recent business disturbances, the Cuban exchange has remained at par.

TABLE I—DESTINATION OF INDUSTRIAL MACHINERY EXPORTED FROM THE UNITED STATES

Destination	1910	1913	1915	1919	1920	1921
Canada, Newfoundland, etc	$14,368,755	$32,740,377	$15,740,484	$57,490,321	$68,534,672	$28,867,066
Europe (except Balkans	14,151,707	29,117,195	89,790,973	112,178,313	116,848,098	44,844,196
South America	5,553,574	10,690,991	4,606,836	26,180,072	35,787,203	30,631,382
Mexico and Central America	6,914,500	6,433,548	2,858,474	11,450,859	22,293,921	34,381,861
West Indies, etc	2,923,918	5,375,266	4,466,958	22,248,987	47,087,299	27,146,318
Total Latin America...	$15,391,992	$22,499,805	$11,932,268	$59,879,918	$105,168,423	$92,159,561
Asia (except Asia Minor	3,805,620	6,530,936	4,443,287	73,116,419	71,296,081	64,424,150
Australasia	2,209,862	3,566,129	2,999,898	5,792,748	8,171,153	7,706,546
Africa	1,441,949	1,591,746	1,573,369	5,615,898	7,652,579	4,643,732
Other ...	119,713	424,884	567,052	6,382,142	5,959,351	3,791,113
Grand total	$51,489,598	$96,471,072	$77,047,331	$320,455,759	$383,630,357	$246,436,364
Percentage to Latin America	29.9	23.3	15.5	18.7	27.5	37.4

Mexico—More American machinery was absorbed by Mexico than by any other country in the world in 1921. In spite of unsettled conditions that country for a number of years has been one of our most important markets. It is true that there are certain problems involved in contracting to deliver machinery and receive payment at a Mexican destination, but those manufacturers who arrange to collect before their products cross the border have found their Mexican business very attractive and the volume of such business has been large. The Mexican exchange is very close to par.

Brazil—During the years 1921, 1919, 1913, and 1910 Brazil ranked 9, 10, 5, 9, respectively, among the markets for American machinery, absorbing over $8,700,000 worth in 1921, in spite of the fact that the rates of excxhange have been very unsatisfactory. In July, 1913, the milreis was worth 32.45 cents; by July 31, 1920, it had fallen to 21.6 cents; and on November 15, 1922, it was quoted at 11.53 cents. It should be remembered that Brazil is larger than the United States, but its railway mileage is only equal to approximately what was in operation in the United States in 1855. The country is undeveloped and contains wonderful opportunities for development that lead to the purchase of machinery. The population of Brazil is over 30,000,000. The country shows signs of developing rapidly, and appears to have reached the state where it will require large quantities of machinery.

Argentina—Ranked 10, 11, 10, 6 as a market for our machinery in the years 1921, 1919, 1913, and 1910. Exchange, which stood at 43.45 cents to the peso in July, 1913, and was 39.06 cents on July 31, 1920, and 20.125 cents on August 17, 1921, had recovered to 36.1 cents on November 15, 1922. Argentina, though only about one-third the area of Brazil, has a 20 per cent greater railway mileage, with a population of about 8,500,000.

Peru—Among the markets for American machinery Peru ranked 14, 20, 19, 21 in the years 1921, 1919, 1913, and 1910. In July, 1913, the Peruvian pound had an exchange value close to parity. On July 31, 1920, it was worth $3.65, and on November 15, 1922, had recovered to $3.91. Peru took more machinery than South Africa in 1921. At present important railway expansion, irrigation work, and the development of hydro-electric and other utilities are being suggested in Peru, which will require machinery, in addition to the mining demand.

Chile—Ranked 15, 12, 14, 14, respectively, in 1921, 1919, 1913, and 1910. Chilean exchange has been unsatisfactory, although it has improved somewhat recently. To a great degree Chile depends upon the prosperity of the nitrate business. Chile took $5,600,000 worth of American machinery in 1919 and $3,500,000 worth in 1921.

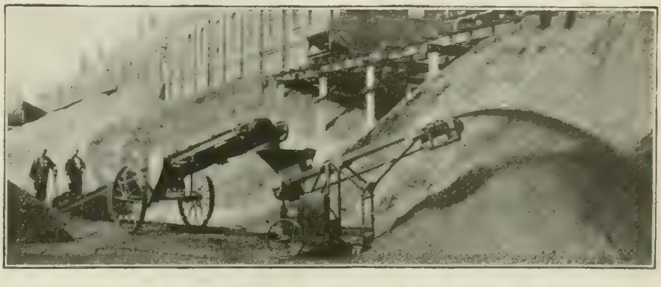
Dominican Republic—In 1921, 1919, 1913, and 1910 the Dominican market ranked 16, 24, 18, 22 in the shipments of American industrial machinery. In 1921 it absorbed $3,250,000 worth.

Colombia—Ranked 18, 25, 21, 24 among our machinery markets. In the interval since 1913 Colombia has placed its currency on a gold basis, so that the exchange problem is no longer important. At present Colombia is an exceptionally promising market, because of the extensive oil operations and the comprehensive railway program.

Venezuela—Ranked 25, 29, 26, 26 in 1921, 1919, 1913, and 1910, but it should be remembered that, although the rank has not changed materially in a decade, the volume of the country's purchases of our machinery has expanded from $110,000 to $1,400,000. Venezuela is a promising market.

Japanese Handle Coal With American Conveyors

Japanese engineers, selecting machinery for their purpose from Link-Belt publications, have made the application shown in accompanying illustration for storing out and reclaiming coal. The coal is so largely of small size or slack that the use of a Pratt box-car loader for building piles of coal does no harm from breakage, as it might with high grade lump coal. The combination of this machine with a portable belt conveyor makes a flexible device for handling coal to and from various parts of the yard.



AMERICAN CONVEYORS, IN TANDEM, STORE COAL IN JAPANESE YARD

This combination can be used for handling other bulk materials which would not be injured by the action of the box-car loader. This machine was developed for delivering sand and other materials to the farthest corner of a car, without having the machine itself take up much room or be difficult to manage in a confined space.

More Suggestions—

For Better Equipment and Repair Parts Service

IN the Dec. 14 issue was begun a discussion of "Better Equipment Maintenance and Repair Parts Service." Its object is to show how some of the misunderstandings between maker and user of construction machinery can be avoided. This week's contribution is a recital of experiences by a manufacturer of steel forms, buckets and steel buildings.

From the Blaw-Knox Co., Pittsburgh, Pa.

THE Blaw-Knox Co. runs a rather more elaborate service department than is customary with the average manfacturer. For example, we have service men constantly on the road who inspect our clamshell buckets, instruct operators, give us a full report of the condition of buckets, and bring our service to the attention of the owner.

The use of a clamshell bucket for purposes for which it was not manufactured results either in the failure of the bucket to function properly or a large upkeep cost over a comparatively short period. There is no such thing as a universal clamshell bucket—that is, one that will do everything efficiently. This company makes buckets for every variety of work, some of which will do a greater variety of work than others, but each has its particular work and construction features. We have found many instances of buckets made to handle some loose bulk material being utilized for heavy excavation. Of course, the bucket does not function properly in this use.

It would appear that education, which must be of an extremely varied character, is the only solution for this problem, but the owner and manufacturer both suffer, because at times the conscientious manufacturer, endeavoring to meet his customer's problem, is somewhat higher in price than a competitor who is using as his basis of figuring a bucket not adapted to meet the special conditions. Of course, where you know that such conditions exist they can be met by proper salesmanship, but there are many instances where an order is lost and the exact reason for its being lost does not become known until it is too late.

The placing of orders for road forms for immediate delivery during the height of the road-building season is something which we, in common with other manufacturers, experience. In some instances, of course, such action is necessary, but it is believed that the great majority of orders for last minute shipment could be anticipated and the manufacturing curve stabilized along a straighter line than exists at present. Naturally, the user suffers in two ways: (1) He cannot obtain his equipment in time for the job and is obliged to use either a makeshift or a grade of equipment which is not efficient. (2) There is a question of price balance which could possibly result in a slight reduction if the manufacturer could figure with more or less exactitude on a certain manufacturing program, carrying a steady load through divisions of his shop during all months of the year.

The contractor would be much better served if he were always specific in orders for repair parts. We have, however, so systematized our work along these lines, that we are able to furnish in the majority of cases, the right part for the right apparatus without receiving a great number of details to the apparatus itself. This, however, represents a high degree of efficiency on the part of our organization and does not excuse the contractor from his duty to the manufacturer.

A definite plan of plant inspection on the job by the contractor would result in greatly increased efficiency. Some contractors exhibit great acumen in observing the fine details of plant inspection, and have a very well developed mechanical sense which enables them to put together apparatus which is more or less complicated without the use of manufacturer's drawings. As is always the case, you will find that these contractors are the most successful in their lines and have the best and most up-to-date equipment. On the other hand, you often run into cases where the contractor will "holler for help," and of course, we send our service men and give him the required assistance.

The more the contractor understands the manufacturer's problems, the greater the contractor's own efficiency will become. Co-operation will be reflected both in the price and the quality of the manufacturer's products.

Business Notes

ADENSITE CO., INC., New York City, has recently been formed for the manufacture of a liquid integral compounded from calcium chloride, gums and other carbon compounds, for use in the making of Portland cement concrete and mortar. John R. Lapham, professor of civil engineering in George Washington University, Washington, D. C., is in charge of the laboratory tests carried on with Adensite. William C. Kober and Thomas Moore, both formerly with the Anti-Hydro Waterproofing Co., are active in the management of the new company. Both Mr. Kober and Mr. Moore have poured concrete on the job and their outlook is not limited to the laboratory. The Adensite Co. will specialize in concrete texture, keeping absolutely out of all problems that are in the province of the structural engineer.

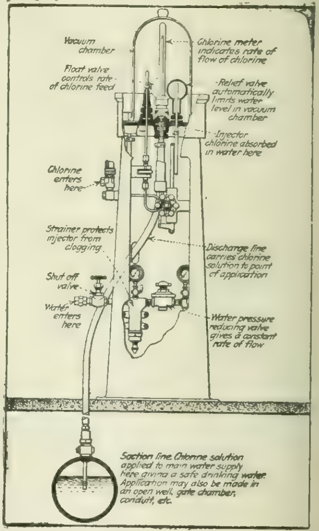
AMERICAN INTERNATIONAL CORP., New York, has announced the resignations of Frank A. Vanderlip as chairman of the board of directors and Charles A. Stone as president. M. C. Brush, senior vice-president, has been elected chairman of the executive committee and president. Gordon H. Balch has been elected a vice-president.

EASTON CAR & CONSTRUCTION CO., makers of cars, track and equipment for industrial purposes, as well as Easton roll-over and scoop bodies for trucks and other similar equipment, announces the opening of a new office in Harrisburg, Pa. The office will be under the personal direction of GEORGE D. FRAUNFELDER.

Equipment and Materials

Apparatus for Chlorinating Water and Sewage Has New Control

The largest installation of chlorine control apparatus in the world is now at the Westerly Sewage Disposal Plant Cleveland, Ohio, where six W@T Type MSV chlorinators of a total capacity of 3,960 lb. of chlorine per 24 hours, are in operation. This type of chlorinator has only recently been perfected by the Wallace & Tiernan Co., Inc., Newark, N. J., and represents a new principle in chlorine control. Sturdiness of construction, simplicity of operation and elimination of small delicate parts have been sought in the design. The chlorine gas, from the time it enters the apparatus until it is made into chlorine solution, is always under a vacuum so that the possibility of leaks is reduced to a minimum. Furthermore, the flow of chlorine automatically ceases whenever the water supply to the apparatus is shut off.


Vacuum chamber
Chlorine meter indicates rate of flow of chlorine
Float valve controls rate of chlorine feed
Relief valve automatically limits water level in vacuum chamber
Injector chlorine absorbed in water here
Chlorine enters here
Strainer protects injector from clogging
Discharge line carries chlorine solution to point of application
Shut off valve
Water enters here
Water pressure reducing valve gives a constant rate of flow
Section line Chlorine solution applied to main water supply here giving a safe drinking water. Application may also be made in an open well, gate chamber, conduit, etc.

The chlorine is controlled by the vacuum produced by an auxiliary supply of water flowing through an injector, the vacuum drawing the chlorine into the injector where it is mixed with the auxiliary water supply. The chlorine solution thus formed is conveyed to the water supply to be chlorinated.

The auxiliary water supply first passes through a strainer and then through a reducing valve to the injector. The suction created by the water passing through the injector is transmitted through a silver adjustable head tube to the inside of a glass bell jar which stands in a partly filled tray of water. The vacuum created causes the level of the water inside the bell jar to rise above the water level outside the jar. This opens a float reducing valve which allows the chlorine to enter the bell jar, the chlorine cylinder being connected directly to the feed line to which this float valve is attached.

A glass meter tube with a calibrated orifice at the top fits over the silver adjustable head tube. Connection through several small ports is made from the inside of the meter tube to the inside of the bell jar so that normally water levels in both would be equal. The only way that the chlorine can enter the injector is through the orifice at the top of the meter tube and down through the silver tube. Since the flow of gas through an orifice depends on the drop in pressure across the orifice, it is only necessary to measure this drop to know the flow of gas at any time. The water level inside the meter tube can be adjusted by varying the elevation of the adjustable head tube inside the meter and the chlorine flow regulated in this manner. The pressure drop across the orifice is equal to the difference in height of the water inside the bell jar and inside the meter tube. The orifice meter tube is empirically calibrated to convert this difference to pounds of chlorine per 24 hr. A ratchet arrangement enables the adjustable head tube to be set as desired.

The chlorine then goes down into the injector where it mixes thoroughly with the water and then passes to the point of application through the discharge line.

New Trench-Digging Attachment for Locomotive Crane

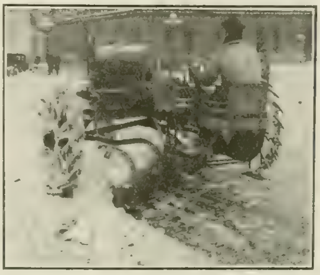
The range of application of its Model 16 crane, on which interchangeability features are provided for clamshell bucket, power shovel, dragline, and hook and block operation, has been extended by the Bay City Dredge Works, Bay City, Mich., in the form of a new ditcher attachment, illustrated in the accompanying photograph. This is not a new machine, but consists merely of an auxiliary boom attached to the standard clamshell or dragline boom, with a dipper of the power shovel type mounted on its under side.

The device will dig a trench up to 16 ft. in depth and of variable widths, depending upon the width of the ditcher scoop. The weight of the boom, the manufacturers point out, may be transferred to the bucket, making it possible to dig very hard material. In operation the scoop digs toward the machine, making it possible for the latter to remain on solid ground instead of spanning the trench. The auxiliary boom, it is stated, can be removed in about an hour's time and a standard boom with clamshell bucket substituted.

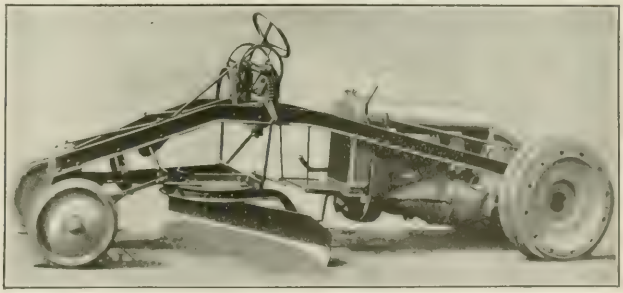
The features of the machine, other than the digging attachment, are a two-speed propelling arrangement for the caterpillar trucks, providing speeds of ¾ and 2 miles per hour. The operator's position is at the front of the machine where he can get a good view of his work at all times.

Road Graders Used for Snow Removal

A wider use of road grading equipment is being developed by adapting it to snow-removal work on city streets and state and county highways. In Peoria, Ill., this winter, the Avery Company's "road razer" was used for clearing snow from the city streets as shown in the accompanying photograph. This type of machine has been employed for the same purpose in Salina, Kansas. The manufacturers of this equipment are emphasizing its all-year-round usefulness for highway maintenance and construction purposes in summer and snow removal in winter.

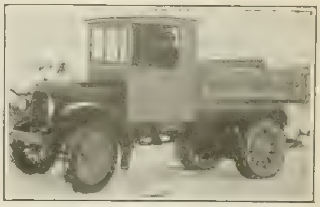


In the city of West Allis, Wis., the Commissioner of Streets has been using for both road work and snow removal a one-man power grader manufactured by the Wehr Co., Milwaukee. This machine consists of a 6-ft. blade connected to a frame on which a Fordson tractor power unit is mounted, as shown in the accompanying photograph. The equipment is mounted upon disk wheels equipped with solid rubber tires. To assemble the Wehr grader and Fordson tractor, the tractor axle and wheels are removed and the tractor suspended in the yoke of the grader.



Motor Truck Designed for Road Construction Work

Designed especially for use with a standard 21-E paving mixer, the "Road Builder" truck manufactured by the Ruggles Motor Truck Co., Saginaw, Mich., has a two-batch, end-dump body, short wheel base and turning radius, pneumatic tires, and a low gear ratio providing high tractive effort. The gross weight (including chassis, body and load) is 6½ tons and the wheel base is 115 in., resulting in a turning radius of 17 ft.



The truck may be equipped either with under-body hydraulic hoist and dump body, or automatic gravity end-dump body. For contractors who handle dry aggregate the body is divided by a center swinging partition to handle two five-bag batches. For wet aggregate the center swinging partition is removed. A 2-cu.yd dump body is supplied for handling gravel and earth, together with double-acting tail gate and spreading attachment.

Publications from the Construction Industry

Steel Pipe — NATIONAL TUBE Co., Pittsburgh, has published a 64-page illustrated booklet on the manufacture and uses of Matheson joint pipe, ranging in diameter from 2 to 30 in. The various steps in the process of manufacture are described in detail, the special joint, which is of the bell and spigot type, is illustrated and described, and numerous photographs show applications of the pipe on a variety of projects. One of the advantages claimed for the pipe is the absence of rivets, overlapping seams and ribs, thus improving its hydraulic properties. The joint is ordinarily used for a working pressure of 150 lb. per square inch, but when reinforced by a special clamping device it is suitable for pressures up to 350 lb. Data are given covering the amount of lead required per joint and per mile of pipe. One portion of the booklet deals with protective coatings to prevent corrosion. Tables give the thicknesses and weights of National pipe for various pressures and a comparison with cast-iron pipe.

Feed Water Heater — POWER SPECIALTY Co., New York, describes the Foster economizer in a 32-page illustrated [illegible] a general discussion of boiler-room savings that may be effected by preheating water [illegible]. Results of [illegible] these economizers are given and there are tables of the properties of steam.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Lumber Exports Gain 27 Per Cent in Year

Principal Softwood and All Hardwood Exports Increased—British Lumber Trade Improved

The 1922 lumber export trade shows considerable improvement over the preceding year, according to reports of the Lumber Division Chief, United States Department of Commerce, Feb. 19, 1923. The report, in part, is as follows:

"In 1922 our total exports of lumber amounted to 1,532,934,000 ft. b.m., as compared with 1,204,808,000 ft. in 1921, an increase of 27 per cent. The 1913 exports of lumber were 2,576,233,000 ft., making the 1922 exports 40 per cent less than 1913.

"The leading wood during the year under review was Douglas fir, of which 614,704,000 ft. were exported abroad. In 1921 the quantity of this wood exported was 455,233,000 ft. The 1922 increase was 35 per cent. The export of Douglas fir in 1913 amounted to 665,295,000 ft. During 1922 nearly one-half the Douglas fir went to Japan, nearly one-fifth to China, and the next largest quantities to Australia and Peru. The 1922 increase was taken by these countries, except Peru, and in addition the United Kingdom, Chile, and British South Africa.

YELLOW PINE SECOND TO DOUGLAS FIR

"The second leading export wood in 1922 was southern yellow pine, 474,258,000 ft. being exported, an increase of about 10 per cent over 432,736,000 ft. in 1921. The 1913 figure was 869,737,000 ft. Nearly one-quarter of the southern yellow pine in 1922 went to Argentina, nearly one-sixth to Cuba, and less amounts of importance to Mexico, United Kingdom, Canada, Spain, and Belgium. A very large increase occurred in the yellow pine exported to Canada over 1921, and the export to Spain was 184 per cent over 1921. However, Mexico took about 60 per cent less.

"In other softwoods, comparing 1921 with 1922, spruce increased about five times to 35,178,000 ft., redwood more than doubled to 33,143,000 ft., white pine increased 78 per cent to 25,811,000 ft., and western yellow pine more than doubled to 8,358,000 ft. However, other softwoods, not specified, declined one-third.

"Oak was the third leading export wood, and the leading hardwood in 1922, increasing by 59 per cent over 1921 to 108,214,000 ft. In 1913, 287,855,000 ft. of oak were exported. Oak exports to United Kingdom increased over 60 per cent to 49,200,000 ft., to Canada over 50 per cent to 32,338,000 ft., and increased amounts also went to Belgium, Argentina, Uruguay, and Spain. Although of small proportion to the total, it is significant that the export of oak to Spain in 1922 was three and one-half times the 1921 export.

"The lumber trade of the United Kingdom showed much improvement during 1922. Imports of lumber of all kinds were approximately 50 per cent greater in volume than in 1921. Not only did this increase go into consumption, but stocks generally were less at the close of the year than at the beginning."

Relation of Lumber Production and Shipments to Normal

The relation of actual weekly production and shipments to normal weekly production, and to seasonal monthly production and shipments, is shown in the accompanying charts.

The year 1922 began with a production rate of about 50 per cent of normal and ended at approximately the same level. Throughout the entire year the output came within a fraction of normal on only three occasions, namely, the last weeks in May and August and the second week in October, 1922.

Shipments at the outset of the year 1922 were about 60 per cent of normal production, rising to a point as high as 10 per cent above normal during April, May and June and dropping to around 80 per cent at the close of the year.

The closed curved line on both charts shows the relations of actual weekly production and shipments, respectively, to normal weekly production. The broken curved line in Chart I shows monthly and seasonal variation in production in relation to average production. The same line in Chart II depicts monthly and seasonal variation in shipments in relation to average shipments. In other words May and August have been found to be the seasonal peaks in lumber output and shipments in each year since 1912. Similarly, December, January and February are the low points. Average production centers around 76 per cent of normal, and average shipments, about 73 per cent of normal production.

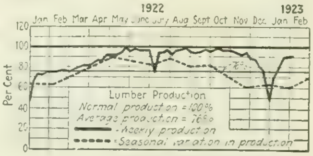


CHART I—LUMBER PRODUCTION

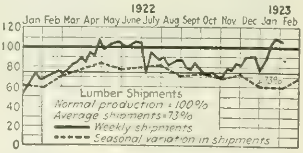


CHART II—LUMBER SHIPMENTS

The National Lumber Trade Barometer, Feb. 16, 1923, shows production at 13 per cent below normal; orders 116 per cent and shipments 105 per cent of normal production.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 95 to 108, are the following:

Waterworks, Wynnewood, Okla., bids received by city clerk, $85,000.

Sewer, Springwells, Mich., bids received by city clerk, $70,000.

Bridges, Columbus, Kan., for Com'rs Cherokee Co., $150,000.

Grading and paving, 16,000 sq.yd. of street, Royal Oak, Mich., for H. P. Oliver Land Co., $70,000.

Factory addition, Chicago, Ill., for Geib and Schafer, $200,000.

School, New York, N. Y., for Board of Education, 500 Park Ave., $750,000.

Bulkhead and pier, Baltimore, Md., for Consolidated Gas, Electric Light and Power Co., $100,000.

Apartment, Chicago, Ill., by W. W. Ahlschlager, arch't., 65 E. Huron St., $2,100,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 95 to 108, are the following projects:

Installing water mains, Cleveland, O., to Gantose Construction Co., $176,647.

Sewer, Pittsburgh, Kan., to Beeson Machinery Co., Kansas City, Mo., $98,801.

Bridge, Burnham, Ill., to Strobel Steel Construction Co., Chicago, $173,462.

Canal, Merced, Calif., to C. R. Adams, Planada, $94,120.

Paving 6,600 yd., 2-in. rock asphalt on 5-in. base, Oklahoma City, Okla., to Western Paving Co., $37,029.

Factory, Brooklyn, N. Y., to J. W. Ferguson Co., Paterson, N. J., $500,000.

Hotel, Chicago, Ill., to E. Bloom, $3,500,000.

Natatorium, Annapolis, Md., to Boyle-Robertson Construction Co., $355,858.

Park, Astoria, N. Y., to T. Di Roma, New York, N. Y., $111,903.

Waterworks and street car system, Harbin, Manchuria, to Beckman & Linden Engineering Corporation, San Francisco, Calif., $3,000,000.

Apartment, Long Beach, Calif., to Scofield Engineering Co., Los Angeles, $1,000,000.

Fewer Business Failures

The reports of failures received by *Dun's Review* for the five days ending Feb. 17, indicate that all districts of the United States, except the Pacific, have had small decreases; the Pacific section shows a slight increase. The week's total is 361, as against 371 for the six business days of the previous week. In the five-day week a year ago 610 defaults were reported.

A decrease, both absolutely and proportionately, is evident in the number of insolvencies with liabilities of more than $5,000 in each case; this week they number 198, or 54.8 per cent of the total, while for the week preceding they aggregated 220, or 59.3 per cent.

Building Trades Labor Rates Advanced in Minnesota

Building trades mechanics in Minnesota, during the coming summer, both skilled and unskilled, will receive wages averaging 10 per cent higher than the present scale, according to agreement reached at the annual convention of the Minnesota Building Employers' Association in St. Paul. Fourteen cities are included in the agreement, as follows: Minneapolis, St. Paul, Duluth, Winona, Stillwater, St. Cloud, Mankato, Red Wing, Owatonna, Albert Lea, Austin, Rochester, Fergus Falls and Hibing. It is expected that, as in the past, the rates paid in these leading cities of the state will govern, in the main, the scale to be observed in the state generally. The new scale is to become effective June 1, this arrangement enabling contractors on work now in progress to complete it within original estimates.

The newly established rates per hr. and those now obtaining are:

	New	Present
Bricklayers	$1.12½	$1.00
Plasterers	1.12½	1.00
Stone setters	1.10	1.00
Carpenters, cement finishers, electricians, hoisting engineers, structural iron workers, wood lathers, painters, plumbers, steam-fitters, sheet metal workers, stone masons	.87½	.80
Teams and teamsters	1.05	.95
Mason tenders	.71½	.65
Laborers	.55	.50

In announcing this agreement, the association directed attention to the fact that the present wage scale in the fourteen cities was lower than scales obtaining generally the past year in cities in the northern half of the country. The resolution embodying the new scale stated:

"Be it resolved that in determining wage scales due consideration be given to the highly skilled workmen, and it is our recommendation that such men be paid as a maximum wage in the crafts mentioned the amounts herein shown. In making this recommendation, we urge careful consideration of the principle that workmen be paid according to their skill and efficiency."

Cotton Spindles and Steel Output Gain in Activity

Evidence of further business expansion appeared during the week ending Feb. 17, according to reports received by R. G. Dun and Co. Activities in most quarters steadily gained momentum, and the point has been reached in different instances where results are being compared with the best previous records. No month even in war times saw as many cotton spindles running as was the case this January, and the steel industry has attained practically the highest rate of operation possible under existing conditions. The main problem now, broadly considered, is not one of finding employment for workers, but rather of securing enough men to maintain outputs on the scale warranted by current demands. Some buyers, quicker than others to sense the changed situation, have endeavored to commit themselves heavily with manufacturers, so as to secure protection against future requirements. The policy of not a few producers, however, is one of discouraging over purchasing, and there is more of a tendency, especially in the steel trade, to look to jobbing channels for sources of supply.

Business Briefs

Call money reached high point of 6 per cent, Feb. 13; low, 4 per cent, Feb. 16. Similar rates prevailed during same week in 1922.

Time loans at maximum of 5 per cent, Feb. 13; low, 4¾ per cent. Same rates in effect Feb. 14, 1922.

Commercial paper at high, 5 per cent, Feb. 13; low, 4½ per cent. Same week, 1922, high, 5 per cent; low, 4¾ per cent.

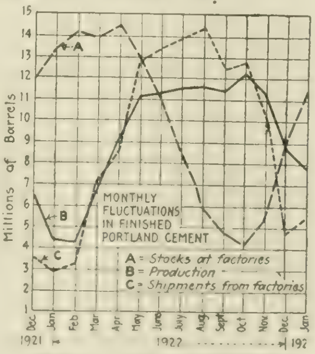
Foreign exchange: Sterling at $4.70⅜, Feb. 19, highest since 1919; due to heavy demand for international requirements. Franc, 6.06c.; rise of .95c. in two days. Mark, .0048c., down from .0051½c., Feb. 17.

Money supply for entire country, Feb. 1, shows decline of over $171,000,000 in month, due to retirement of reserve notes.

Cement Output and Shipments Higher Than Year Ago

Cement production and shipments were higher in January than during the corresponding period last year, but reserve stocks at the mills are somewhat lower than the quantity on hand a year ago.

The total output for the country, according to the Geological Survey, was 7,704,000 bbl. for January, 1923, an increase of over 3,000,000 bbl. as compared with January, 1922.



CEMENT OUTPUT, SHIPMENTS AND STOCKS

Shipments during January, 1923, amounted to 5,419,000 bbl., an advance of over 2,000,000 bbl. compared with the corresponding period last year.

Stocks on hand, at mills, Feb. 1, 1923, reached 11,426,000 bbl. as against 13,316,000 bbl. available at the same time last year.

The monthly fluctuations in production, shipments and mill stocks of finished portland cement, throughout the country, are shown in the accompanying chart.

That prices of many commodities are strengthening under pressure of the larger consumption has been clearly shown by Dun's list of wholesale quotations, which has disclosed an excess of advances in every week this year, and reports are becoming more common of premiums being offered to hasten shipments. Difficulty in making prompt deliveries frequently is encountered, owing to storms and cold.

Important Foreign Construction Projects Reported

Progress on a number of important construction projects in foreign countries, is reported by the United States Department of Commerce, Feb. 19, as follows:

Manchuria.—The South Manchuria Railway is reported to have set aside about 7,000,000 square feet of land for the establishment of a hospital, a chemical institute, a bacteriological institute, schools, a museum, etc. (Trade Commissioner Frank Rhea, Peking.))

China.—An American engineering firm has been awarded a contract for repairing a 3-mile break in the dikes of the Yellow River. (Trade Commissioner Frank Rhea, Peking.)

Chile.—The departmental board of railways has asked the Government of Chile for authority to float a loan of 5,000,000 pesos to be used for the construction and improvement of roadways near Santiago. It is understood that this request was well received by the Government. (Assistant Trade Commissioner Embry, Santiago.)

Canada.—It is reported that tenders will shortly be called for the construction of a dam on Lake Kenogami, in the Lake St. John district, Province of Quebec. It is understood that the total investment involved is approximately $2,500,000. Other important work is also being done in this district. (Consul E. Haldeman Dennison, Quebec.)

BIG CUBAN PUBLIC WORKS JOBS

Cuba.—Under the $50,000,000 loan just floated for Cuba, $6,000,000 is set aside for public works. It is anticipated that this sum may be increased should the other items of the appropriation not absorb the full balance of the $50,000,000. Also, the total available for public works will scarcely permit the completion of undertakings already started. More definite particulars will be available later. (Commercial Attaché Edwards, Havana.)

India.—It is reported that the Government consulting engineers have been asked to prepare an estimate of the cost of the cantilever bridge across the Hooghly River at Calcutta. Experimental cylinders on the Calcutta and Howrah sides are being sunk. (Vice Consul Harold Shantz, Calcutta.)

Philippines.—The following items appear in the appropriation bill recently submitted to the legislature: For wireless stations and equipment, $75,000; for maintenance of public buildings, $200,000; for maintenance and improvement of roads and bridges, $1,060,000; for studies regarding public improvements, $120,000, for waterworks, $250,000; for harbor work, $60,000; for telegraph and telephone systems, $120,000; for lighthouses, buoys, and beacons, $50,000. (Manila Daily Bulletin, December 13.)

France. — The Supreme Railroad Council has approved of reconstruction work on the important French railways, totaling 1,045,000,000 francs. Of this, 270,000,000 francs are for electrification and 775,000,000 francs for general construction work. (Ambassador Myron T. Herrick, Paris.)

West Indies.—The Government of Trinidad and Tobago has obtained sanction for a scheme to supply water to the southwestern portion of the island of Tobago, including the towns of Scarborough and Plymouth. The sum of $359,000 is involved, which will be taken from the loan raised in 1920. The construction of this system will be under the direction of the public works department of the government of Trinidad and Tobago at Port of Spain, (Consul Henry D. Baker, Trinidad.)

South Africa.—The harbor advisory board of Port Natal has suggested that the main wharf of Durban harbor be extended 1,300 feet. Recommendation has been approved by the government, and plans and estimates will be made. This board has also recommended the construction of a coaling station to store between 70,000 and 80,000 tons of coal, but this has not yet been sanctioned and plans have not yet been prepared. Consul Lewis V. Boyle, Durban, Natal.)

Switzerland.—A large electric power company has just floated a loan of 6,000,000 francs to be used for the construction and extension of the electric-power and distributing systems in Switzerland. (Consul James J. Murphy, Jr., Lucerne.)

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of February 1; the next, on March 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.29	$3.95	$4.40	$3.05	$3.30	$3.95	$3.35	$3.80	$3.75
Structural rivets, 100 lb	3.85	4.60	5.25	3.75	4.00	4.95	4.75	4.25	5.50
Reinforcing bars, ¾ in. up, 100 lb	3.19	3.85	3.15	2.95	3.20	3.62½	3.30	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	51%	53%	45%	59½%	55-5%	38%	38.2@46.5%	45%	32.76
Cast-iron pipe, 6 in. and over, ton	+56.50	+51.00	+57.00	53.20	58.50	65.00	57.00	57.00	55.00
Concreting Material:									
Cement without bags, bbl	2.60@2.70	2.75	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd	1.00	1.24	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd	1.75	2.00	2.00	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	+63.00	37.00	+53.00	56.50	+43.75	—51.00	+40.00	29 00	95.00
Lime, finishing, hydrated, ton	16.80@17.10	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	3.00@3.25	1.85	2.50	1.40	1.25	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	12.00	11.00	11.00	17@19	12.00	15.50	13.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0859	.115	....	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1230	.0859	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal	.99	1.02	+1.10	1.02	+1.09	+1.21	+1.09	.86	1.02
Common Labor:									
Common labor, union, hour	.60	35	.30@.50	......	......	.50@.55	56¼	.50@.60	....
Common labor, non-union, hour	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.50	....	.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net. and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile. 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine casing. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.80). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

With the present finished steel market in an unusually firm position, due to recent heavy deliveries and an active demand, the absolute minimum on steel bars and structural shapes is placed at $2.15 per 100 lb., Pittsburgh; plates at $2.20. These quotations, however, apply on heavy contract tonnages only. Premiums for specified deliveries bring out quotations of $2.25 on shapes and bars and $2.25@$2.35 for plates. The market on structurals is particularly strong; inquiries indicating an active spring demand. Continued buying of steel for railway car building, together with increased demand for plates, in oil-storage tank construction, feature the current market.

Although the Birmingham base price of $43 per ton on 6-in. cast-iron pipe still holds firm, the tendency is upward in the dealers' warehouses. New York quotes $56.50 as against $56 per ton; Dallas, $57 as compared with $56 per ton, one week ago.

The current lumber market is very active, particularly in long leaf yellow pine for car construction. Mills report the heaviest bookings since 1916, with a scarcity of freight cars. Production, however, is very heavy with reserve stocks somewhat limited.

New York quotes rise of $2 per M ft. in long leaf yellow pine, structural sizes, during week. Price now $63, delivered, for 3x12 pine in 20 ft. lengths, as against $61 per M ft. b.m., one week ago. Dallas reports rise of $3 in yellow pine and San Francisco, $4 per M ft. in Douglas fir.

The stiffening of linseed oil prices reflects the general upward tendency in nearly all paint materials. Raw oil, in 5 bbl. lots, is quoted at $1.10 in Dallas, up from $1.07; $1.21 in Denver (wooden bbl.), advanced from $1.19 and $1.09 in San Francisco, as against $1.04 per gal., one week ago.

Despite advances in iron, steel and clay products, lumber, linseed oil and other important construction materials, the prices of brick and cement remained fairly stable during the week, throughout the entire country.

Although the New York brick supply from the Hudson River district is cut off by ice, the supply in reserve at the plants is sufficient to meet all requirements when navigation opens up in the early spring.

The present price of $20 per M, wholesale, alongside dock has continued firm since the first of the year, but the anticipated seasonal demand is preventing manufacturers from covering deliveries at the current prices

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AND CONTRACTING

E. J. MEHREN
Editor

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Immigration Still a Problem

IN VIEW of the situation in the Senate no expectation survives that the present Congress will pass a new immigration law, and those industries which have been urging revision in order to insure an adequate supply of common labor must derive what consolation they can from the fact that they escaped the bill reported by the House committee. This provided clearly for further restriction rather than for a lowering of the bars. Meanwhile under the existing laws, the number of arrivals is higher than it was last year, but there is no expectation that these will meet the estimated requirements of industry. Although it appears, therefore, that we must make shift as best we can during the coming year, the need still is urgent for regulation that will provide at the same time for needful restrictions and an assured supply of selected immigrants qualified to meet our industrial needs. The new congress must tackle this whole problem anew in the light of the experience of the current year.

Bottle-Neck Street Intersections

LONG before the days of the ubiquitous automobile, traffic congestion at street intersections became a problem. Attempts at relief were made here and there by easing off corners and by traffic regulation. With the extension of automobile use in many parts of the country to what we may hope is nearly the saturation point, traffic congestion at thousands of points has become almost intolerable. More through-traffic streets are the most commonly urged relief measure but it is becoming more and more evident that street intersections are the bottle necks that retard traffic. Moreover, these bottle necks are by no means restricted to cities, as every one who uses the automobile for country travel well knows. From now on relief of traffic congestion at street intersections must have increasing attention. It will be necessary as a matter of traffic regulation and as an element in city replanning. It is imperative that it be given careful attention in all layouts of new streets. The basic facts for providing the remedy are set forth convincingly and in detail in Mr. Swan's article elsewhere in this issue. There may also be consulted with profit an article by Mr. Swan on the control of automobile speeds that appeared last week. Both articles are important contributions to the science and art of traffic regulation and of city planning.

Opposing Henry Ford

THE Ford offer for Muscle Shoals is dead for the present session of Congress, but it will be resurrected. When it is brought up at the next session it is to be hoped that its advocates will recognize the honesty of the real opposition to the proposal. In the South, particularly in the neighborhood of the plant itself, the feeling is intense that those opposed to Mr. Ford are urged by political or financial prejudices, in plain words that they are either Republicans or denizens of Wall Street. These enthusiasts might well take to heart Barrie's fine injunction in his address on "Courage"—"never impute to your adversary motives lower than you have yourself." Politics and finance play their part in the fight on the Ford plan but we believe the balance of the opposition is held by those who for years have been fighting for an equitable water-power policy and who see in Ford's Muscle Shoals offer a direct refutal of that policy made in the name of expediency by one of the most powerful individuals in the country. If there is to be one law for Henry Ford and another for the rest of us, we might as well make him dictator instead of president as his friends are urging. Only a few changes in the Ford proposal are needed to bring around to his side those whose opposition is based on principle. Will not Mr. Ford's advisers persuade him to volunteer those changes and thus make possible the useful development he has planned?

British Concrete Road Practice

PROTECTIVE bituminous covering for concrete roads have proved to be of such indifferent value in America that highway engineers here will regard with interest the statement in the article on British concrete road practice that some adhesive covering is held to be absolutely essential in England to make concrete roads a complete success. Incidentally none of the reasons given for bituminous covering would be considered in this country to be a justification for the extra cost and trouble of construction. One feature of the English construction which is to be remarked by those who have had trouble from "peeling" of the bituminous carpet is the care taken to prepare the surface of the concrete so as to insure adhesion. It exemplifies the obviously greater care and deliberation which the British road builder considers practicable to adopt in his concrete road building. Two other practices which stand out in the English work are the care taken in constructing the subgrade and the building of the slab in blocks laid alternately. Both entail an extra cost which American road officials would regard askance although the care in subgrade construction could well be taken as an example. This English road work is worth noting in another respect—provision is made for protecting the operations so that slab construction can proceed in wet weather.

Quantity Surveying

IN ENGLAND, as most of our readers know, the quantity survey system in bidding on construction is well established. All prospective bidders take the quantity figures computed by the surveyor as the basis for bids, which are made up in each case by extending those quantities against unit prices estimated by each bidder. In America the practice has never obtained a good foothold, although several attempts have been made to establish it. Individualism of the American contractor, probably, is the controlling cause; he is reluctant to trust anyone outside his own organization on a matter so affecting his total bid. It is worth noting, though, that this reluctance is being overcome in one or two centers, notably in the middle northwest where, in Wisconsin and in Michigan, quantity survey bureaus have been operated with some success. It requires some time for any such bureau to breed confidence and to prove its economy to the individual contractor, but the system itself, if efficient, is a move toward a general economy in the business of construction and as such should be encouraged.

Italian Water-Works Enterprise

AS AN AQUEDUCT SYSTEM and in number of communities supplied the Apulian aqueduct with its branches feeding many score networks of street mains stands unequalled. The Coolgardie pipe line in Australia is far longer than the Apulian main trunk, but it is only a small steel force main supplying communities relatively few in number and small in total population. The Los Angeles aqueduct is considerably longer than the Apulian main trunk and much larger but it supplies fewer people, and these are mostly concentrated in one city. The Catskill aqueduct approaches in length the Apulian main trunk, has several times its carrying capacity, and supplies the American metropolis, but here again the enterprise is that of a single city. In number of places supplied from a single water-works system the Hackensack Water Co., in northeastern New Jersey, comes next to the Apulian enterprise, serving more than fifty separate municipalities with pumped and filtered water. Details of the Apulian system, with its 993 miles of main and branch aqueducts and subsidiary conduits, not counting the pipe distribution systems within its 266 communities, cannot fail to interest the entire water-works fraternity as well as all who watch the ambitious engineering projects being carried out in various parts of the world. The Apulian project does great credit alike to the engineers who conceived and executed it, the concessionaire who had the courage to undertake it and the Italian Government which took it over in 1919 and placed its administration in the charge of a board which includes representatives of the interested provinces. Apulia is to be congratulated on having provided for it a water supply which will doubtless restore some of its communities to the prosperity if not the glory of old. Portions of the district, if we mistake not, are the scene of the travels recorded in Gissing's charming "By the Ionian Sea," in the course of which stress is laid on the desolation caused by lack of water.

Crossing the Niagara

SINCE the earliest days, anything connected with crossing of the Niagara River has commanded universal interest. And from the time the first suspension bridge was begun all that has been done in bridging the gorge contributed notably to the advance of the bridge engineering art. The cantilever bridge which is shortly to pass out of existence was among these works of note, and in spite of the weaknesses which increasing knowledge and the test of service have brought to light, its long life—now nearly forty years—testifies to the excellence of the engineering skill embodied in it. Its successor, the 640-ft. arch to be built this year, carries fully as much interest as any of the other Niagara Gorge bridges, not only because of its great size but perhaps even more because of the remarkably thorough methods applied to its design. Its general form and dimensions being largely determined by the local topography, are probably not to be taken as representing the unhindered ideas of the engineers concerning ideal proportions for a heavy arch of six to seven hundred feet span. But aside from exterior outline the design is a model of excellence of practice, both in the proportioning of members and in the working out of details. The two outstanding points of note, perhaps, are the unusual floor construction and the high unit stresses applied to the dimensioning of the members. The floor is an important development in bridge construction; the separate superimposed floor structure on top of the main frame of the bridge may prove to have merits aside from the reasons which led to its being devised for this case. Further, it carries the use of heavy ballasted decks into the field of very long spans, establishing a new record in this respect. The high unit stresses used in the design similarly represent a reaching out toward a new standard of practice. But in considering these high figures it should be observed carefully that the stress computations took into account every effect of load and distortion that could be evaluated, including secondaries, torsion and the like. In other words, the engineers consciously endeavored to reduce the margin of unknown actions to a minimum, and thereby minimize the functions of the conventional "safety margin." The advance of modern structural engineering thought and practice is quite clearly in this direction; the engineers of the Michigan Central have given the movement a strong forward impetus by their work.

Solving the Truck Overload Problem

IF THE operation of motor vehicles and the construction and maintenance of roads were paid for out of the same purse it is probable that we should soon see the end of destructive truck loading. In railway operation this condition of a common pocketbook exists and therefore there has seldom been for any long period any great discrepancy between the strength of the road structure and the weights of the vehicles which travel over it. Railway roadbed and track and railway train loads are, generally speaking, reasonably well co-ordinated. This should be as true of highway transportation and for exactly the same reason. It is the peoples' money that operates the vehicle and provides the roadway on which it runs; the only difference from railway practice is that the money is handed out directly for vehicle operation and is paid through an agent—the public road official—for building and keeping up the road structure. It is this difference, however, which keeps the overloaded truck on the highway. The heavy truck operator, perhaps two per cent of all, is not so ingenuous that he does not realize that while he takes all the profit of overloading his neighbors help him to pay the damages to the road. The neighbors because they pay indirectly by means of taxes are not alert to the function imposed on them. Did they realize it the giant truck would soon be ruled off the public road. Highway departments have not been highly effective in their methods of carrying the lesson of truck overloads to the public.

One phase of the question in which there is room for reform is in the routing of heavy trucks. Arguing that the truck weighing 18 to 20 tons laden has an economic place in highway transportation a class of truck builders and operators contend that it must be provided for and not abolished. It is again argued, in this case by shippers and manufacturers, that transportation emergencies arise not seldom when truck loads and speeds are superior to any hazard they bring to the highway. There is unquestioned truth in both arguments. In New England factory states instances are notable where, other transportation routes having been closed up, heavy and fast motor trucks traveling paved roads to their destruction have kept at work whole communities of people who otherwise would have been idle.

Where the traffic is constantly heavy enough to keep it busy, the 18 or 20-ton laden truck has an economic advantage over smaller trucks. To exclude it, then, from the service of transportation, demands justification. To permit it to be a free agent in choosing its own routes and speeds is impossible. The remaining resort is to restrict trucks of this class to specified lines of highway and, consequently, to build these roads to carry the loads. In isolated instances in several parts of the country such heavy truck roads have been built but in no case, we believe, is any one of them the result of a set policy to segregate by route heavy truck traffic from general traffic. Even in city street traffic, where the need is greater and the problem more simple, scarcely any segregation by routing of traffic has been undertaken in consideration of pavement service. In brief, states and cities have scarcely begun to administer their roads as a part of a transportation business.

"The Mountain Hath Labored—"

AS RECORDED in the news section of this issue the Board of Direction of the American Society of Civil Engineers has adopted a set of resolutions bearing upon registration for engineers. The resolutions are a disappointment. Nearly two years ago the board appointed a committee of five to study and report on the licensing question and since that time, this committee has been investigating, holding hearings and deliberating. Although its findings and conclusions have not yet been made available to the membership, the present resolutions, in all probability, are based upon the results of its studies. It is true that, as the resolutions indicate, the most diverse and inconclusive opinions on this subject prevail throughout the profession but few were prepared for so vague and fruitless a pronouncement by the board as is embodied in these resolutions.

Disappointment is increased, moreover, with the realization that the action now taken could just as well have been taken a year or more ago, and that had this been done the society might already have made a material contribution of the sort it now is talking about. The trend that is here "recognized" was just as obvious a year ago. It was a matter of record then that more than half the inhabitants of this country were living in states that had adopted registration laws. Everyone knew then that the various laws were not uniform and that many contained objectionable features. Many, indeed were highly exercised over the fact. Those who were at all familiar with developments knew that many state legislatures—notably some that meet only once in two years would consider registration bills during their 1923 sessions. Now after two years of deliberation the board solemnly utters these commonplaces and instructs its committee to return in three months with a model law and a recommendation as to how the society is to do the things that might have been got under way a year or more ago. Truly the mountain hath labored and brought forth a mouse.

As the matter now stands, draft of a uniform law is to be submitted to the Board of Directors at its April meeting. Then, perhaps, it will be sent to a referendum of the society, for the resolutions provide that it "shall be approved by the society." By the time all this has come to pass summer will be upon us and practically all of the legislatures will have adjourned for two years. Meanwhile laws already passed will become effective, and desirable modifications will be far more difficult to bring about than they would have been heretofore. Valuable time has been lost and if the society is to make any effective contribution to this development, in which so many of its members are interested, it is earnestly to be hoped that the board will take definite and final action, so far as is within its power, at the April meeting.

Institutional Fire Protection

AS WAS to be expected, the terrible fire in the state asylum on Ward's Island in New York City where so many helpless inmates were killed, has aroused the state authorities to belated action. The governor has sent a special message to the legislature recommending a $50,000,000 bond issue to provide funds for the erection of new fire-safe buildings for state institutions and in so doing has called specific attention to the deficiencies in the existing structures. The intimation is that it took the fire to reveal all these defects and further that the only remedy is complete new construction.

Neither assumption is quite true. The deplorable conditions at Ward's Island were called to the attention of the state authorities as long ago as 1916 when the city, through H. F. J. Porter and A. L. A. Himmelwright, two local engineers, made extensive repairs to many of the city's institutional buildings which were veritable fire-traps. These repairs, described in *Engineering News*, Jan. 18, 1917, p. 101, were directed toward restricting the area of any fire and toward the easy removal of patients and inmates in case of fire mainly by horizontal passageways into separated sections. Similar action was recommended to the state for application to the Ward's Island buildings but the suggestion met no response and was therefore dropped by the engineers. The fact remains that for a comparatively small sum these buildings, since destroyed, could have been provided with fire walls and stops and with horizontal exits through automatic fire doors and the recent loss of life avoided.

Similar treatment can measurably add to the safety of many of the other buildings which the governor wants replaced. There is no doubt that new modern fireproof structures are much superior to old structures protected by such devices as are possible, but the cost of new structures may prove prohibitive. If the legislature is found to be in an economical mood it is imperative that at least some funds be appropriated for protective measures.

The lesson, too, may extend beyond New York State. Institutional buildings everywhere should be examined and, if found necessary, revamped not to make them fireproof, for that is impossible with an old structure, but to reduce the fire hazard and to make it reasonably certain that the more or less helpless inmates can be readily removed in case of fire.

Long-Span Steel Arch Bridge Over Niagara Gorge for Michigan Central R. R.

Well-Known Cantilever Bridge Will Be Replaced After 40 Years' Service by Two-Hinged Spandrel-Braced Arch of 640-Ft. Span, Carrying a Solid-Floor Independent Deck—Advanced Methods of Design

A LONG-SPAN double-track arch bridge will be built over the Niagara River gorge, just below the city of Niagara Falls, N. Y., to replace the old cantilever bridge of the Michigan Central R.R. The location of the new crossing resulted from an unusually thorough study of the local topography and other physical conditions, while the design of the structure itself represents a noteworthy application of advanced bridge engineering principles. At the present time the design and all preparations for construction are completed, and contract for the construction of the steelwork has been let to the American Bridge Co., work to begin this spring. The abutments and other items of substructure work will be built under a separate contract. A review of the design is presented herewith, on the basis of data supplied by J. F. Deimling, chief engineer, and H. Ibsen, special bridge engineer of the railway.

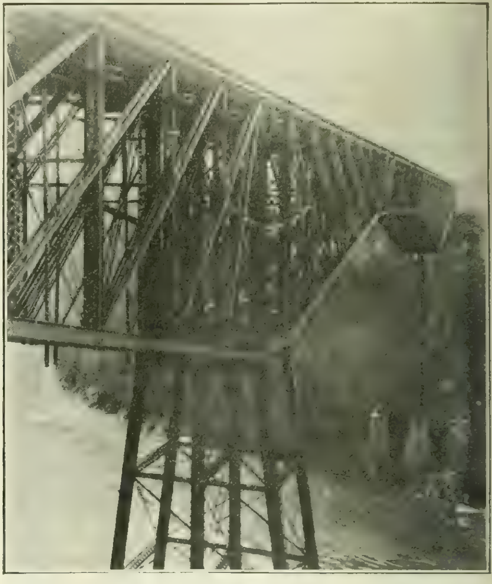


FIG. 2—NIAGARA GORGE AT SITE OF NEW BRIDGE
Present cantilever bridge of Michigan Central R.R. seen looking from American toward Canadian bank; the new arch will be alongside and downstream, about on the line of the right-hand edge of the picture, where the shortest span between hard rock strata is obtained.

The new bridge is required because the cantilever bridge, now forty years old, has for a long time been much overloaded, and has been costly and troublesome to maintain, in addition to necessitating speed and load restrictions which have become more and more objectionable. The planning of a new bridge began in 1916 and has been much delayed as a result of the war. The old cantilever bridge controlled the location, both because of the narrowness of the gorge at this point and because of the existing track and yard facilities. Arch construction was early decided upon as best suited to the case, and a complete design was prepared for an arch to be built around the cantilever—the old alignment being retained, in spite of the great difficulty of such construction, because the charter for the old bridge narrowly restricted its location. Subsequent explorations of the subsoil to reveal the topography of rock surface made it evident, however, that on the line of the cantilever the span between suitable points for arch abutments would be much longer than on a slightly different line, 50 to 100 ft. downstream. The revised location afforded satisfactory abutments for an arch of 640 ft. span, as determined from rock contours and profiles obtained by means of some sixty vertical and inclined borings in the side of the gorge, while on the line of the cantilever a span of 700 ft. would be necessary. As indicated in the map Fig. 1 the new structure will be close alongside the old one at the west or Canadian end, thence diverging to the north as the American side is approached.

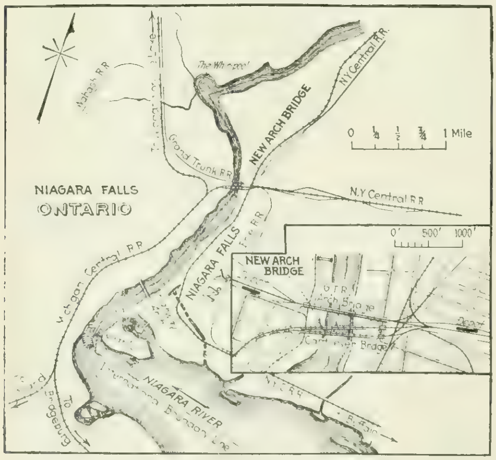


FIG. 1—NEW RAILWAY ARCH BRIDGE TO CROSS NIAGARA GORGE BETWEEN EXISTING CANTILEVER AND ARCH BRIDGES

Old Bridge—The cantilever bridge, built in 1883, from designs of C. C. Schneider, has a main span of 495 ft. c. to c. towers. It was originally proportioned for a loading of two 66-ton locomotives followed by 2,000 lb. per foot of track, corresponding roughly to E23. By 1900 the cantilever was no longer of sufficient capacity, and a third (middle) truss was put in, with independent tower posts and pedestals for them; the stringers were doubled at the same time, and the capacity was thus brought up to E35. Subsequently various other repairs and improvements were made in the structure. The webs of the floorbeams developed cracks at their ends, from being bent transverse to their plane, caused partly by the restraining action of the stringers and of a separate wind chord added in 1891, that prevented the floorbeams, which are riveted to the truss post, from following the truss motion under live-load strain, and partly by the pull of the lateral bracing, which is attached to the floorbeam web a short distance inward from the floorbeam connection. The connections of the floorbeams to the trusses were also poorly detailed. The floorbeam connections and the webs were repaired, and the lacing of the posts, which showed itself inadequate, was doubled. The hip pins in the anchor arms had worn into the web metal of their posts, and this wear was repaired by adjustable bars looped around the pin and supported on brackets riveted to the post. Other troubles could not readily be corrected, such as the imperfect working together of the separate tension and compression members of the top chord, which was made up of eyebars inside a normal compression section, the former to take tension and the latter compression. The structure has required more or less constant attention. In the meantime traffic loads steadily increased; the maximum loading now permitted on the bridge is the equivalent of E45, operated at limited speed.

Gorge Conditions—Borings made alongside the tower pedestals of the cantilever bridge in 1900 showed that solid rock is about 200 ft. below water, and that the filling of the gorge bottom is a talus of large rock on which the cantilever bridge foundations rest. The river channel is grooved out in this talus mass, and according to two very careful series of soundings, the first made in 1900 and the second in 1918, carried out with 400- and 600-lb. cast-iron sounding weights from the deck of the cantilever bridge, is about 85 ft. deep at the middle, with general outline about as shown in Fig. 3. The walls of the gorge present horizontal strata of firm limestones, shales, and sandstones. An arch sprung between the gorge walls was the most natural and suitable solution of the problem of a heavy-capacity bridge under these circumstances.

At the top of the gorge walls there is found a 50-ft. thickness of Niagara limestone, under which is a bed of shale of about the same thickness. Directly below this shale about 20 ft. of Clinton limestone occurs, resting in turn on Medina shales and sandstones. Of the series, the Clinton, a hard and durable stratum, was the most suitable as support for the bridge abutments. Much of this stratum, however, is masked by a talus slope which covers the lower part of the gorge walls. The true outlines of the undisturbed rock surface were not known until the results of an exhaustive series of borings were available. From these results the shortest span between the Clinton limestone outcrops could be determined, and the present location is the result. In Fig. 3 is included a small-scale reproduction of the rock profile and the locations of the borings.

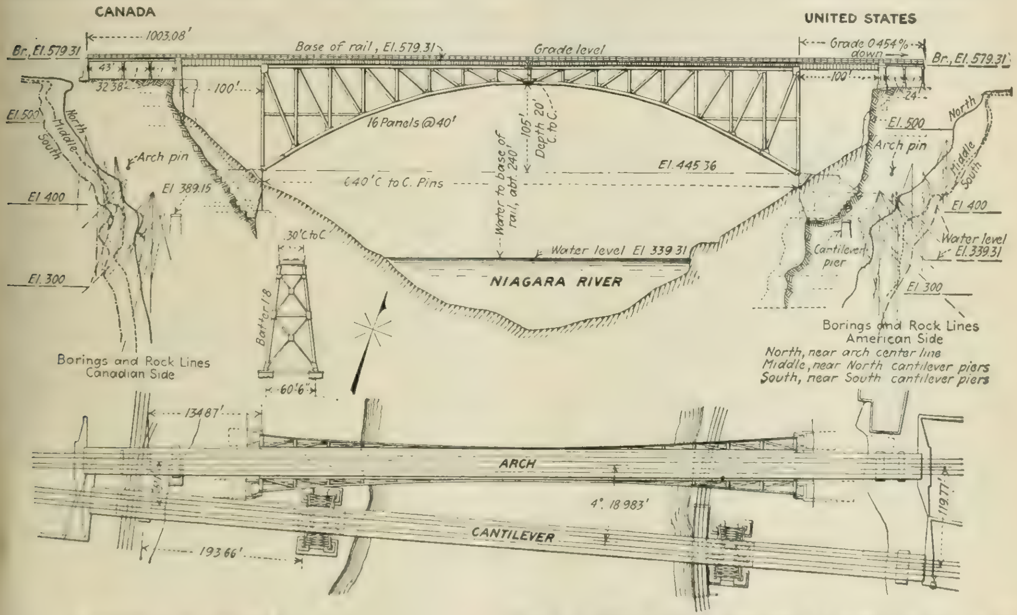
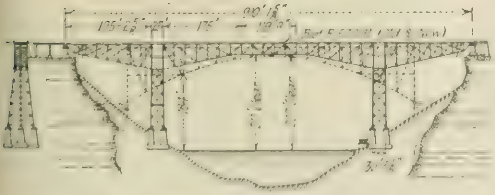


FIG. 3—NEW BRIDGE DESIGNED AS TWO-HINGED ARCH OF 640-FT. SPAN WITH TRACK 240 FT. ABOVE WATER



The plans for the new crossing required rail level to be at the same elevation as the present. However, as there are several grade crossings on both sides of the river, which may at some future time require a change of grade, the floor construction was worked out in such a way as to permit of raising the floor without affecting the main carrying structure.

General Design—As represented in Fig. 3, the arch designed to suit these conditions is of the two-hinged spandrel-braced type, in which respect it is similar to the 550-ft. arch close by. Its span is 640 ft. center to center of end pins, its bottom-chord rise 105 ft., and the crown depth 20 ft. The web system comprises sixteen panels of 40 ft., but the floor panels are only one-third as long. The two arch trusses are spaced 30 ft. apart in the line of the top chord, and thence downward have an outward batter of 1:8.

The spandrel-braced two-hinged type of arch was adopted for superior rigidity and appearance, as against a rib arch. Appearance also dictated the parabolic curve of the bottom chord.

Full riveted construction was decided upon. Subsequently, on computation of the secondary stresses in the structure, it was found that the short web posts in the middle section of the arch would be subjected to excessively heavy bending, and for this reason four posts were detailed with pin connections at their ends. Except for these pins and the pins which form the skewback hinges, all connections are riveted. During erection and until completion of the structure, however, there will be a hinge at the crown of the bottom chord; the top chord is not to be connected until after completed erection, so that the dead-load stresses in the bridge will be those corresponding to three-hinged condition. It is intended to make the connection of the top chord (after setting the closing member) at the mean temperature assumed in the design (50 deg. F.), using in this process a device similar to that originated for the closure of the Hell Gate arch, where the last joint, brought into contact at the proper temperature, was held together by tie rods to prevent its separation until riveted up.

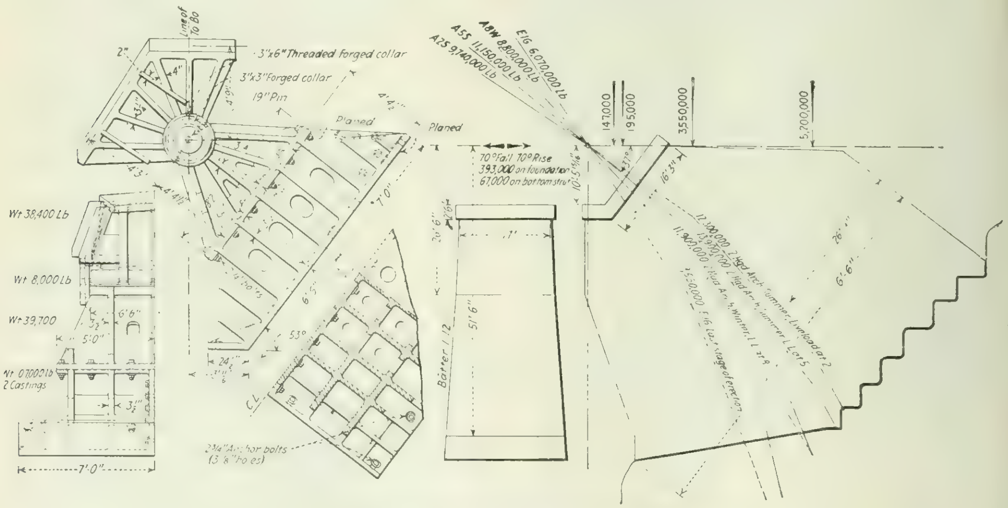


FIG. 4—END SHOE, CONCRETE PIER AND REACTIONS

The floor construction, as already indicated, is decidedly novel. The entire floor rests on the top chord, and forms no part of the arch structure. Over each of the two top chords there is a line of longitudinal girders, carried on cast-steel shoes at the main panel points; transverse floorbeams are riveted between the girders at intervals corresponding to one-third the truss panel length, and the deck stringers rest on these floorbeams. Each main-panel section of floor is kept independent of the adjoining one, so as to form an expansion section by itself, and avoid participation of the floor in the arch stresses. The stringers, which are groups of four 15-in. I-beams under each rail, supplemented by edging and footwalk beams, are covered with a ⅜-in. steel deck plate. The roadbed ballast will be placed on this plate after a layer of waterproofing with its bedding and cover of concrete is applied. At the ends of each expansion section the deck plate is edged by a transverse I-beam which forms a retaining curb for the ballast and is joined to the curb of the next floor section by a cap plate riveted to one of the two curbs.

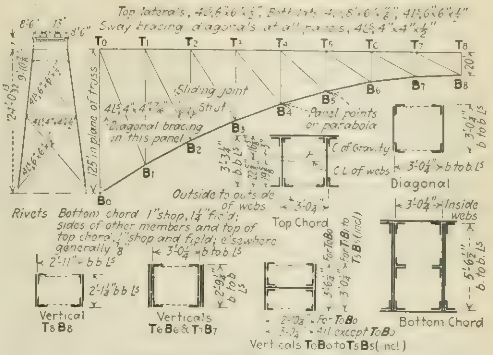
In connection with the description of this remarkable deck construction (Fig. 7), it should be noted that the floor on the approach spans is closely similar to that on the arch, so far as the deck plate and parts above are concerned. The carrying members are transverse, however, and rest directly on the top flanges of the main girders. A section of the floor of the 100-ft. plate girder approach span is shown in Fig. 7, together with the deep transverse plate girder between the end posts of the arch which carries the approach span.

Design and Details—On account of the importance of the structure it was desired to provide for all future requirements as far as foreseeable. For this reason, a high live load was taken into account and full provision was made for lateral, longitudinal and all other forces and actions. All the separate elements of stress amenable to calculation were computed. Accordingly, high unit stresses could be used.

Dead-load stresses were computed for the three-hinged arch condition, this condition being maintained by the erection procedure until after the floor dead load is in place. Live-load stresses were computed for the two-hinged arch condition. Stresses due to wind, a separate transverse force, longitudinal or traction forces, and temperature were separately computed. Secondary stresses due to distortion under load were computed for the middle half of the bridge, outside of which length the members are of such proportions that the secondary stresses will be small. Torsion due to single-track loading and due to wind was computed by a method of approximation; the division of torsional moment at five separate cross-sections of the bridge was computed, and the shears in the laterals and truss webs for the five sections were then averaged, with the general result of assigning to the bottom laterals 65 per cent of the total resistance to wind pressure, to the top laterals 10 per cent, and to each arch 12½ per cent, which figures were used in determining stresses.

All these stresses except lateral and secondary were included in the computation of required cross-section by the normal unit stresses, noted below; secondary stresses were provided for by increase of cross-section only where they exceeded one-third of the axial stresses.

The design of members and details was carried out with a view to obtaining sturdy construction. Simplicity of connections was also sought, and for this reason the joints were made by two gussets, and splices were made without interleaving of webs. The bottom chord was designed as a box-shaped member of uniform depth throughout, composed of two I-shaped ribs and top and bottom cover plates. This member is very heavy, reaching a maximum cross-section of 714.8 sq.in. in the end section, the latter forming a 70-ton erection piece. The field joints in the chord are faced to broken outline each outer third of the depth of the face being backed off 1/16 in. so that the bearing during erection is concentrated in the middle section and the joint can adjust itself to distortion until the splice is riveted up.



Typical Sections of Members

TOP CHORD			BOTTOM CHORD			VERTICALS			DIAGONALS		
MEMBER	RESULTANT MAX AND REVERSAL STRESSES	MAKE-UP	MEMBER	RESULTANT MAX AND REVERSAL STRESSES	MAKE-UP	MEMBER	RESULTANT MAX AND REVERSAL STRESSES	MAKE-UP	MEMBER	RESULTANT MAX AND REVERSAL STRESSES	MAKE-UP
T_0T_1	Max. -487 Rev. +110 Req. 41 in.²	1 Cov Pl, 53 x 7/8 2 Top Ls, 5x5x5/8 2 Top Ls, 8x8x5/8 4 Bott Ls, 8x8x3/4 2 Webs, 39 x 1 3/8 Net 189.71 in.²	B_0B_1	Max -9701 Req. 713 in.²	8 Webs, 66 x 5/8 12 Ls, 8 x 8 x 3/4 2 Cov Pls, 60 x 1 1/16 2 Cov. Pls, 60 x 1 Gross 714.78 in.²	T_0B_0	Max -2144 Req. 193 in.²	2 Pls., 42 x 1 4 Cor Ls, 8x8x7/8 4 Diaph. Ls, 8x8x7/8 1 Web, 34 x 1 Gross 223.84 in.²	T_0B_1	Max. -614 Rev. +771 Req. 84.5 in.² Max. +1132 Rev. -283 Req. 75 in.²	2 Pls, 36 x 3/4 4 Ls, 8 x 8 x 5/8 Gross 92.44 in.² Net 76.69 in.²
T_1T_2	Max -964 Rev +234 Req 81 in.²	1 Cov Pl, 53 x 7/8 2 Top Ls, 5x5x5/8 2 Top Ls, 8x8x5/8 4 Bott Ls, 8x8x3/4 2 Webs, 39x1¼ Net 181.90 in.²	B_1B_2	Max -9321 Req 680 in.²	8 Webs, 66 x 5/8 12 Ls, 8x8x3/4 2 Cov Pls, 60 x 1 1/16 2 Cov. Pls., 60 x 11/16 Gross 677.28 in.²	T_1B_1	Max. -1521 Rev + 3 Req. 136 in.²	2 Pls., 36 x 3/4 4 Cor. Ls, 8x8x5/8 4 Diaph. Ls, 6x6x1/2 1 Web, 36 x 5/8 Gross 136.10 in.²	T_1B_2	Max. -628 Rev +644 Req. 114 in.² Max. +1031 Rev. -278 Req. 74 in.²	2 Pls, 36 x 1 4 Ls, 8 x 8 x 11/16 Gross 114.12 in.² Net 94.87 in.²
T_2T_3	Max -1491 Rev. +356 Req 125 in.²	1 Cov Pl, 53 x 7/8 2 Top Ls, 5x5x5/8 2 Top Ls, 8x8x5/8 4 Bott Ls, 8x8x3/4 2 Webs, 39 x 15/16 Net 162.37 in.²	B_2B_3	Max -9107 Req. 664 in.²	8 Webs, 66 x 5/8 12 Ls, 8x8x3/4 4 Cov Pls, 60 x 13/16 Gross 662.28 in.²	T_2B_2	Max -1391 Req 148 in.²	2 Pls., 36 x 1 4 Cor Ls, 8x6x5/8 4 Diaph Ls, 6x6x1/2 1 Web, 36 x 5/8 Gross 150.94 in.²	T_2B_3	Max. -602 Rev. +542 Req. 87 in.² Max. +968 Rev. -221 Req. 67 in.²	Same as T_0B_1
T_3T_4	Max -2057 Rev. +430 Req. 170 in.²	1 Cov Pl, 53 x 5/8 2 Top Ls, 5x5x5/8 2 Top Ls, 8x8x5/8 2 Bott Ls, 8x8x5/8 2 Webs, 39 x 5/16 Gross 175.64 in.²	B_3B_4	Max -8961 Req. 649 in.²	8 Webs, 66 x 5/8 12 Ls, 8x8x3/4 2 Cov Pls, 60 x 13/16 2 Cov Pls, 60 x 11/16 Gross 647.28 in.²	T_3B_3	Max -1275 Req 118 in.²	2 Pls, 36 x 5/8 4 Cor Ls, 8x6x1/2 4 Diaph Ls, 6x6x1/2 1 Web, 36 x 5/8 Gross 117.50 in.²	T_3B_4	Max -543 Rev. +443 Req 69 in.² Max. +934 Rev -132 Req. 62 in.²	Do.
T_4T_5	Max -2599 Rev. +346 Req 208 in.²	1 Cov Pl, 53 x 3/4 2 Top Ls, 5x5x5/8 2 Top Ls, 8x8x5/8 4 Bott Ls, 8x8x3/4 2 Webs, 39 x 1 3/16 Gross 209.08 in.²	B_4B_5	Max -8860 Req 631 in.²	Do.	T_4B_4 and T_5B_5	Max T_4B_4 -1171 Max T_5B_5 -1096 Req T_4B_4 = 97 in.² Req T_5B_5 = 84 in.²	2 Pls, 36 x 1/2 4 Cor Ls, 6x6x1/2 4 Diaph Ls, 6x6x1/2 1 Web, 36 x 5/8 Gross 104.5 in.²	T_4B_5	Max. -403 Rev +529 Req. 55 in.² Max. +960 Req. 59 in.²	Do.
T_5T_6	Max -2928 Rev. +133 Req 227 in.²	1 Cov Pl, 53 x 7/8 2 Top Ls, 5x5x5/8 2 Top Ls, 8x8x5/8 4 Bott. Ls, 8x8x3/4 2 Webs, 39 x 1 5/16 Gross 225.46 in.²	B_5B_6	Max -8723 Req 628 in.²	8 Webs, 66 x 5/8 12 Ls, 8x8x3/4 2 Cov Pls, 60 x 13/16 2 Cov Pls, 60 x 9/16 Gross 632.28 in.²	T_6B_6	Max -1131 Rev 0 Req 81.5 in.² Max +182 Rev -757	4 Pls, 33 x 11/16 4 Ls, 8x8x11/16 2 Pls., 16½ x 11/16 Gross 155.55 in.²	T_5B_6	Max -594 Rev. +407 Req 66 in.² Max +1052 Rev -53 Req. 65 in.²	Do
T_6T_7	Max -2948 Req [illegible] in.²	Do.	B_6B_7	Max. -8414 Req 606 in.²	8 Webs, 66 x 5/8 12 Ls, 8x8x3/4 4 Cov Pls, 60 x 5/8 Gross 617.28 in.²	T_7B_7	Max. -1146 Rev +49 Req 82 in.² Max. +298 Rev -861	4 Pls, 33 x 11/16 4 Ls, 8x8x11/16 2 Pls, 16½ x 11/16 Gross 155.55 in.²	T_6B_7	Max [illegible] Rev [illegible] Req. 115 in.² Max +1374 Rev. -374 Req. 93 in.²	2 Pls., 36 x 1 4 Ls, 8x8x3/4 Gross 117.76 in.² Net 97.76 in.²
T_7T_8	Max -2606 Req 196 in.²	Do	B_7B_8	Max -7768 Req 558 in.²	8 Webs, 66 x 5/8 12 Ls, 8x8x3/4 2 Cov Pls, 60 x 3/4 Gross 557.28 in.²	T_8B_8	Max -717 Req 51 in.²	2 Pls, [illegible] x 5/8 4 Ls, 8x8x[illegible] Gross [illegible]	T_7B_8	Max. [illegible] Rev. [illegible] Req [illegible] Max. +1616 Rev. [illegible] Req [illegible]	2 Pls, 36 x 1 4 Ls, 8x8x3/4 [illegible] [illegible] Gross 166.26 in.² Net 138.39 in.²

FIG. 5—STRESS AND MAKE-UP SHEET FOR NEW NIAGARA ARCH

Design made for [illegible] train loading and based on unit stresses of [illegible] lb. per sq. in. for dead load and [illegible] lb. per sq.in. for live load. Ample wind and lateral and longitudinal force calculations were included and secondary stresses were allowed for in the middle part of the structure insofar as they exceed one-third of the primary stresses.

The top chord is of normal top-chord section, composed of two channel-shaped side members with cover plates. The posts have channel-shaped side members connected by a continuous longitudinal diaphragm. The diagonals are of similar section without a diaphragm. The open sides of all members are laced with stiff lacing.

generally composed of 6-in. channels attached on the inner face of the flanges.

The gusset plates, built into the chord members, are 1-in. and 1¼-in. plates. Their edges within the web of the chord are not planed to bearing but are fully cover-spliced.

Rivets ranging from ⅞ to 1¼ in. in diameter are used. In general, the bottom chord has 1-in. shop rivets and 1¼-in. field rivets, the side and top main connections of the top chord 1-in. rivets, the laterals and lacing of the same chord ⅞-in. rivets, the web members generally 1-in. rivets, and all minor parts ⅞-in. rivets. In every case where the grip is over four diameters, taper rivets are specified; these have a diameter for 1-in. from the head $\frac{3}{64}$ in. larger than the nominal size, and thence taper to a point diameter $\frac{1}{64}$ smaller than the nominal size. Such rivets must have their points cooled.

Rather high-grade workmanship is specified for the fabrication of this structure. All main riveting is to have drilled or sub-punched and reamed holes, and quite detailed requirements are set up for the accuracy of match of holes. The arch is to be assembled in the shop yard in sections of three panels at a time, the connection holes being here drilled or reamed to the unstrained position of the members. The lengths of the members, however, are to be made to a camber equal to the deflection under dead load plus one-half live load plus impact.

At the skewbacks, a simple pin hinge was adopted, as contrasted with the circular roller bearing used in the near-by 550-ft. arch. The load is transferred by this pin to a cast-steel shoe having a base area 14 ft. x 14 ft. 8¾ in. where it rests against the abutment concrete. This shoe as finally designed consists of three pieces, the bottom section being formed of right and left halves while the top or pin section is one piece. The pin, 19 in. in diameter, is not seated in the steel of the chord but in a cast-steel pin casting which receives the end of the chord. Upper and lower pin castings are held together at either end of the pin bearing by a steel retainer collar 3x3 in. in cross-section.

The maximum thrust delivered to the abutment through the shoe is 11,150,000 lb. The change in inclination of the thrust under load and temperature variations is represented in Fig. 4.

In the same figure the form of the concrete abutments is represented. The four abutments differ considerably in size, according to the location of the edge of the hard rock stratum. They range in volume from 750 to 2,200 cu.yd. of concrete each. As the firm rock is covered by a considerable depth of talus at these points, a relatively large amount of excavation is required, totaling 28,000 cu.yd. for the four. The bedding surface for the shoe is to be dressed plane, and a $\frac{1}{16}$-in. sheet of lead is to be placed under the casting.

Material—Normal bridge steel or mild steel will be used in constructing this bridge, with specified ultimate strength of 56,000 to 64,000, elastic limit 33,000 minimum, and elongation 25 per cent (less for thick material, down to 20 per cent). Rivet steel will be softer, with 46,000 to 54,000 ultimate, 28,000 elastic limit, and 30 per cent elongation. All material is required to stand a bend test, which for the structural material is flat closing for thicknesses of ⅞ in. or less, ranging to a bend around twice the thickness of the piece for thicknesses over 1¼ in.

Medium or high-carbon steel was not considered desirable for this bridge. Alloy steel was considered, but in the opinion of the engineers its use was not warranted if its cost exceeded that of ordinary steel by more than 1 cent per pound. Present differences of price are considerably greater than this.

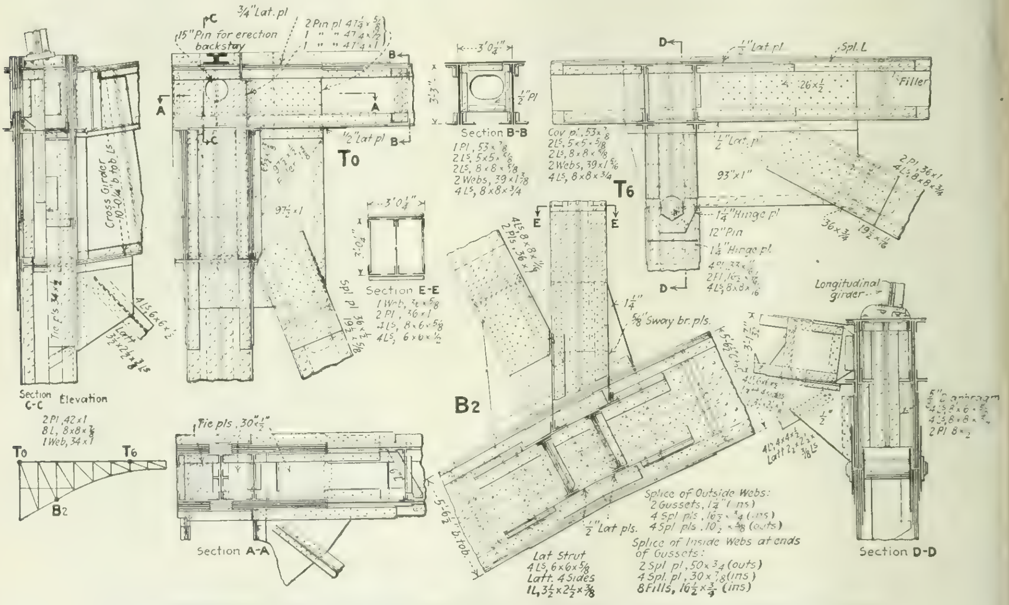


FIG. 6—REPRESENTATIVE DETAILS OF MICHIGAN CENTRAL ARCH OVER NIAGARA GORGE

The detailing is exceptionally simple for a structure involving members of maximum proportions. Two-web construction and pairs of 1¼-in. gusset plates are used in the chords. All latticing is made of angles or channels. The 1 to 8 batter of the two arch trusses affects only the lateral bracing connections and cast-steel floor girder pedestals.

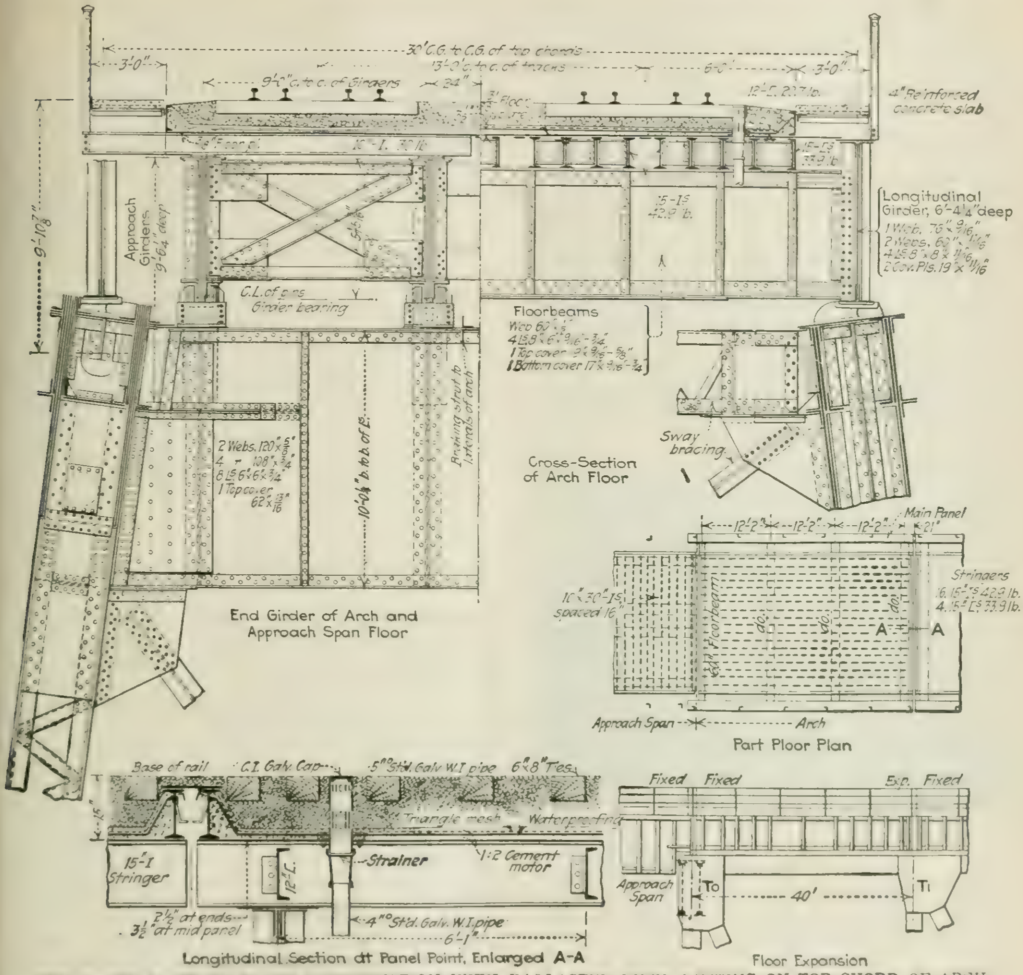


FIG. 7—SUB-PANELED FLOOR CONSTRUCTION WITH BALLASTED DECK, RESTING ON TOP CHORD OF ARCH

Design Data—The floor of the bridge was designed for Cooper's E70 locomotive loading (two consolidation locomotives, 2-8-0, with 70,000-lb. driving axles spaced 5 ft., representing a total load of 994,000 lb. on a 104-ft. wheel base, followed by 7,000 lb. per foot of track). For the arch members this wheel loading was replaced by a uniform load of 7,000 lb. per foot following a 110-ft. length of 9,000 lb. per foot of track. These loadings are higher than the New York Central Lines' standard for a 640-ft. span, which is E65; it was believed that for so important a structure a larger margin for future development should be allowed. However, as the unit stresses are higher than those generally employed, the actual design is substantially the same as would have resulted from E65 loading with ordinary unit stresses.

In applying this loading, stresses from double-track loading were reduced by 5 per cent. The transverse-beam deck of the approach spans was proportioned for a load of 18,000 lb. per foot of track, distributed over a 10-ft. width, while the longitudinal-beam deck of the main span was proportioned for the E70 wheel loading direct. Live-load stresses were increased by an impact allowance equal to half that of the Turneaure formula, or $\frac{15{,}000}{30{,}000 + L^2}$, where L is the span (or the floor panel length), but 10 per cent was used as minimum impact. For the beams of the approach-span deck, the impact was taken as 50 per cent.

Wind pressure was taken as 30 lb. per square foot on 1½ times the vertical projection of the bridge, plus 360 lb. per lineal foot applied 8 ft. above the rail; all these pressures were considered for a position of the deck 15 ft. higher than its original position. During erection, a 50-lb. wind on one and one-half times the elevation of the bridge and the traveler is to be taken into account. In addition to the normal wind pressure, the completed bridge was also required to withstand a transverse force, due to the train, of 500 lb. per lineal foot of bridge applied 6 ft. above the rail. Similarly, a longitudinal force applied at the same height was taken into account, amounting to 10 per cent of the live load for the arch and 20 per cent on the minor spans. Temperatures changes of ± 70 deg. F. were considered.

Wind and lateral-force stresses were ignored where they did not exceed 25 per cent of the sum of other stresses (except secondaries). Secondaries, whose computation has already been referred to, were similarly ignored where they did not exceed one-third the combined axial stresses not including those due to wind and lateral force.

Two sets of unit stresses were used in proportioning the members, those applicable to live-load stresses being about nine-tenths as great as those applicable to dead-load and erection stresses. The principal figures are: tension on net section, 20,000 for dead load and erection, 18,000 for live load; compression on gross section, 18,000 — 80 l/r with 17,000 lb. maximum, and 16,000 — 70 l/r with 15,000 maximum; shear, 15,000 and 13,500; pin bearing, 27,000 and 24,000, except that for reversing bearing pressure half this stress was used; rivet bearing, 30,000 and 27,000. Except for bearing pressure, cast steel was figured at 10 per cent lower unit stresses.

In the application of these stresses several special provisions were considered, among which the following are important: Connections and splices were designed 10 per cent stronger than their members. All compression splices were made full, and were proportioned for a stress in the splice material of 16,000 lb. on gross section. Countersunk rivets and field rivets were increased in number by 25 per cent over the number of shop rivets required. Members carrying reversed stress were proportioned separately for each kind of stress increased by one-half the smaller, and end connections were proportioned for the sum of the separate stresses. The riveting was increased one-third for each filler plate between splice plate and main plate, and 1 per cent for each $\frac{1}{16}$ in. by which the grip exceeded four diameters.

Columns were limited to a length of 100 radii for main members and 120 for bracing members. In all columns a shear of 300 times the cross-sectional area was provided for, except that in case of a longitudinal diaphragm the lacing was allotted only half the shear.

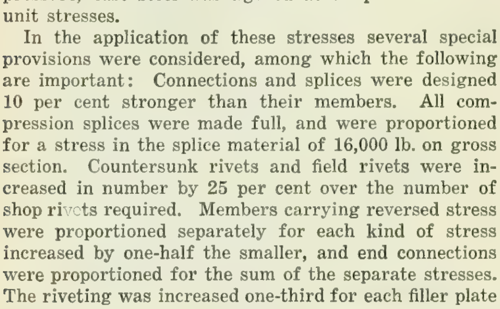


FIG. 8—INSPECTION LADDERS AND PLATFORMS

Erection—Each half of the arch will be erected as a cantilever, being held by an eyebar tie running back to an anchorage in the upper part of the cliff side. One such anchorage is sketched in Fig. 9; the steel anchor girders and tie members up to the face of the rock are to be left in place, after casing in concrete.

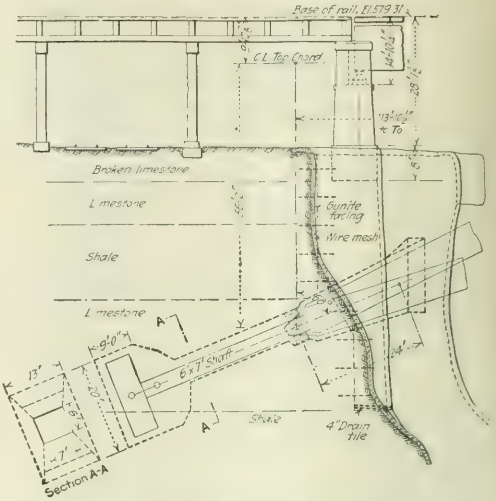


FIG. 9—ERECTION ANCHORAGE
The steel anchor members will be left in place, encased in concrete.

The bottom-chord splices are not to be riveted until the arch is joined at the crown of the bottom chord. The top chord center joint is not to be drilled or riveted until after the complete arch structure and the floor steel are in place, so that all these dead loads will be resisted by three-hinged arch action. The top-chord joint is then to be brought to bearing at 50 deg. F., and the abutting segments held together by ties until the joint splice is drilled and riveted.

Provision will be made in the members of one-half of one of the two arches for strain-gage readings, by twelve gage-point holes drilled in each member. It is intended to make such readings before, during and after erection and under live load, so as to obtain accurate information concerning stresses.

Quantities—The structure of the arch itself includes 4,800 tons of steel, including bracing and castings. A further weight of 1,250 tons of steelwork is contained in the floor. Nearly 1,500 tons of steel are required for the two 100-ft. approach girder spans, the adjoining street spans and the erection backstays, making the total steel weight 7,500 tons. About 11,000 cu.yd. of concrete will be required in the abutments and auxiliary foundations.

The contract price for the steelwork, erected, is about $116 per ton, of which about $7 is freight from fabricating shop to site.

The design of the bridge was developed under the direction of H. Ibsen, special bridge engineer, Michigan Central R.R., assisted by C. L. Christensen, assistant bridge engineer. The project is under the general direction of J. F. Deimling, chief engineer of the railway. Col. George H. Webb, late chief engineer, had the general direction of the project from its start until he went to France in 1917 as lieutenant-colonel with the 16th (Railway) Engineers, and again after his return in April, 1919, until his death on Nov. 3, 1921. Olaf Hoff, consulting engineer, is acting as advisory engineer on the project.

Some Tests of Light-Weight Aggregate

By Harry V. Mathews
Midwest Gas Plant, Salt Creek, Wyo.

A LIMITED series of strength tests on concrete made from the light-weight aggregate known as Haydite made last summer for the Midwest Refining Co., gives some indication of the strength to be expected from this aggregate. The plant for making the aggregate was built by the company because of the scarcity of natural aggregate in the Salt Creek oil field, where some concrete work had to be done. Haydite, as described in earlier issues of *Engineering News-Record*, is made by grinding shale and burning it in a rotary kiln. The burning expands the water in the shale and blows it up so that it is porous and looks a little like coke. The Haydite is then cooled and crushed to any desired size.

In all, twelve samples were made and tested. For comparison samples were made of bank run gravel and crushed rock. In the accompanying table, the letters *A*, *B* and *C* stand for different sizes of Haydite, *A* being from dust to ¼ in. and weighing 53 lb. per cubic foot dry, *B* from ¼ to ¾ in. and weighing 46 lb. per cubic foot dry, and *C* from ¾ to 1¼ in. *S* stands for sand and *SR* for sandrock.

TABLE SHOWING COMPARATIVE COMPRESSIVE STRENGTH OF SAND AND HAYDITE AGGREGATE

Sample No.	Wt. per Cu.Ft. Lb.	Mix	Unit Stress Lb. per Sq.In.	Remarks
1	136	S SR 1 : 3 : 3	1,260	Little too wet
2	136	S SR 1 : 3 : 3	2,045	Very good mix
3	89.7	A B C 1 : 1 : 1 : 1	1,965	Too wet to tamp
4	91.2	A B C 1 : 2 : 1 : 1	2,680	Good mix
5	88.7	A B C 1 : 2 : 2 : 1	1,910	Good mix
6	88.3	A B 1 : 3 : 2	2,385	Too dry
7	77.8	A B 1 : 4 : 2	1,230	Too dry
9	108	S A B 1 : 3 : 1 : 2	1,745	Little too wet
10	112.2	A SR 1 : 2 : 3	2,310	Very good mix
11	78.5	A B 1 : 3 : 2	1,210	Too wet
13	77.3	1 : 3 : 2	820	Very wet

All samples were 6 x 12-in. cylinders. The Haydite was soaked in water before being used in concrete, as it will absorb 12 per cent by weight of water.

A great deal of trouble has been experienced in using Haydite for concrete, due principally to its lightness. The aggregate will not flow on being tamped as will ordinary concrete and when there are irregularities in the forms such as floor benches, etc., it is hard to fill these up completely. On removing the forms, the concrete does not have as smooth an appearance as ordinary concrete and takes more time to finish.

The tests were made by the gas department of the company, of which W. R. Finney is superintendent. The writer is superintendent of the Salt Creek Gas Plant.

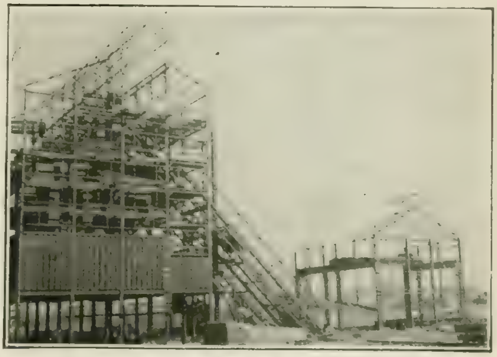
Puzzolan Cement Used on Federal Aid Road

On certain of federal-aid roads in Jefferson County, Ala., puzzolan cement has been used for the concrete base course. About three years ago the county requested the Bureau of Public Roads to approve this cement for such courses and after investigation of the specifications the Bureau consented. The cement used is a slag cement manufactured in Birmingham, where there is a good deal of concrete base course work made from the cement. This concrete is satisfactory, the Bureau reports.

Electric Crushing and Screening Plant at Quarry

Rope Drive for Main Crushers—Direct Connection for Most Machines—Waste Stone and Stripping Fill Old Workings

A NEW STONE CRUSHING and screening plant with an output capacity of 10,000 tons per 8-hour day, built recently at Marblehead, Ohio, by the Kelley Island Lime & Transport Co., has the following special features: (1) Electrical operation throughout, with individual drives; (2) gyratory crushers for both main and secondary crushing; (3) combinations of rotary and shaking screens and pan and belt conveyors, including pan conveyors of exceptional length; (4) extensive weighing equipment. The plant produces crushed stone in numerous sizes, stone for limekilns and furnace flux and ground limestone for agricultural use. A view of the plant is shown in the accompanying illustration.



STONE CRUSHING AND SCREENING PLANT

Building at right covers crusher pit 40 ft. deep. Inclined conveyor delivers stone to top of screenhouse at left. Bins in lower part of house deliver stone to railway cars standing below. Quarry car at right.

Quarry—On about 400 acres of a 3,000-acre property the top ledge is being worked to a depth of 22 to 25 ft. along a face aggregating 3½ miles. A 12-in. loam overburden is removed by light traction steam shovels, the stripping being used to cover quarried areas which have been filled with waste rock. Blast holes are put down with well drills and the stone is loaded into quarry cars by large steam shovels. One of these machines is mounted on crawlers and is said to be the first steam shovel thus equipped for work in quarries. Geared locomotives handle the cars between the quarry and crushing plant.

Crusher Plant—Two steel-frame buildings housing the crushers and screens are connected by an inclined gallery for the conveyor which extends from the crusher pit to the top of the screen house. Large steel-sash windows are provided in the corrugated sheathing and roof ventilators are expected to create an upward draft which will carry away much of the dust. Electric current purchased from a utility company is brought in over a 12-mile transmission line. Individual motors are used and in most cases are geared directly to their machines, but rope and belt drive is used where shocks and irregular load must be considered, as in the case of crushers. In view of the dusty character of the work all motors are fully inclosed and have dust-proof bearings.

Crushers — Two gyratory crushers with receiving openings 48 x 125 in. perform the main crushing and are placed in a pit with their tops 10 ft. below the surface tracks for the quarry cars. Above them is a steel bin having its bottom level with the tops of the crushers, the stone forming its own hoppers as it feeds through the openings into the crushers. With tracks along both sides of the pit two trains of three 10-yd. side-dump cars can be dumped at once into the bin. This arrangement dispenses with dumping inclines, and the cars do not have to be uncoupled. If a car does not dump promptly, its body is tilted by the piston rod of a compressed-air cylinder below the track. In erection, a railway wrecking crane handled crusher parts weighing 34, 38 and 60 tons, but a 50-ton overhead traveling crane provides for renewals of heavy parts. Each crusher is operated by a 200-hp. motor by means of a rope drive having twenty-six turns of ¾-in. rope. The 6- to 8-in. oversize material from the initial screens is suitable for charging into limekilns, but when necessary this material may be further crushed by a pair of smaller gyratory crushers in the screen house, each crusher belted to a 75-hp. motor.

Conveyors—Two 72-in. pan conveyors 176 ft. long and inclined 45 deg. carry the product from the discharge of the main crushers, 38 ft. below the ground to the top of the screen house, 88 ft. above the ground. It is stated that the great load which such conveyors impose upon the head shaft usually limits the length to about 130 ft. To permit of the greater length in this case an equalizing device is placed in the supporting trestle at about 65 ft. below the head shaft. This device takes the entire dead load up to that elevation, leaving the head shaft to carry only 65 ft. of the dead load and all the live load. These conveyors are operated by 200-hp. motors with silent chain drives and speed-reduction gearing.

Belt conveyors 20 in. wide take the screen product of less than ⅜-in. size and deliver it to a vibrating screen for smaller sizes. Belt and bucket elevators return the product of the secondary crushers to the 60-in. main screens.

Screens—Stone from the pan conveyors is discharged into two revolving screens 5 x 24 ft. The first half of the length has 3-in. circular holes and is surrounded by a jacket having 2¼ in. holes, while the second half has openings 6 x 6 in. Material from these last large holes and the rejections from the jacket are stored for use as furnace flux. For grading into various commercial sizes the 2¼-in. material goes to a second battery of revolving screens 4 x 20-ft. and thence to double-deck shaking screens, the rejections going to a vibrating screen which makes the final sizing for ⅜-in., ¼-in. and "dust."

Tracks and Scales—About 20 miles of 36-in. track serve the quarry and crushing plant, but all tracks at the screenhouse have three rails so that the product can be loaded into standard-gage cars for rail shipment or into the narrow gage quarry cars for transfer to limekilns, a boat dock or an agricultural grinding plant. In each of four tracks passing under the storage bins is a track scale, and cars standing on the scales are loaded by bottom discharge gates of the scissors type. Four air-operated quadrant gates with hinged spouts can load cars on a track alongside the oversize bins.

This crushing plant was designed and built by the Allis-Chalmers Mfg. Co., Milwaukee, Wis.; the steel buildings were designed by the Jones & Laughlin Co., Pittsburgh, Pa., and erected by the Massillon Bridge Co., Massillon, Ohio. All plans were prepared in co-operation with the Kelley Island Lime & Transport Co. Foundation work and installation of machinery was handled by this company under the direction of I. J. Sauvey, superintendent of construction, and A. C. Schultz, chief engineer.

Practical Arrangement of Building Codes

By Frank Burton

Commissioner of Buildings, Detroit

Criticizing building codes as being burdensome to both designer and builder by their illogical arrangement, Mr. Burton in a paper on "Essentials of a Building Code," read before the Michigan Engineering Society on Feb. 9, suggested in outline how a code might be arranged for practical usability, as reproduced here.

Building codes are a very heterogeneous hodge-podge of don'ts and shan'ts, and I honestly cannot criticize a builder who loses faith with a code and goes ahead the best way he knows how. Those who write building codes must first get clearly in their mind just what they are writing about. Then they must assemble this material in a logical sequence and place it before the builder in an orderly manner so that he can grasp the subject without an unreasonable amount of study:

(1) Types of construction, such as fireproof construction, mill construction, etc. Describe each type completely, starting with bearing walls, columns, and then going to floors, roofs, pent houses, roof structures, porches, windows, etc., so that no element of construction is left in doubt. Then classify the buildings definitely as to their use, such as factories, theaters, apartment houses, giving as many classes as are necessary but no more than are necessary. Under each class of buildings should be assembled all data pertaining to that class of building, even though this may mean repetition in some cases. For example, under factory buildings there should be discussed, first, the type of construction to be used, depending on height, size, etc.

(2) Mixed occupancy, such as using one part of the building for a garage or theater.

(3) Stair requirements.

(4) Shaft enclosures.

(5) Fire area requirements.

(6) Protection from fire on the lot line side, such as fire windows.

(7) Fire protection apparatus, such as standpipes and sprinklers.

(8) Special protection, such as setting of furnaces and other heating apparatus.

(9) Exceptions to the general rules which may be allowed in particular cases.

Two other subjects could probably be discussed here, since all the requirements mentioned above would pertain to new buildings. We should give the requirements for old buildings which ought to be improved and put in better condition; also, the requirements for existing buildings where it is desired to use them for other types of occupancy.

This scheme does not take in the question of engineering features, which will be entirely independent of both type of construction and class of occupancy and should properly be kept separate from the general outline. Engineering data are usually grouped for use by theoretical persons rather than practical builders; for example, most codes devote sections to the subject of stresses in the abstract, another to materials, and still another to methods of calculation. When a practical builder wishes to erect a mill building and wishes to determine the requirements for his timber members, he must read portions of three or four articles in order to get the data needed. My idea is to collect in one place all of the data regarding materials, stresses, methods of calculation of timber, steel or concrete members.

The Apulian Aqueduct—Southern Italy's Water Supply

Most Extensive System of Its Kind in World Nears Completion After 16 Years' Building—Serves 266 Municipalities Comprising a Population of 3,000,000

By I. Gutmann
With the Hydraulic Division of the Electric Bond & Share Co., New York City

The Apulian Aqueduct in Southern Italy, which after sixteen years of work is now nearing completion, is a unique example of co-operation in water supply. It supplies water not to just one municipality, nor to one compact cluster of municipalities forming a metropolitan district, but to fully 266 communities scattered over an area of some 8,100 sq.miles, having a total population of some 3,000,000 people. This estimate is based upon partial returns of the census taken on Dec. 1, 1921. To this region, which is on the Eastern, Adriatic slope of the Appennine Peninsula, the aqueduct brings water from a remote watershed on the Western, Tyrrhenian slope of the peninsula, piercing in its course the backbone of the Appennine Mountains.

A home parallel for this would be a system supplying water to the whole state of Massachusetts, exclusive of the City of Boston (not the Metropolitan District) the water coming from the other side of the Hoosac Range, say, from some hypothetical springs above Troy, New York.

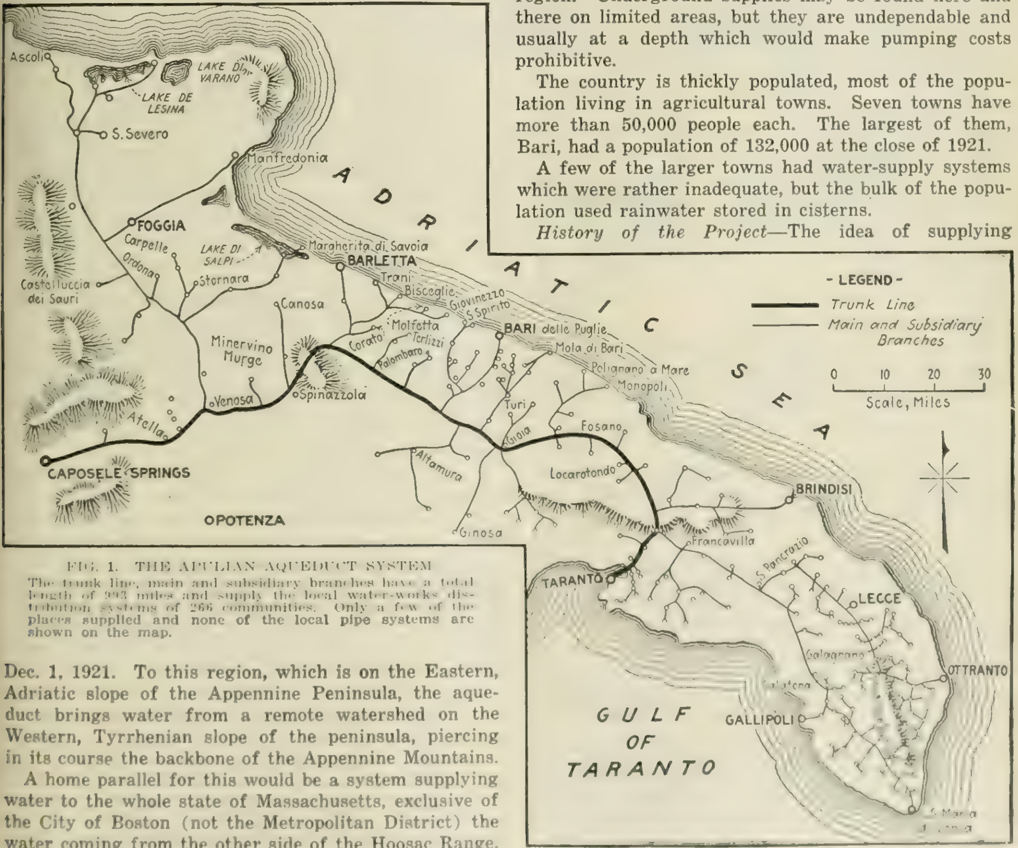


FIG. 1. THE APULIAN AQUEDUCT SYSTEM

The trunk line, main and subsidiary branches have a total length of 993 miles and supply the local water-works distribution systems of 266 communities. Only a few of the places supplied and none of the local pipe systems are shown on the map.

The Region of Apulia—The region served by the aqueduct is ancient Apulia, now subdivided into the three administrative provinces of Foggia, Bari and Lecce. It is the heel portion of the famous boot shape of the Appennine Peninsula—a country of irregular topography abounding with seismic faults and famous for violent, devastating earthquakes. The region is fertile though its climate is arid. It is in general not unlike the Los Angeles region in California. The yearly rainfall varies from 15 to 25 in. No rain falls in summer. The country is on a porous often fractured calcareous formation which rises from the Adriatic in a series of terraces finally attaining an elevation of a thousand feet above sea level. The runoff is rapid. What remains of the rainfall sinks very rapidly in the fissured tufaceous limestone. There are neither perennial streams or reliable impervious reservoir sites in this region. Underground supplies may be found here and there on limited areas, but they are undependable and usually at a depth which would make pumping costs prohibitive.

The country is thickly populated, most of the population living in agricultural towns. Seven towns have more than 50,000 people each. The largest of them, Bari, had a population of 132,000 at the close of 1921.

A few of the larger towns had water-supply systems which were rather inadequate, but the bulk of the population used rainwater stored in cisterns.

History of the Project—The idea of supplying "Thirsty Apulia" with water from the more humid western slope of the Apennines occurred first to a humble government engineer, Adjutant Rosalba, who, in 1868, pointed out the Sanita Springs of Caposele, at the head of the river Sele, as a desirable source for a water supply for Apulia. But in those days the Appennine Range was considered an insurmountable obstacle, and Rosalba's scheme was put aside as utopian. Twenty years later the project was studied in detail by Zampari who prepared fairly detailed plans for its constructions. But even then no construction company would dare tackle so vast a project. Urged by Apulian representatives, the Italian Government appropriated in 1901 a fund of almost $200,000 for the completion of the technical report. The project was criticized by some engineers and geologists, notably by M. F. Casarti, who called it a "national error" from both the economical and technical standpoints. The opponents argued that a long aqueduct line was unsafe in a fault-fractured country subject to violent earthquakes. It was also claimed that local artesian supplies were obtainable at reasonable depths (130 ft. or more) in many districts in Apulia.

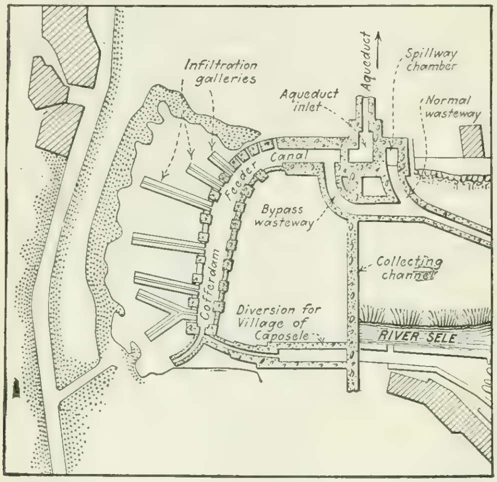


FIG. 2. PLAN OF HEADWORKS OF APULIAN AQUEDUCT
"Tapping galleries" empty into a collecting channel which leads to a feeder canal terminating in the equeduct intake.

A detailed technical report by Michele Maglietta was published by the Ministry of Public Works, under date of Oct. 20, 1902. In 1905, after an international competition, the contract and concession were awarded to the construction firm, Ercole Antico & Soci, of Genoa. It may be observed here that the rather delicate matter of adjudicating water to non-riparian provinces, completely outside of the watershed, transpired in a manner which in the Western American states would be deemed quite unexciting. At the end of 1906 work was commenced and in April, 1915, water was delivered at the City of Bari, on the Adriatic, about 120 miles from the Caposele Springs.

At the present time most of the work in the provinces of Bari and Foggia has been completed. Nearly all of the work remaining to be done is in the Lecce Division, where some very difficult construction is contemplated; the design calls for a siphon 75 miles long.

General Layout—The Apulian Aqueduct, conducting water from one source of supply to 266 centers of demand scattered over an area of 8,100 sq. miles, necessitates a system of conduits on this general plan: One main trunk from the springs to the territory served, diverging into systems of main and subsidiary branches, finally terminating in the various communities served. The main trunk of the Apulian Aqueduct (Fig. 1) commences at the Caposele Springs, very soon pierces the Appennine Range in a nearly eastern direction by means of a series of 38 grade tunnels, totaling almost 50 miles in length and comes within about 15 miles of the Adriatic Coast. Thence it turns southeast, generally paralleling the coast, and terminates about 90 miles away, at Villa Castelli, in the province of Lecce. This stretch is largely a cut-and-cover conduit. The total length of the main trunk is almost 152 miles (244 km.). It comprises 99 tunnels of about 67 miles total length, about 76 miles of cut-and-cover conduit; 93 aqueduct bridges totaling 4.25 miles in length; and 6 siphons of a total length of 4.6 miles.

From this main trunk branches are sent out to the various towns and their districts: Foggia, Bari, Brindisi, Taranto, etc.

The total length of supply conduits will be 993 miles: 152 miles of main trunk and 841 miles of main and subsidiary branches. There will be in addition about 550 miles of distribution mains and service pipes within the municipalities served. Compared with this, the Coolgardie pipe line, in Australia, heretofore considered the longest in the world, is 350 miles long, and the Los Angeles Aqueduct, which is the longest in America, is about 240 miles in length.

The topography of the country traversed is very irregular, it being crossed by many ridges, gorges and stream beds. At some points, it was necessay to insert drops. The energy developed at the various drops will be utilized for the generation of a total of 8,500 hp. Of this, about 7,000 hp. will be taken up by industrial enterprises. The remainder, augmented with power from other sources, will be used for pumping water to points which are inaccessible to the gravity flow of the aqueduct. The greater part of the territory south of the city of Lecce will be served from pumping plants.

Capacity and Rates of Consumption—The maximum capacity of the aqueduct is 137 m.g.d., which is about one-half the capacity of the Los Angeles aqueduct. For the present, the Caposele Springs have been developed only to the extent of yielding 126 m.g.d. but this is about 100 per cent above the present demand.

The allowed daily per capita rates of consumption fall into eight categories, as shown by Table I.

Storage—Covered distribution reservoirs of reinforced concrete are provided at all the important centers served. There will be 152 such reservoirs of a total capacity of 76,000,000 gal.; the largest one, at Taranto, will hold 4,227,000 gal. The population of Taranto probable exceeds 75,000. As to capacity, these reservoirs have been designed to store a normal 48-hour supply for points along a descending conduit line, and a 72-hour supply for points along an ascending conduit. For reservoirs in the Bari division, which is close to the main trunk, the reserve-storage is for normal supplies of only 30 and 56 hours respectively.

TABLE I. PER CAPITA CONSUMPTION ALLOWANCES FOR VARIOUS CLASSES OF COMMUNITIES SERVED BY APULIAN AQUEDUCT SYSTEM

	Gal. per Cap. per Day	
		For Communities with a Gravity Supply
1	24	For the Cities of Bari, Lecce, Foggia, Barletta, Taranto
2	18.5	Towns of more than 20,000
3	16	Towns of 10,000-20,000
4	14.5	Towns of 5,000-10,000
5	13.25	Towns of 5,000 or less
		For Communities with a Pumped Supply
6	13.25	Towns of 10,000 or more
7	12	Towns of 5,000-10 000
8	10.6	Towns of 5,000 or less

This is by no means excessive in a country subject to violent earthquakes which may cause in the main-trunk-structures damage requiring much over 72 hours to repair. Nor is it excessive for a system in which only a few of the centers of consumption are less than 75 miles away from the source of supply. The Catskill Aqueduct, which is located in a non-seismic country, is provided with more than 72 days reserve-storage almost within the city limits of New York. Kensico and Hill View have a storage capacity of nearly 40 billion gallons. The Los Angeles Aqueduct, which like the Apulian traverses an earthquake region, is provided at its terminus with a reserve storage equal to half a year's supply. Chatworth and the two San Fernando reservoirs have a capacity of about 22 billion gallons. The similarly situated city of San Francisco is even better provided against emergencies along its comparatively short aqueduct line. It should be hoped that means will be found to remedy this weakness of the Apulian Aqueduct.

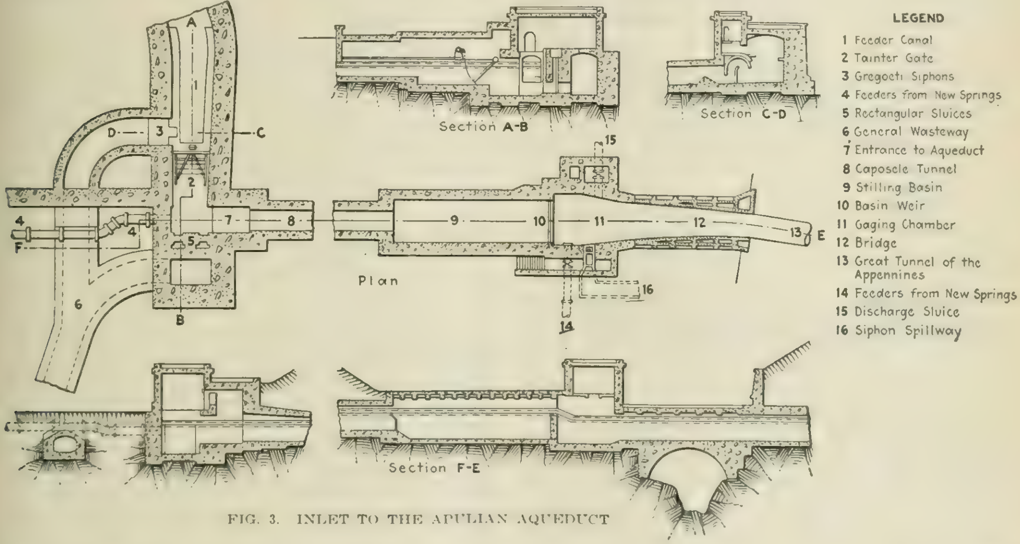


FIG. 3. INLET TO THE APULIAN AQUEDUCT

The Caposele Springs and the Aqueduct Headworks—The Caposele Springs, which feed the Apulian Aqueduct, belong to a group whose combined yield is estimated at about 500 m.g.d. They crop out at El. 1,378 ft. along the contact of a fracture calcareous formation with an underlying impervious belt. This calcareous mountain group, which is the catchment area of these springs, is 233 sq. miles in extent and reaches El. 3,400 ft. The annual rainfall of the area is from 55 to 88 in., of which only 10 per cent falls in the summer.

The yield of the Caposele Springs alone varies from 82.5 to 136 m.g.d. The maximum yield, which occurs in summer, may exceed the winter minimum of the same year by 40 to 45 per cent. The present requirements of the territory served are much lower than the minimum yield. The springs can be easily developed to yield, at their minimum stage, the 137 m.g.d. which is the maximum capacity of the aqueduct, plus the 11.4 m.g.d. which were reserved by the water users below the springs.

The quality of the spring water is excellent: Chlorine from 0.0355 to 0.071 per 100,000; organic matter absorbed by oxygen, 0.0024; and only traces of nitrogen compounds; hardness, 14 degrees on the French scale, or about 9.8 on the English; temperature, usually around 49 deg. F.; bacterial content from 22 to 41 per c.c., of which 5 per cent may be of the liquefying varieties.

The springs were intercepted—"captured"—in the following manner: About a dozen tapping galleries, abutting in the rock at the points of richest water-outcrop, empty into a common collecting channel which curves into a feeder canal, conveying the water into the intake of the aqueduct. (Fig. 2.)

The tapping galleries are of varying lengths and have a uniform rectangular section of 2 ft. 7½ in. x 3 ft. 11 in. Their bottom is of unlined natural rock. The side walls are of concrete blocks whose vertical sides do not touch but are about 6 in. apart. Concrete slabs simply resting on the sidewalls form the roofs of these galleries.

The collecting channel, which is approximately normal in direction to the galleries, is 180 ft. long and 9 ft. 9½ in. wide at its upper end and 16 ft. 5 in. at its lower end. A canal heads near the upper end of the collector and diverts water to the community of Caposele. The bottom of the collector is on a grade of 0.5 per cent and has a concrete lining 20 in. thick. The two sidewalls consist of two series of pillars and arches of masonry, forming two arcades running along the general direction of the channel. The arch panels are filled out with concrete blocks forming porous walls similar to those of the tapping galleries. The arch spandrels are filled with masonry, and a concrete slab roofs the channel.

The excavation in the rear of the sidewalls of the tapping galleries and the collecting channel has been backfilled with coarse rubble which allows infiltration from the surrounding water-bearing strata. The galleries and the collector are covered with a heavy layer of tamped earth.

The collecting channel merges into a feeder canal which has impervious masonry walls and is 56 ft. long and 16 ft. 5 in. wide at its upper end, 13 ft. 1 in. at its lower end. (Fig. 2.) Its grade is also 0.5 per cent. In the right wall, near the lower end of the feeder, there is a Gregotti siphon spillway discharging into a bypass wasteway. (Fig. 3.) Near the same point, there is a Tainter gate, across the feeder; and close to it there is the abutment of a low masonry dam (7 ft. high) which extends into the underlying impervious strata to cut off any seepage from the springs area into the river bed below. Below the Tainter gate the bottom of the canal is depressed and the inlet to the aqueduct begins at a right angle to the feeder canal. The aqueduct inlet consists of a succession of chambers, a tunnel passage, and a stilling basin having a Bazin measuring weir at its end. At the upper end of the aqueduct inlet, in the wall opposite the Tainter gate there are two short galleries, controlled with sluice-gates, which may be used to divert the flow into a chamber opening out into the already mentioned bypass wasteway. Near the lower end of the aqueduct inlet, a little below the Bazin weir, there is a siphonic spillway, in the sidewall of the channel; and also a superstructure, housing various gages and water measuring apparatus. Hence the channel is carried on an arch bridge across a stream bed and finally enters the Great Tunnel of the Appennines.

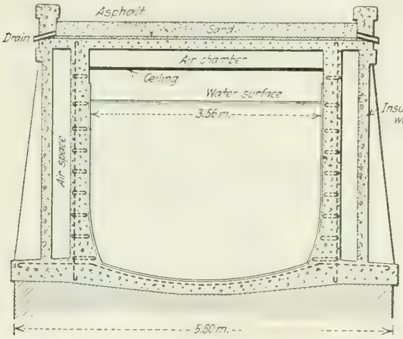


FIG. 4—AQUEDUCT ON REINFORCED-CONCRETE BRIDGE

All of this collecting and intaking system is under a covering of earth. The ground around it was converted into a park which is walled and guarded. The mountainous territory above the springs was expropriated and all cultivation and grazing on it are prohibited. About 5,000 acres situated near the springs are planted with pines. To prevent devastating "avalanches," the extensive slipping formations in the neighborhood of the springs were solidified by drains and retaining walls.

Tunnels—The main trunk of the aqueduct comprises 99 grade tunnels having a total length of almost 67 miles. In the judgment of the designers of the system tunnels are best suited to resist earthquake shocks; therefore tunnel sections were often used even where other forms of construction might have been adopted. Grade tunnels were preferred to pressure tunnels on account of less seepage losses and easier construction and maintenance. The tunnel sections were designed on the basis of the new Bazin formula:

$$V = \frac{87\sqrt{RI}}{1 + \gamma\sqrt{R}};\ \gamma = 0.11 \text{ (metric system)}$$

The velocities allowed range from 1 to 4 ft. per second, the grades from 0.025 to 0.040 per cent. In the most unstable formations the circular cross section was adopted; in more solid formations, the horseshoe; in firm rock, the inverted U section. All the tunnels are lined; most of them with a 1:2:3½ concrete, and the others with brick in cement mortar. Local limestone crushed and ground furnished the rock and the artificial sand for concrete.

The following are the longest tunnels of the system: The Great Tunnel of the Appennines, Croce del Monaco-Ginestra, and Murge.

The Great Tunnel of the Appennines is 50,055 ft. long or more than twice the length of the Walkill pressure tunnel of the Catskill system. It is curved in alignment and its grade is 0.025 per cent. Its cross-sectional area is about 75 sq.ft. Throughout most of its length a horseshoe section, 8 ft. 9 in. wide by 9 ft. 5 in. high, was used but for swelling clay formations a 9¼-ft. circular section was adopted. The tunnel lining varies in thickness from 15 to 32 inches.

About 28,500 ft. of the length of the tunnel is in a very treacherous formation, an eocenic slaty clay, the very worst formation which may be encountered in Italy. It required unusually heavy timbering. When exposed to heat and damp air it swells and disintegrates in a short time. In tunneling through this formation only electric power could be used; steam locomotives and gas engines were excluded. It was also essential to have most liberal ventilation facilities, and the brick lining had to follow very closely after the excavation. Other serious difficulties were copious seepage, inflammable gases (grisou), and a large mud pocket—the site of an ancient submerged ravine, which had to be outflanked.

Excavation was done by hand, except that compressed air drills and hammers were used in rock. About 0.5 lb. of dynamite to the cubic yard was used for blasting in brittle conglomerate, and from 2 to 3¼ lb. per cubic yard in sandstone and marly limestone formations. Intermediate quantities of dynamite were used in formations of intermediate hardness. These quantities are quite low in comparison with American practice. (In blasting the limestone of the Rondout tunnel, Catskill system, 4½ lb. of dynamite per cubic yard were used.) Muck was removed by means of 25-hp. electric locomotives.

Tunneling was carried on from both ends and from a shaft, 11½ ft. in diameter, 207 ft. deep, located about 33,620 ft. from the upstream portal. Near the shaft there was opened a service chute, 623 ft. long, on an incline of 24 deg., and also a ventilation shaft, 4 ft. in diameter, 151 ft. deep. Another chute, 490 ft. long, on an incline of 35 deg. was opened at about 6,720 ft. from the upstream portal and was used principally for the discharge of muck.

The Croce del Monaco-Ginestra tunnel is 51,948 ft. long. Its first or Croce Del Monaco half is on a grade of 0.025 per cent and has a horseshoe section 75.35 sq.ft. in area, 8 ft. 9 in. by 9 ft. 5 in. The Ginestra half is on a grade of 0.040 per cent and has a horseshoe section 8 ft. 4 in. by 8 ft. 5 in., 64.6 sq.ft. in area. Most of the formations encountered consisted of a pliocenic blue clay and strata of miocene sandstone and marl.

Enormous difficulties impeded the progress of this tunnel. Fully 8,530 ft. of its length, measured from the upstream portal, had to be entirely abandoned on account of excessive seepage, and a vast pocket of quicksand. At the end of the first third, from upstream, the combustion of copious exhalations of "grisou" raised the temperature to 154 deg. F. and work had to be stopped for about two months. At about 1,600 ft. from the downstream portal, extraordinary exhalations of sulphuretted hydrogen caused asphyxiation and fainting among the laborers and made work well nigh impossible. With the aid of exceptional means of ventilation, this little stretch, only 335 ft. in length, was put through after ten months of work. The shifts were very short.

The tunnel lining varies in thickness from 16 to 21 in. Various types were used: concrete; masonry of brick, rubble, or travertine (a white spongy marble). Excavation proceeded from the two portals and from two intermediate shafts.

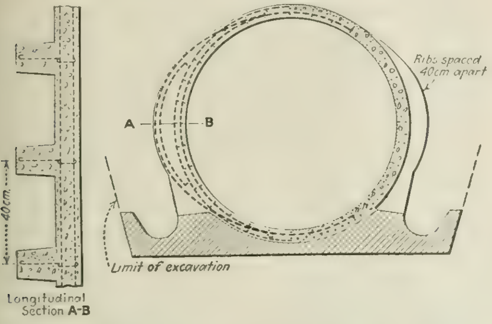


FIG. 5. REINFORCED-CONCRETE RIBBED SIPHON

Shell 4 in. thick, with crescent-shaped ribs spaced 16 in. apart, the latter designed to take care of important secondary stresses.

The Murge Tunnel is the longest of all, having a length of 52 562 ft., or about twice the length of the Elizabeth Tunnel, the longest one on the Los Angeles Aqueduct. It is on the main trunk, downstream of the Foggia branch; therefore it has a reduced capacity of only 176.6 sec.-ft., or 108.7 m.g.d. It is on a grade of 0.040 per cent and its cross-section is a flat-bottom inverted U about 52 sq.ft. in area, 6 ft. 9 in. by 8 ft. 6 in. It is practically all in a uniform formation of fractured cretaceous limestone of medium hardness. Excavation was done with pneumatic hammers; there was no seepage; timbering was unnecessary. In general, there were no special difficulties with the exception of a cave, 90 ft. long, which necessitated a detour of 330 ft. Excavation proceeded from the two portals and from five intermediate shafts, one of which was 630 ft. deep. The tunnel is lined with concrete throughout.

TABLE II. NOTABLE SIPHONS ON THE APULIAN AQUEDUCT SYSTEM

Name	Length, Ft.	Head, Ft.	Diameter, Ft.	Loss of Head, Ft.	Capacity Sec.-Ft.
Venosa (steel)	2 294	138	5.25	5.9	159
Locone (steel)	3,570	184	4.9	4.9	159
Palazzo S. Gervasio (reinforced concrete)	14,308	79	5.4	5.9	162
Ofanto (steel)	19,243	528	2.3	100.9	45.5

Cut-and-Cover Sections—Below the Murge Tunnel, the main trunk is largely in a cut-and-cover canal, a horseshoe or inverted U in cross section. There are 76 miles of this type of channel in the main trunk. The masonry conduit is either entirely sunk in a trench or it is built along a hillside bench. The abutment walls of the horseshoe sections vary in thickness from 1 to 4 ft. To maintain a low water temperature, the top of the conduit is ballasted with a layer of selected material, not less than 6½ ft. in thickness.

Aqueduct Bridges—Ravines and stream beds are crossed preferably by means of aqueduct bridges ("ponti canali") which carry the aqueduct stream on a slope of 0.050 per cent. There are 93 bridges totaling 4.25 miles in length, in the main trunk. Where good stone was available, the bridges were built as masonry arches supported on massive ashlar-faced piers founded on solid rock. The most remarkable of these are the bridges crossing the Bradano and the Atella Creeks. The Bradano bridge comprises 14 arches of 39.4 ft. clear span each, and has a maximum height of 105 ft. and a total length of 690 ft. The Atella bridge consists of 32 arches of 32.8 ft. clear span each and one arch of 65.6 ft. clear span. Its maximum height is 75.5 ft.; its total length is 1,368 feet.

To prevent rise in the temperature of the water, the conduit is made structurally independent of the bridges: it is set between the bridge parapets and is insulated by means of air spaces, walls of hollow bricks laid on their sides, and layers of asphalt. (Fig. 4.) The conduits are covered with slabs surcharged with a heavy ballast of earth and gravel. The bridges are made wide enough to accommodate maintenance traffic. A wind pressure of some 50 lb. per square foot is taken care of in the design.

Siphons were employed only where bridges would have cost much more. (See Table II for details of the most notable siphons.) It was desired to have a minimum number of siphons and not more than 98.4 ft. (30 meters) hydrostatic pressure in them. The siphons all consist of a double conduit, twin pipes of reinforced concrete or riveted steel. Of the available operating head, 0.66 ft. was usually allowed for various minor losses and the remainder for friction losses. The interior is coated with a rich cement mortar. The diameters were designed on the basis of the formula:

$$\text{Diameter} = D = \sqrt[5]{\frac{B\,L\,Q^2}{Y}}\text{, in which}$$

L = length in meters; Q = discharge in cub. meters per sec.; Y = friction head in meters; B = a coefficient varying with the diameter.

A siphon over 70 miles long has been designed for the Lecce branch of the aqueduct. The Ofanto Siphon has not yet been constructed. To diminish the hydrostatic head, this siphon will be carried on a reinforced-concrete bridge on seven arches of 82 ft. clear span each.

The siphon crossing the plain of Palazzo San Gervasio is unique in its design. (Fig. 5.) It is of a uniform thickness of 4 in. throughout its length and has corrugated sides. The corrugations consist of crescent-shaped ribs spaced 16 in. apart and projecting out about 6 in. at their middle points. These ribs taper in thickness from 5 in. at the surface of the siphon pipe to about 4 in. at a distance of 6 in. from it. A portion of the reinforcing hoops is imbedded in the ribs close to their outward surface. These ribs have been designed to take care of important secondary stresses which, when occurring in pipes of large diameter, will displace the tension curve to a considerable distance from the center of the pipe shell. The design is due to Prof. C. Guidi of the Torino Polytechnic College.

The siphon pipes have no contraction joints. They were poured in winter; when set they would be filled with aqueduct water and the water held in them until the concrete became as cool as the water. Then the siphon would be drained and any cracks which might be found would be carefully filled with cement mortar, the soft mortar patch being held in position by means of wire netting until it set and became hard.

Pressure Conduits of Reinforced Concrete and "Eternit"—The main branches conveying water to Bari, Lecce and other districts consist very largely of reinforced-concrete pipes ranging in diameter from 6 to 32 in. and able to withstand hydrostatic pressures of 98 ft. In cases of higher pressures or smaller diameters metallic pipes were used. Some of these pipe lines have a capacity of 42 sec.-ft.

Most of the reinforced-concrete pipes were made by a centrifugal method which has been quite popular in Australia and South Africa as well as in Italy. The concrete is fed into a rotating single-wall steel cylinder, of proper diameter, which contains the reinforcement of the pipe to be turned out. The centrifugal force generated by the rotation of the cylinder automatically distributes the concrete and produces a pipe shell of uniform thickness. An interior coating of asphalt, $\frac{1}{8}$ in. thick, is applied by the same method. This coating makes the pipes impervious to heads as high as 200 ft. The reinforcement usually consists of helical wires crossing each other and forming a cylindrical shell of rhomboidal mesh. The pipes are manufactured in standard lengths of 9.8 ft. (3 meters). They are left in the cylinders, in which they were revolved, for 24 hours, after which they are kept wet for 48 hours and then are buried in gravel for 15 to 20 days. After they have been dug out from the gravel, they are kept in a shaded place for one or two months. "They ring like bells" at the end of this period.

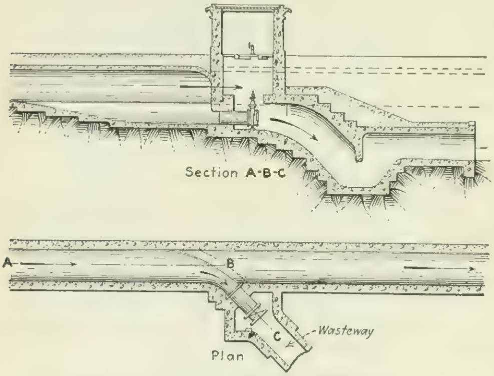


FIG. 6. TYPE OF CANAL WASTEWAY
These are placed every 6 or 7 miles and are generally pipes some 30 to 44 in. in diameter.

In difficult, isolated regions, pipes of "Eternit" have been used. "Eternit"—a concrete made of asbestos fiber and portland cement—is remarkable for its lightness, hardness, strength, and imperviousness. It may have a compressive strength af 12,000 to 14,000 lb. per square inch and a tensile strength of 1,400-2,000 lb. per square inch. Pipes of Eternit are impervious to heads of 400 ft. The Apulian Aqueduct has an Eternit pipe line near Locorotondo, which is 6 in. in diameter, 4,920 ft. long and bears a hydrostatic head of 130 ft. There is also one of the Brindisi line, 12 in. in diameter, 4,265 ft. long, with a hydrostatic head of 130 ft. Eternit pipes have given complete satisfaction on these lines. Promising experiments of great importance were made on the use of Eternit pipes of small diameter for distribution lines. These pipes can be sawed, turned, perforated and riveted and it is very likely that they may be adapted for use on service lines.

Several types of joints for concrete pipes were tried and used. The collar joint has been found to be the simplest and most efficient one, and has therefore been most extensively employed. The exterior surface of the pipe ends is roughened and washed, and the ends are simply cemented together. A strip of wire mesh about 8 in. wide is tied around the joint, and a collar of 1:1 cement mortar, one-half the thickness of the joined pipe shells, is built around it. The lower portion of the collar is incorporated in the cradle on which the pipe rests.

Advantage has been taken of the topography to provide also canal wasteways for every six or seven miles of line. (Fig. 6.) A wasteway of this sort usually consists of a pipe, 30 to 44 in. in diameter, which heads in a depression sunk below the grade of the channel bed and leads out into a ravine or natural channel of some sort. This pipe is controlled by a sluice gate at its lower end. With an operating head of some 10 ft. it is capable of carrying off the flow of the conduit. Manholes are located about 1,500 ft. apart along the aqueduct line. The distribution net has been designed on the basis of a peak factor equal to two and one-half times the normal demand.

Rates, Cost, Administration—The water rates vary from 15 to 35 centesimi per cubic meter, which at par rates of exchange would mean about 11 to 26c. per 1,000 gal., or 8 to 19c. per 100 cu.ft. The rates for irrigation and industrial uses range from about 6 to 9c. per 1,000 gal., or $4\frac{1}{2}$ to 7c. per 100 cubic foot.

At the time of its inception the estimated cost of the project was 136,000,000 lire, which is about $27,000,000 at par exchange. The construction firm to which the concession was awarded received 100,000,000 lire from the Italian government, and 25,000,000 lire from a consortium of the provinces of Bari, Foggia and Lecce. The concessionaire had the right to exploit the system for 90 years from the time of the completion of the principal aqueduct lines, but the Italian government reserved the option of taking over the system within the first thirty years of its operation, provided the concessionaire is duly compensated. The government availed itself of this option and on April 15, 1919, the entire completed portion of the system was taken over by an autonomous board which includes representatives of the interested provinces and is financed by the Italian government. This board will operate the system and will complete its construction. The board is also laying plans for an extensive sewerage system for the towns of Apulia, and agricultural irrigation works.

Engineers—The eminent Italian engineers Zampari, M. Maglietta, G. B. Bruno and I. Maganzini are responsible for the general planning and construction of this system which was first conçeived of by Adjutant Rosalba. The construction of the great tunnels was under the successive supervision of Brandau, the builder of the Simplon tunnel, Gianafranceschi, and Bazzochi. Muzzani was in charge of the Great Tunnel of the Appennines, while Meocolombo was in charge of the Murge tunnel. Maselli acted as chief hydraulic engineer. Professors C. Guidi of Torino and G. Fantoli of Milan acted as consulting engineers, particularly on the design of the pressure lines of large diameter. Lack of space will not allow the mentioning of a number of other eminent Italian engineers and administrators who contributed to this achievement of Italian genius.

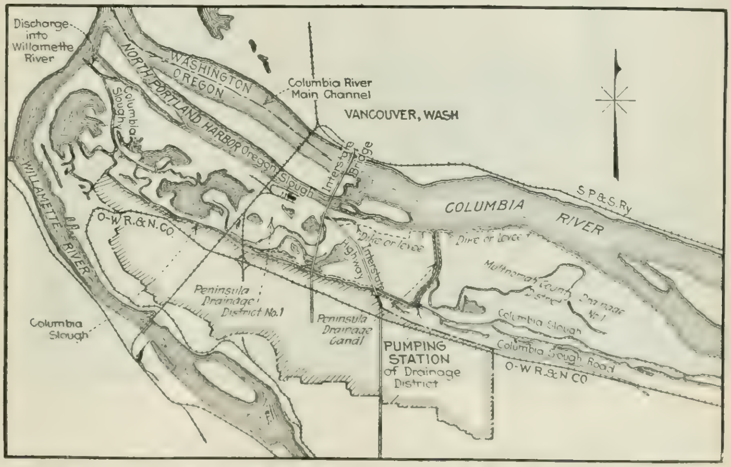
Drainage Project on the Columbia Adjoining Portland, Ore.

Levees and Pumping Plant with Three Types of Motor-Driven Pumps—New Sluice Gate —Design—Assessment System

By W. P. Hardesty
Civil Engineer, Portland, Ore.

A ZONE ASSESSMENT plan, balanced sluice gates or flood gates and motor-driven chain-pumps for low lifts are features of interest in the drainage and reclamation of 8,478 acres of low land along the Columbia River in Oregon by Multnomah County Drainage District No. 1. This district is adjacent to the city limits of Portland, Ore., and extends east for about eleven miles from the interstate highway connecting that city with Vancouver, Wash. It is bounded by the higher ground south of the river and has a maximum width of about 1¾ miles. The appraised valuation of the land is nearly $3,000,000.

Levees—An 11-mile levee along the river front is set back 50 to 100 ft. from the bank in order to be protected from erosion by the fringe of willows and cottonwood trees. The east end of the district is closed by a short levee. The west end is closed partly by the embankment of the interstate highway and partly by a dike built by the city in connection with the outlet of a sewer district. The main levee has a top width of 10 ft. with side slopes of 1 on 2 for ordinary soil, but 1 on 3 is used with sandy material and when the height exceeds 8 ft. Where the borrowpit is on the inside of the levee a banquette of 1 on 5 was formed. Most of the work was done with teams and scrapers but dragline excavators were used for about 1¼ miles at the lower end. Before placing the fill the site was cleared, grubbed and plowed in the usual way. The top elevation of the levee corresponds with a gage height of 30 ft. in the river at Portland. The slope of the water surface at different stages was determined by a series of levels and the grade of the levee was thus fixed to allow a clearance or freeboard of 2 ft. for a stage of 28 ft. on the Portland gage, with allowance for increased height due to the restriction of the channel by the levee. This 28-ft. elevation is practically the highest flood stage except that in 1894 the record was 5 ft. higher.



COLUMBIA SLOUGH IMPROVEMENT FOR SEWAGE AND LAND DRAINAGE

The area inclosed by hatching is the portion of Portland, Ore., for which the enlarged slough affords sewage disposal by dilution. Multnomah County Drainage District No. 1, the westerly end of which is shown on the map, has its surface drainage pumped into an enlarged connection between the Columbia River and the Columbia Slough, shown on the map as "Peninsula Drainage Canal."

Drainage and Pumping—For the removal of interior water due to seepage and rainfall and for the drainage of some shallow lakes and sloughs there is a system of main and lateral ditches connecting with natural channels. This drainage system leads to a concrete dam and pumping station at the lower end of the district. For natural or gravity discharge through the dam there are five sluices of 25 sq.ft. area. Pumping depends mainly on the stage of the river, but at low stages it is influenced by the tide, although the district is 100 miles from the ocean. In operating the pumps the water level in the channels is to be kept well below that required for drainage of the land. Such seepage as occurs is through the natural ground beneath the levee.

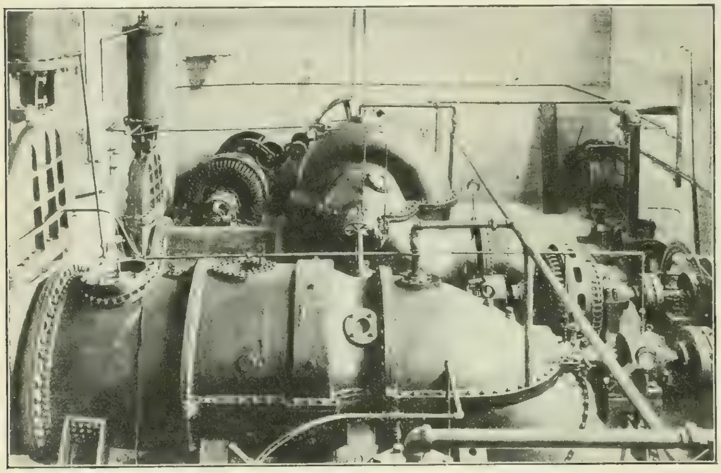
Near the east end of the district is a fine lake, called Blue Lake. Since Blue Lake is too deep for drainage, two dams have been built to maintain it at a certain level. Each is an earth dam backed by a wide sand slope, as the rotten volcanic sandstone formation is unsuitable to carry any concrete structure.

When all the land is under cultivation the district authorities will be required to keep the water down to a level corresponding to a gage height of about 3 ft. in the river. In practice the water is usually drawn down as low as 2 ft. during certain pumping hours.

With electric operation there is economy in running the pumps at full capacity in order to shorten the pumping period and to limit it to night service. The latter is important because the night rate for electric current is only 5½ mills per kw.-hour, while the day rate is 12½ mills. These low rates are granted because of the use of synchronous motors and because of running during off-peak periods. In this way it is economical to lower the intake side far below the required level during the night and allow the channels to fill during the day.

Three pumps are provided. For the lower lifts there is a screw pump with capacity of 50,000 gal. per minute, having a 7-ft. lift and driven at 230 r.p.m. by a 150-hp. motor. This pump has a 48-in. discharge end and can be worked efficiently up to 12-ft. lift. For the higher lifts there are two centrifugal pumps, each with a capacity of 35,000 gal. per minute under a lift of 22 ft. and working at 350 r.p.m., each driven by a 250-hp. motor. These pumps have 36 in. discharge ends and are worked up to a 26 ft. head when required by changing belts and by using a smaller pump-shaft pulley. The screw pump is more economical for the ordinary stages of the river, but as a rule all the pumps are used on account of the economy in pumping only at night. During a few weeks of the average year pumping against a head of 15 to 25 ft. is required. Two of the pumps are shown in the photograph.

Chain Pumps for Low Lift—An interesting practical problem developed with reference to pumping during the low-water season, since for about half the year only three low areas (lake beds) require the aid of pumping and these form but a small part of the total area. A chain-lift type of pump or water-elevator has been designed for use with the low lift required, 4 to 6 ft. Each of these elevators will be automatically controlled by means of float-switches so as to require only occasional visits from the attendant, and the power required for each will not exceed 15 hp.

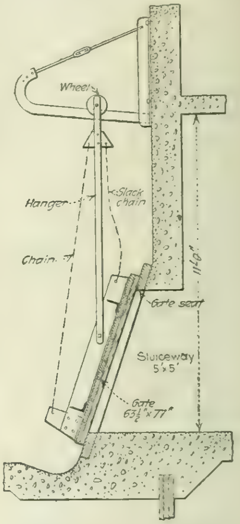


SCREW AND CENTRIFUGAL DRAINAGE PUMPS

These water elevators will discharge into the main drainage ditch, in which the connections with other drains will be temporarily closed. As this channel will carry water up to a height of approximately 10 ft. on the river gage before overflowing its banks, the water will be carried to the pumping station and there afforded an abundant outfall head for gravity discharge into the city outlet drainage channel. By this arrangement the pumping station may be shut down for a longer period during the year. An advantage of the chain-lift type of pump over the ordinary type for such low heads is in obviating the loss in velocity head and in entry through the foot-valve, which in such circumstances amount to a large proportion of the total load.

Balanced Flood Gates—For the sluiceways at the pumping station flap valves of a new type are used to permit outflow from the drained area but to shut off inflow. The construction is shown in the drawing. Both sluiceways and valves are rectangular. The latter are of wood with steel frames and close against wood seats set in the concrete of the sluiceways. The seats are inclined so that the weight of the valve aids in making a tight closure, especially when the water fills only part of the sluiceway. Each valve is suspended from a trolley rail at each side by a hanger or arm 8 ft. long. The arms are attached slightly above the middle of the valve and are pin-connected at both ends, the upper end being attached to a grooved wheel. Less than one inch difference in head serves to open the valve, and as it moves far out when opened and is entirely clear of the sluiceway there is no chance for small sticks that pass the trash screens to collect and prevent tight closing. This arrangement also permits a full flow from the sluiceway with an insignificant loss of head.

The trolley wheels have a travel of about 2 ft. and both the wheels and rails are kept well greased. Two chains attached to the top of each hanger have their lower ends attached to the top and bottom of the valve frame, as shown. The latter serves to hold the valve at the angle provided by the seat, and the bottom of the valve is counterweighted to insure prompt return to this position. The top chain is slack with the valve in closed position and its only purpose is to prevent somersaulting of the valve with a strong current when the sluiceway is open. The trolley-rails are adjustable as to slope or grade by means of turnbuckles in the diagonal suspension rods supporting their outer ends, thus securing the position for quickest response to pressure on either side of the valve.



BALANCED SLUICE GATE IN DAM

Cost and Assessment—The total cost of construction work will be about $550,000. This represents about $65 per acre for the total area, $76 per acre for land in "Zone 1" (100 per cent benefited) in the main district and $114 in a sub-district. That part of the district nearest the city has a potential future value for industrial sites, but only reclamation for farming purposes is at present proposed. Under the Oregon drainage district law the costs of reclamation are met by bond issues which become a direct lien on the land within the district. Interest and principal are met by taxes levied and collected by county officials in the same manner as ordinary taxes.

A zone system was devised in working out a basis for equitable assessment of the land to be benefited. Accurate contour maps were available and river records showed that flood heights up to or near 20 ft. gage could be expected in most years. Floods up to 24 ft. have occurred but those above 28 ft. were very exceptional and no attempt at protection above 28 ft. has been made, so that such high land receives no benefit. There are small areas occupied by the slough and drainage channels and also one very deep lake (as mentioned above) where the bed is too low for reclamation.

From the foregoing considerations, the following ratios were adopted to fix assessment rates in respective zones: (1) Areas below 20 ft. gage height (except deep slough and lake beds), 100 per cent; (2) areas between 20 and 24 ft., 80 per cent; (3) areas between 24 and 28 ft., 20 per cent. No assessment is made against areas in deep slough and lake beds or those above the 28-ft. contour. Each holding of land was first classified and the respective areas were scaled on the map, with the area of each zone multiplied by its percentage rate. Then the sums of products for each ownership and for the entire district were worked out. The ratio for each ownership, above or below the average taken as 100 per cent was then obtained. By this method a uniform rate per acre for each ownership was fixed, and this assessment remains in any subsequent transfers, regardless of the zones. The annual tax is made to cover the interest on the bonds, maintenance and pumping, and also to retire serial bonds as they become due.

This drainage and reclamation project was planned and carried out under the supervision of William G. Brown, consulting engineer, Portland, Ore.

Converting Columbia Slough Into Sewage Outlet

Affords Disposal by Dilution for Part of Portland —Slough Enlarged and Dyked—Design—Construction—Channel Flow

By W. P. Hardesty

Civil Engineer, Portland, Ore.

The greater part of Portland, Ore., lies between the Willamette and Columbia Rivers, and for most of the city the Willamette is the natural outlet for sewers. In the northern portion of the city, however, including most of the district locally known as the "Peninsula," is an area as near to the Columbia as to the Willamette, but still separated from the former by such a wide expanse of bottom lands as to make it very expensive to reach by sewer. A short distance out from the foot-line, and coursing through these bottom lands, is the Columbia Slough, a channel heading in the Columbia River and extending on past the city a distance of 17 miles to its discharge into the Willamette, shortly above the latter's junction with the Columbia. For a number of years the possible utilization of this slough for the discharge of sewage from the area described has been considered. In 1913, very elaborate topographic and hydrographic surveys were made, covering many square miles. The works to be described follow a plan adopted by the city in 1919.

Design—The design consists essentially of an inlet channel from the Columbia River to the Columbia Slough and the improvement of the latter by widening and deepening so that sufficient water may be carried at all stages to dilute the sewage enough to obviate any nuisance. Trunk sewers discharge directly into the channel and slough from moderate-sized districts, taking the shortest routes, and already five of these have been built.

Though Columbia Slough has a connection with Columbia River at medium stages, the supply is so moderate and the slough so deficient in its upper reaches that the idea of using this portion was abandoned. Instead of this an independent inlet is provided, tapping the river directly opposite the city and running about 1⅜ miles across the bottoms to a junction with the slough, from which point on the slough is partly improved by deepening and widening. The sewage flows through the slough about eight miles before it reaches the Willamette.

Preliminary studies indicated an area of about 6,000 acres and present population of about 30,000 to be provided for, and an estimated minimum waterflow through the channel of about 450 sec.-ft. This would give an abundant dilution at present and 6 sec.-ft. per 1,000 people when the district population should become 75,000. It is anticipated that a population of 200,000 in the sewer district will eventually be provided for by enlarging Columbia Slough clear through to the Willamette, but for more than this population the entire channel will have to be enlarged.

As a portion of the area served by the drainage channel lies outside the city limits, a special legislation was required to permit assessment of this land to help pay the costs.

The standard cross-section of the channel has a bottom width of 150 ft.; side slopes of excavation, 2 to 1; slopes of dykes alongside, 3 to 1 on the inside and 2 to 1 on the outside, with 10-ft. bermes. One dyke has a top width of 10 ft. and the other of 16 ft., the latter providing for a future roadway. Where the right-of-way is contracted the inside dyke slopes are made 2 to 1 and the bermes are omitted.

The elevation of the bottom of the channel is —6 by U. S. G. S. datum, or 6 ft. below mean sea level, although the discharge of the Columbia into the ocean is over 100 miles away. This provides a water depth of 7½ ft. at low-water. The elevation of the top of the dyke is 33 ft. (39 ft. above bottom).

In its course from the river inward to connect with Columbia Slough the channel follows McBride's Slough most of the way, to lessen excavation. Columbia Slough itself (running westerly nearly parallel to the river) was deepened and widened down to the Interstate Highway, a further distance of ¾ mile. At different places along the route five tributary sloughs are crossed, so that the dykes in some places are as much as 43 ft. above the slough beds. In its alignment the channel has three curves with radii of 874 to 3,350 ft. To prevent wash, riprap was placed on the outside of the sharper curves as well as for a few hundred feet adjacent to the river entrance and also on the high embankment dykes at the slough crossings. The riprap was brought in on barges and unloaded by means of floating derricks. At the off-take from the river the channel has a slight upward course, but this was not sufficient to prevent entry of floating drift, so a boom was built consisting of four dolphins with a line of sheer boom sticks (logs) on each side which are loosely fastened to the dolphins with chains, so that they raise and lower with the water level. This boom is 240 ft. long, and at its downstream end an opening remains sufficient for entry of barges and boats. Just inside the entrance a pile-trestle provides a road crossing.

This has a 50-ft. movable truss span that can be picked up bodily by a derrick on a barge and set back on the trestle, to permit passage of water-craft.

At the junction with Columbia Slough the slough itself is dammed off on the upper side, and the outlet from it into the channel is provided by means of sluiceways through the pump-house of Multnomah Drainage Dist. No. 1. (See preceding article by Mr. Hardesty in this issue.—EDITOR.)

It may here be stated that the dykes of the channel are not essential to its purpose of dilution and discharge, but were adopted by agreement between the city and this drainage district and one other one, really to protect lands being drained from *overflow* resulting from the new opening from the river. A much shallower section of channel would have been adopted if the lands had not been under reclamation, with bottom grade the same but with no provision of high dykes to prevent overflow from the channel during high water. The dykes after completion were turned over to the drainage district for maintenance.

DREDGING COLUMBIA SLOUGH, TO AFFORD SEWAGE DISPOSAL BY DILUTION
Dredge at left loading onto barge. Loaded barges were towed back and unloaded to form dykes. In right distance, barge being unloaded by clamshell bucket operated by derrick on barge.

The contract for the entire channel improvement was awarded during the winter of 1919-20 to the Pacific Bridge Co. of Portland, and the work was completed in the spring of 1922. The prices were quite low (for inflation times), and the item of 18c. per cubic yard for excavating and depositing material wherever needed made it very difficult for the contractor to break even.

Methods of Construction—The entire area to be covered by dykes was first cleared and grubbed, after which it was ploughed to give a good bond with the embankment. Dredging appliances were used as far as possible, as being cheaper, so work had to start at the river end and progress inward. No fewer than seven different types of excavators were used at different times. The first cut, and also a second where ground was higher than the average, were taken out by a dragline excavator placed on either bank and hoisted over for the dyke.

The big dredge "Titan," with a 4-yd. dipper, was one of the most efficient of the appliances. It loaded onto barges, which were then towed back to where needed and unloaded by clamshell buckets operated by derricks mounted on barges. Clamshell dredges were also used in excavating from the channel and placing directly in the dykes. These dredges had booms 125 ft. long. During low water they were at a disadvantage as, riding so low, the upward angle of the boom (by shortening) made it difficult to deliver to the outside of the dykes. They were much better adapted to high-water, both on account of riding higher (and so allowing a flatter boom angle) and because they could then float in nearer to the dyke and lessen the required reach. For this reason the contractor contrived to use them as much as possible during high-water. These long-boom dredges could also be used to some advantage in excavating ahead and swinging around to discharge to the rear, where the material was more needed in the dykes.

Much trouble was experienced in depositing the dripping wet material from the dredges onto the banks or dykes because of the tendency to flatten out and spread far beyond the proper limits, especially if deposited in great depth at any one time. The plan was then adopted of building in layers, letting each layer drain and partly dry out before placing the next one, and this necessitated moving the dredge back and forth several times before completion. In some other respects, however, the high water was a detriment, as during the June floods of 1921 (the highest since the record of 1894), the dykes were still uncompleted and there was imminent danger of the water breaking through and flooding the reclaimed land, so that constant watchfulness was required.

In the latter part of the work, when the bottom was down near to grade, a suction dredge of the Port of Portland was employed. This was much better adapted to finishing off to true grade than either the clamshell or the dipper dredges, as scoopholes are bound to result with them and it is very difficult to spot and hit accurately the high points in dropping under water. An advantage of this dredge, also, was the ability to discharge material away from the work, and in this way considerable material was used in filling in adjacent slough and lake beds. The greater proportion of the excess excavation on the job was used, however, in widening and raising the dykes. Some of it was barged out of the channel into the river and unloaded onto low land near the shore. Most of the material was a rather stiff clay, with but little sand, and not easily eroded.

Actual Flow in the Channel—Many measurements of the velocity and volume of flow in the channel were made in the two years before its completion. The fall is only about ½ in. per mile. It was ascertained that a value of 0.047 for n in Kutter's formula was correct while the work was still in the rough, but as work progressed and the slopes and bottom were made smoother this value reduced to 0.040. During the high water of 1921, with a depth of 33 ft. in the channel, the velocity reached about 4 ft. per second.

The flow during low water will become of increasing importance as the sewerage district settles up. During low stages the effect of flood tide in the Pacific is to back up and check the flow in the river and channel, while the outgoing tide accelerates the flow. The results so far show a minimum of 223 sec.-ft. when uninfluenced by tides and 97 sec.-ft. with the tide obstructing. The mean velocity seldom falls below 0.5 ft. per sec. except with tide effect. As the sewerage district becomes more populated the remainder of Columbia Slough, reaching seven or eight miles further on to the Willamette, will have to be deepened and widened. This will tend to accelerate the flow in the channel described and prevent unsanitary conditions along the slough. Considerable deposit of sand from the river has occurred along the upper part of the channel during high water, due to the checking of the velocity of water as it enters the channel.

CONSTRUCTION COST OF COLUMBIA DRAINAGE CHANNEL

Excavation used in embankments, 1,230,583 cu.yd. at $0.18	$221,505
Excavation wasted, 144,005 cu.yd. at $0.18	25,921
Rock excavation, 10 cu.yd. at $5.00	50
Riprap placed, 18,747 cu.yd. at $3.00	56,241
Clearing and grubbing, 43 acres at $200.00	8,600
Plowing under embankment, 49.8 acres at $10.00	498
Extra work	13,389
	$326,204
Right-of-way	23,528
Total	$349,732

Engineering costs not included.

The design of the works described was prepared under the supervision of O. Laurgaard, city engineer. A. J. Wiley, consulting engineer, Boise, Idaho, was employed by the city to pass on the feasibility of the plan proposed. The execution of the work was in immediate charge of R. E. Kremers, chief of the Bureau of Construction, assisted by J. R. Hanson.

Percolation Through and Hydraulic Pressure Under Earth Dams

Discussion and Co-operation of Engineers Solicited to Make Investigation Cover Wide Range of Conditions

BY A. L. FELLOWS

Senior Irrigation Engineer, U. S. Department of Agriculture, Denver, Colo.

THE division of agricultural engineering, U. S. Bureau of Public Roads, co-operating with the U. S. Reclamation Service, is undertaking a detailed investigation of the underlying principles involved in the design and construction of earthen dams and embankments designed for the impounding of water for irrigation and other purposes, with a view to securing a larger measure of safety and efficiency in such works. Among the subjects to be investigated are the rates of flow and amounts of water percolating through such dams, the location of planes of saturation with reference to water levels in the reservoirs, the fluctuations of the planes of saturation, the effects of the saturated portion upon the stability of the dam and the need for drainage of the material forming the outer part of the embankment. Also included in the studies are the extent and effects of the hydrostatic pressures beneath dams, the construction, economic advantages and efficiency of core walls of different types upon the planes of saturation within the embankments.

Much of the available data bearing upon the subject has already been compiled and tentative plans for investigations, with specifications for work to be done, directions to observers and forms for records, have been prepared. The plans for making the further studies proposed at this time contemplate the selection of as large a number of earth dams as is practicable. These dams are to be of various types of construction, heights, materials, facings, cores and other details. Some will be selected which have cores of various kinds such as concrete, puddled or selected clay, gravel, etc., and others without cores will be chosen; similarly, dams with different types of facings will be studied.

The investigation may include the sinking of two types of wells in selected cross-sections, the number and locations of the wells depending upon local conditions. Generally speaking, the two types are to alternate in each section. One type will be sunk approximately three-fourths of the depth through the embankment, practically the entire length of the pipe being perforated; these wells should yield data regarding planes of saturation as related to the rise and fall of water in the reservoir. The other types would be sunk to the natural base of the dam, the pipe being open only at the lower end, and would be for the purpose of obtaining information bearing directly upon the hydrostatic pressure or uplifting force. Records of the water levels, both above and below the dams and in each well, are to be kept and regular reports made.

Obviously the most satisfactory results can be obtained only through the widest co-operation in the engineering profession generally. Any engineer having charge of the construction or operation of earth dams, and who realizes the importance of the subject, will doubtless be willing to assist to the best of his ability. With a view of gaining such aid it is proposed that this plan shall be widely published and discussed among those who may be interested, with the object of obtaining co-operation along the following lines:

1. Furnishing information as to any known data bearing upon the subject under consideration.
2. Suggesting dams where such investigations as those proposed may be made to advantage, or should be made with a view to the preservation of the dam.
3. Recommending such investigations to the owners of dams selected or suggested.
4. Requiring such studies to be made whenever the engineer has the authority and thinks it advisable, particularly in connection with the construction of any new dam.
5. Making such suggestions and raising such questions bearing upon the problems involved as may occur to him.

Supervision of the investigations has been delegated to the writer, from whom any further information desired regarding the matter may be obtained.

Water Consumption and Meters at Woonsocket

The per capita water consumption at Woonsocket, R. I., for the year 1921, according to the latest annual report of the Water Department, was 50.7 gal. per consumer and per inhabitant, it being assumed that the entire population of 49,327 on the pipe lines within and outside the city was supplied. Of the total consumption, 79.9 per cent was metered. The percentage of services metered was 98.

Speeding Up Traffic at Street Intersections

Slow Ups and Hold Ups at Intersecting Streets One of the Chief Causes of Automobile Traffic Congestion —Relief Measures Outlined—Traffic Survey a Prerequisite

By Herbert S. Swan
City Planner, New York City

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I. Why Street Intersections Are Congested

The relative congestion at different street intersections is exceedingly difficult to appraise, not only for the reason that different vehicles obstruct traffic in varying degrees but because their obstructiveness varies within a wide range under different conditions. Were the size, speed and flexibility of vehicles the only factors entering into their obstructiveness to traffic, then each type of vehicle, whether it were an automobile, a truck, a trolley car or a wagon, could be given a weight in proportion to its obstructing character. This would enable one to compute the volume of traffic in terms of obstructing units, thus reducing the traffic conditions at different street intersections to the same common denominator.

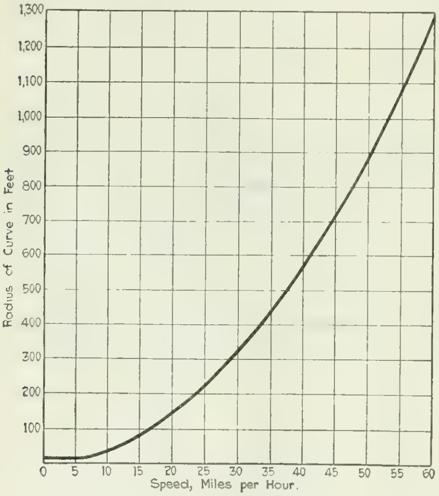


FIG. 1—MAXIMUM AUTOMOBILE SPEEDS ON CURVES

But the problem is far too complex to admit of any such ready solution, for the very same vehicle moving in a different direction or over a different path may either increase or decrease its obstructive character. Obviously, a vehicle paralleling the main line of travel obstructs traffic less than one cutting across it at right angles; a vehicle turning to the right retards movement less than one turning to the left; a vehicle making a slight turn holds back traffic less than one turning through a large angle; a vehicle crossing a narrow street occupies the space within the intersection a shorter time than one crossing a wide street.

Very obviously traffic is obstructed and delayed more at intersections than between intersections: (1) the number of vehicles in intersections exceeds that between intersections; (2) a turning vehicle requires more roadway space than a vehicle moving along a straight line; (3) a turning vehicle must proceed more slowly than a vehicle going directly ahead; (4) numerous conflicting routes are open to traffic at intersections; (5) a vehicle approaching an intersection must, to avoid collision with crossing vehicles, travel more slowly than when between intersections; and (6) cross traffic and through traffic must stop alternately to let the other pass.

1. *Number of Vehicles*—The number of vehicles passing through an intersection is the sum of those arriving from all directions. This is, of course, generally a much larger number than that passing over any of the streets entering the intersection. In the case of two intersecting streets having an equal amount of traffic, the volume within the intersection itself is double that at any point outside the intersection. Where three streets of like traffic intersect, the traffic volume at the intersection is approximately thrice that on any of the individual streets. The more streets that intersect, the greater, as a rule, is the traffic density at the intersection, the exact volume in any particular case varying in direct proportion to the number of intersecting streets where all the intersecting streets have an equal amount of traffic.

2. *Greater Space Required by Turning Vehicles*—A car turning a corner is always harder to keep in position than one moving straight ahead. The car itself, moreover, on account of the relative position of its front and rear wheels occupies more than its normal roadway width, the excess over normal width varying in proportion to the length of the vehicle and the sharpness of the turn. The width of the ordinary automobile is 5 ft. 9 in. Assuming that the body of the machine is 12 ft. long and that it turns on a 21-ft. radius, the width of path required by it in turning is increased to 7½ ft. Neighboring machines must also be taken into consideration; at intersections their path cannot be as acurately gauged and allowed for as between intersections. These factors all demand increased clearance at intersections, a clearance increasing in amount as the curved path diminishes in radius.

3. *Slower Speed of Turning Vehicles*—A turning vehicle must proceed more slowly than one travelling straight ahead. The maximum safe speed around corners depends entirely upon the radius of the turn.

The centrifugal force in turning cannot be allowed to exceed certain well-defined limits or passengers will suffer not only physical discomfort but be imperilled by the possible skidding or overturning of the machine. The outside safe speed with respect to both of these considerations is that in which the car is deflected at right angles from a straight course at the rate of 6 ft. per second per second. This gives rise to a centrifugal force equal to 18 per cent of the weight. A speed not exceeding this amount protects the passenger against an unpleasant nervous sensation. It also provides a factor of safety of about three against skidding on dry asphalt. The safe speed of the machine under these conditions varies as the square root of the radius of the curve in which it turns. Fig. 1 shows the maximum safe speed around curves according to this rule.

(The formula for ascertaining the safe speed of a car around a corner is $V = 1.67\sqrt{R}$, where V is the speed in miles per hour and R the radius of the curve in feet to the center of the machine.)

The minimum turning radius of the average car as measured along the center line of the machine is 21 ft. The maximum safe speed for that radius is 7.7 miles per hour. Only as the radius exceeds this amount can the traffic turning at intersections safely attain a greater speed. Most cars turn in a radius of from 17 to 27 ft. Most curb radii are, however, only 6 ft. or even less. They rarely exceed 12 ft. The consequence is, of course, that cars in turning corners cannot keep close to the curb.

4. *Conflicting Routes*—Between intersections there are but two ways open to traffic, it must move either one direction or the other, but at intersections it has a choice of several different routes, the exact number varying with the number of roadways entering the intersection. Thus where three roadways enter an intersections there are six separate and distinct routes open to vehicles. Where four roadways enter an intersection the number of routes is increased to twelve; where five roadways enter to twenty. The presence of so many routes which frequently conflict with one another naturally necessitates not only greater caution but slower movement on the part of traffic.

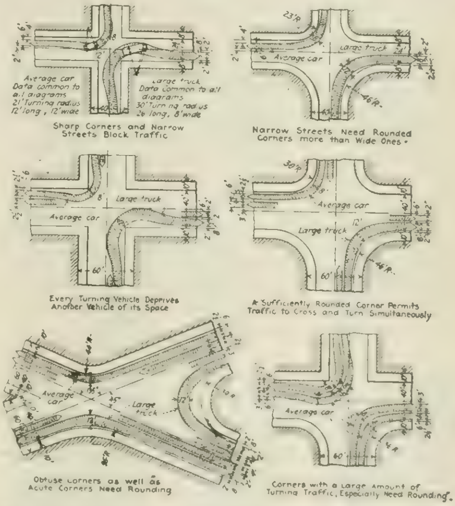
5. *Slower Speed of Crossing Vehicles*—All vehicles upon approaching an intersection, even though they do not turn, must, to avoid collision with vehicles entering from other directions, travel more slowly than when between intersections. It is also often necessary for them to stop to give conflicting traffic the right of way. Vehicles entering an intersection of right-angled streets 40 ft. wide can run only 14.7 miles an hour if they are to stop in time to avoid collision with vehicles approaching the intersection behind obstructing buildings. If the two intersecting streets are 50 ft. wide, the speed may be increased to 17 miles an hour; if 60 ft., to 17.5 miles an hour; and if 80 ft., to 20 miles an hour.

When a vehicle turns at an intersection, even if it does so without any diminution in speed, it does not travel as fast in the direction of its previous course as before turning—and its curved path naturally hinders machines in back of it. When a machine in negotiating a turn slows down, the hindrance to traffic until the traffic line is entirely cleared is, of course, still greater. A turning machine obstructs not only its own traffic line but also all the traffic lines it must cross. If it turns to the right, and it does not happen to be near the curb when it turns, it obstructs all the traffic lines between its own line and the curb; if it turns to the left, and it does not happen to be near the center of the roadway when it turns, it obstructs all the traffic lines between its own line and the center of the roadway as well as the traffic lines on the street moving in a direction opposite to its own.

6. *Alternate Stopping of Cross and Through Traffic*—Vehicles are able to filter through intersections with very little traffic with only occasional stops to avoid conflicting traffic, but as traffic increases, the streets entering an intersection must be opened and closed to traffic alternately or dangerous jams will result. Where the traffic on two intersecting streets of the same width is about equal, each street will be closed approximately one half of the time. Where the traffic on two intersecting streets is equal but the width of one is twice as wide as that of the other, the narrow street will require nearly twice the time of the wide one to pass its traffic. In that case the narrow street will be closed one-third of the time and the wide street two-thirds of the time. The longer a street is closed to traffic, the less traffic will it accommodate.

Table I shows the per cent of time that a narrow street crossing a wide street is open to traffic under different conditions. Quite obviously the acuteness of the traffic problem at intersections varies with the relative width and traffic volumes of the intersecting streets.

The quantities given in the table show the per cent of time required to pass traffic on the narrow street when its traffic and width in proportion to the traffic and width of the wide street are as stated. Thus, for a narrow street, 50 per cent of the width of the wide street, but carrying 200 per cent of the traffic of the wide street, the narrow street would be open 74 per cent of the time and the wide street 26 per cent of the time. If the narrow street is open 44 seconds the wide street would be open 16 seconds. The tabular quantities vary slightly according to the absolute intensity of traffic and the width of streets. Mean values were assumed for these quantities in the computation of the table.



Sharp Corners and Narrow Streets Block Traffic

Narrow Streets Need Rounded Corners more than Wide Ones.

Every Turning Vehicle Deprives Another Vehicle of its Space

A Sufficiently Rounded Corner Permits Traffic to Cross and Turn Simultaneously

Obtuse Corners as well as Acute Corners Need Rounding

Corners with a Large Amount of Turning Traffic, Especially Need Rounding.

FIG. 2—ROUNDED CORNERS RELIEVE CONGESTION

Deceleration upon approaching an intersection means diminished speed upon leaving the intersection; normal speed after leaving the intersection cannot be recovered until sufficient time has elapsed for necessary acceleration. Where intersections occur with great frequency, the intervals between acceleration and deceleration are so brief as not only to effect a considerable reduction in average speed but also in maximum speed. In fact, the maximum speed between intersections, is in many cities on account of the frequent intersections, no greater than and sometimes not as great as the safe speed in approaching intersections.

7. *Right-hand Turns*—The speed at which machines can turn corners depends upon several factors: width of the intersecting streets; whether or not a corner is rounded off and the extent to which it is rounded off:

whether the turn is to the right or to the left; and the distance the machine is travelling from the curb.

How closely a car can keep to the curb and avoid interference with other lines of traffic in turning depends upon its turning radius. A car with a short turning radius can obviously keep nearer the curb and avoid interference with other lines of traffic better than one with a long turning radius. Many machines, especially the bigger one, with large turning radii, experience great difficulty in making right-hand turns without encroaching upon the left-hand side of the roadway. Particularly on the narrower streets it is no uncommon occurrence for machines to swing almost over to the left-hand side before turning to the right. Sometimes this swing to the left is carried out within the intersection itself in a manner to block the intersection from all directions. Right-hand turns executed in this manner are more embarrassing to traffic than those to the left. The vehicle unit nearest the curb can turn to the right about equally well on all streets, irrespective of width—the greater clearance on the narrower streets balances the greater curb radius on the wider streets.

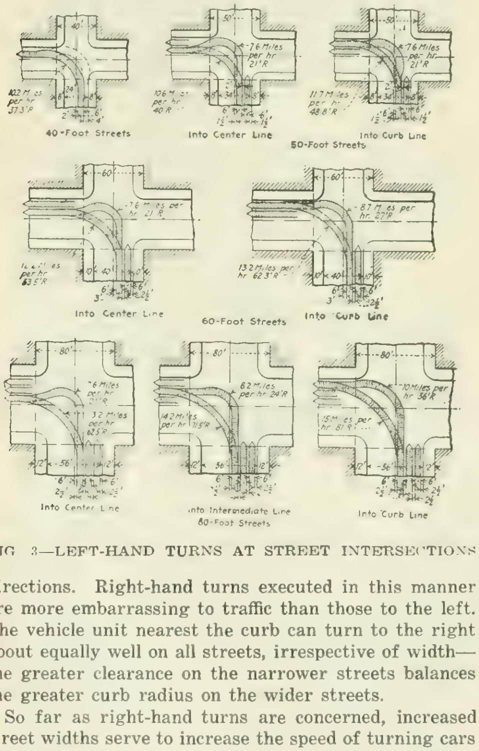


FIG 3—LEFT-HAND TURNS AT STREET INTERSECTIONS

So far as right-hand turns are concerned, increased street widths serve to increase the speed of turning cars only as they turn near the center of the roadway. To avoid interference with other lines of traffic, however, they should turn as near to the curb as practicable. With curbs rounded by a radius equal to the least sidewalk width cars can generally make the turn without encroaching on other traffic lines, but the margin of clearance is quite small. The safe speed of the traffic unit next to the curb in turning is about eight miles an hour, that of the second traffic unit from the curb nine miles, and that of the third traffic unit from the curb ten miles.

Fig. 4 shows the vehicular paths taken by right-hand turns at intersections on the assumption (1) that machines maintain the same clearance around the turn as they do upon the main highway stem, and (2) that they make the sharpest turn possible within their turning radius but in such a manner as not to transgress the centers of the two intersecting streets unless absolutely necessary. The first column of diagrams to the left shows the vehicular paths with unrounded curbs; the second from the left, curbs rounded with a radius of 6 ft.; the third from the left, curbs rounded with a radius equal to the least sidewalk width; and the fourth from the left, curbs rounded with a 20-ft. radius.

8. *Left-hand turns*—In making a left-hand turn a car travelling near the curb has the greatest turning radius. It can, therefore, move with greater speed than a car near the center of the roadway but its longer path more than offsets its increased speed.

When a car, in making a left-hand turn, has to go around a central point, turning radii and safe speeds on streets of different widths are the same as with turns to the right around a sharp corner. Left-hand turns around a central standard are in fact sharper and more difficult to negotiate than right-hand turns around rounded curbs.

On a 40-ft. street, a machine cannot make a left-hand turn without venturing on the opposite side of the roadway. In the case of a 60-ft. street only one of the two traffic units accommodated can turn to the left; either the inside unit must halt while the outside unit turns, or the outside unit must come to a standstill while the inside unit turns—there isn't sufficient room for both of the units to turn at the same time. On 80-ft. streets only two of the three traffic units can turn at the same time.

Fig. 3 shows the vehicular paths taken by the center traffic line on streets of different widths when it transgresses not at all or as little as possible the space and clearances reserved for other traffic lines moving in the same direction. One path is shown with the maximum radius possible under the above conditions when the vehicle passes around a standard in the center of the intersection; the other path is shown with the maximum radius possible, also subject to the above conditions when the vehicle passes around standards in the center of the street upon entering and leaving the intersection but with the privilege of cutting across the center of the intersection itself. When a street has room for two or more traffic lines, the turning vehicle, though always shown in the center traffic line upon approaching the intersection, is shown after having completed the turn as leaving by each of the respective traffic lines.

II. How to Relieve Congestion at Intersections

Relief to intersections may be afforded in various ways:

1. Curb corners may be rounded off with greater radii.
2. Corners may be cut off and additional land included within intersections.
3. Building lines may be established to keep buildings back of street lines.
4. Streets may be splayed out near intersections.
5. Vehicular paths around corners may be marked upon pavements.
6. Parking may be prohibited near intersections.
7. Standards may be erected to guide traffic.
8. Traffic may be re-routed.
9. One-way streets may be established and left-hand turns prohibited.
10. Cross streets may be opened and closed synchronously.
11. Fast and slow traffic may be separated.
12. Grades of intersecting streets may be separated.

1. *Rounded Curbs*—A rounding off of curb corners with greater radii not only facilitates the movement of turning vehicles but increases their safe speed around corners. So far as the convenience of traffic is concerned the curb should be turned with a radius that will permit a car with the maximum turning radius to follow the curb. To employ such a large curb radius would, however, require the taking of property at street corners. If the street intersection itself is not to be enlarged and additional area included within the street lines, the best curb radius that can generally be used in right-angle crossings is one equal to the least sidewalk width at the intersection. This is the largest radius compatible with retaining a uniform sidewalk width around the corner while retaining existing street lines.

TABLE I—RELATIVE TRAFFIC INTERVALS AT STREET INTERSECTIONS

Width of Narrow St. In % of Wide St.	—Traffic on narrow street in percent of traffic on wide street— 10	25	50	75	100	200	300	400	500	1,000
	—Percent of time narrow street is open to traffic—									
40	36	47	58	65	71	78	84	85	86	89
50	34	43	54	61	65	74	79	81	82	86
60	32	41	50	57	61	71	75	78	79	83
70	31	38	47	54	58	67	72	75	76	80
80	30	37	45	51	55	64	69	72	74	78
90	29	35	43	48	52	61	66	69	71	75
100	28	34	41	46	50	59	64	66	68	72

2. *Cutoff Corners*—Cutting off the corners and including additional land within the intersection affords not only greater turning radii to machines but greater visibility of approaching traffic. Both result in additional speed without diminishing the relative safety. As machines need more clearance in rounding curves than in moving along straight lines, cutting off corners even by a moderate amount will greatly facilitate traffic at intersections where many turns are made. They not only increase the safe speed of approach to the intersection but increase the safe speed with which the corners of the intersection may be turned. A cutting off of corners is, as one would naturally expect, of much greater importance to intersecting streets of a narrow width than to streets of a great width. The speeds possible around cutoff corners on streets of different widths, allowing vehicles ample time to stop without colliding, are indicated in Table III.

3. *Building Lines*—Building lines may be established 10, 20, 30 or more feet back of the property lines which will increase the amenities of residence sections by affording planting strips, as well as augment the safety of streets for fast traffic. The setting back of building lines affords a longer view of traffic approaching an intersection. This enables all traffic crossing the intersection to travel faster without any diminution in relative safety. Cutoff corners have a marked effect in enlarging the angle of vision at an intersection but the setting back of building lines has a still more marked effect. Indeed a building line setback, when observed on both streets, need be only half as great as a cutoff to afford the same visibility. In other words a building line setback of 10 ft. on both streets is equivalent to a 20-ft. cutoff. The speed at which two machines approaching an intersection at right angles may safely travel and yet have time to stop without colliding is indicated for streets of different widths and different setbacks in Table IV.

4. *Splaying Out of Streets Near Intersections*—The width of streets may be splayed out at intersections to provide reservoir space for vehicles waiting to cross the intersection. Such an enlargement of streets will enable a greater number of vehicles to cross the intersection in a given time, lessen the time cross traffic is stopped and afford more room for turning vehicles. An inexpensive way of adding to the vehicular traffic capacity of an intersection is by widening the roadway near an intersection at the expense of the sidewalk.

5. *Markers on Pavement*—The different paths to be taken by vehicles through the intersection may be marked upon the pavement so that the different lines of traffic will not interfere with one another.

6. *Prohibition of Parking*—Prohibition of all parking within a distance, say 100 ft., of the intersection is desirable. Parked vehicles at each curb occupy nearly the same space as is required by two moving vehicles. The provision of a broad front for waiting traffic enables it to cross in the minimum time when the street is open.

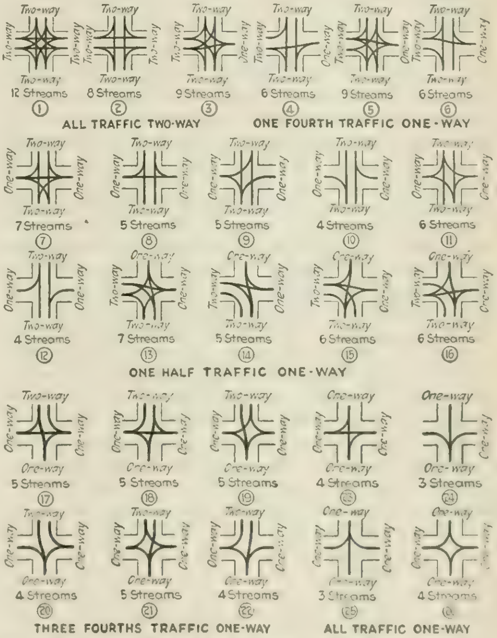


FIG. 4—TWENTY-SIX WAYS OF UNTANGLING TRAFFIC AT STREET INTERSECTIONS

7. *Standards*—Standards should be erected immediately before and after the intersection is reached instead of at the center for left-hand turns. It is quite evident that the necessity of rounding a central standard may result in an appreciable diminution in the traffic capacity of an intersection. This difficulty can, however, be obviated without any lessening of control over traffic by requiring it, in lieu of rounding a central standard, to round standards immediately before entering and after leaving the intersection. The rounding of standards outside of the intersection, moreover, permits the negotiation of turns with greater radii than does the rounding of a central standard, and greater radii are, of course, accompanied with corresponding increases in the speed permissible without any sacrifice in relative safety.

8. *Re-routing of Traffic*—Often much traffic turns or crosses where a more direct way to its destination would

TABLE II—SAFE SPEED IN TURNING AT INTERSECTIONS

Right angled intersections. Sidewalks one-fifth street width. Curb turned with radius equal to sidewalk width. One traffic unit in each direction on 40 and 50-ft. streets; 2 on 60-ft. streets; and 3 on 80-ft. streets.

Width of Street in Feet	40	50	60	80
Miles per hour: (*a*) Right-Hand Turns				
Free to occupy any part of roadway	13.6	15.8	17.6	20.9
Keep within one-half of street moving near center	8.5	10.3	11.8	14.4
Center of own side and 1 ft. clearance of corner:				
Right unit	6.2	8.5	8.0	8.1
Intermediate unit				9.3
Left unit	....	....	9.3	10.3
Miles per Hour: (*b*) Left-Hand Turns				
Free to occupy any part of street and not round center	13.6	15.8	17.6	20.9
Keep within own half of street and round center	7.0	8.8	10.3	12.8
Center of own side and 1 ft. clearance of center:				
Right unit	....	....	....	10.1
Intermediate unit				9.1
Left unit				
Center of own side, clearance at center not required but leaving room for right-hand turns:				
Right unit	9.3	10.7	11.4	13.1
Intermediate unit				12.2
Left unit			10.4	11.4

avoid the intersection entirely. Existing competing routes should be properly paved so as to attract traffic and where found imperative new thoroughfares should be laid out to divert traffic that can better be taken care of by new routes. Crossing traffic in general should greatly exceed turning traffic, for the crossing streets presumably lead in the directions traffic desires to take.

9. *One-way Streets and Prohibition of Left-Hand Turns*—The establishment of one-way streets and the abandonment of left-hand turns reduces the number of traffic streams flowing through an intersection. This makes the movement of vehicles more orderly. It also reduces congestion. The reduced number of traffic lines where left-hand turns are prohibited or where traffic is routed through the streets one way is shown for different conditions in Fig. 4.

Left-hand turns are particularly obstructive to main traffic as all vehicles making this turn have to cross all traffic coming from the opposite direction and do so while the roadway would otherwise be open for that traffic. No left-hand turns should be eliminated without adequate arrangements first being made for taking care of the additional traffic that will fall upon other intersections.

10. *Synchronized Opening and Closing of Cross Streets*—With one master street controlling the synchronized opening and closing of all cross streets, the main street may be opened from end to end at one time so that traffic may proceed at normal speed for a considerable distance without interruption.

11. *Separation of Fast and Slow Traffic*—Probably nothing retards the free movement of traffic more than intermingling of fast and slow vehicles. The speed of the slowest vehicle tends to become the speed of all the vehicles using a street. The fast vehicle cannot, of course, travel any faster than the slow vehicle in front of it. Promiscuously mixed traffic invariably results in congestion. A separation of fast and slow vehicles is absolutely essential to a mobile condition of traffic at crowded street intersections.

TABLE III—HOW CUTOFFS INCREASE THE SAFE SPEED IN TURNING CORNERS

Right-angled intersections. Sidewalks one-fifth street width. Curb turned with radius equal to sidewalk width. One traffic unit in each direction on 40-ft. streets; 2 on 50-and 60-ft. streets; and 3 on 80-ft. streets. The figures in miles per hour are for the traffic line nearest to the curb.

	Width of Street in Feet			
Amount of Cut-Off Measured Back on Each Street Line	40	50	60	80
Miles per Hour: (*a*) Right-Hand Turns.				
0	6.2	8.5	8.0	8.1
10	9.0	10.0	9.6	9.7
20	10.4	11.3	10.9	11.0
50	13.9	14.6	14.3	14.4
Miles per Hour: (*b*) Left-Hand Turns				
0	9.3	10.7	10.4	11.4
10	10.7	11.9	11.7	12.5
20	11.9	13.0	12.8	13.6
50	15.0	15.9	15.7	16.4

12. *Separation of Grades*—A separation of street grades in eliminating all cross traffic, of course, opens each intersecting street in its entirety to through traffic. Being open all of the time naturally enlarges the traffic capacity of both streets enormously—sometimes several hundred per cent. No stop need be made for cross traffic, and very little reduction need be made in the speed in passing over or under intersecting streets. Indeed, except for the caution required to avoid collision with turning vehicles, all limitations upon the safe speed of approaching intersections are removed.

The Traffic Survey—What should or should not be done to relieve congestion at a particular intersection can be determined only after a careful survey of all the factors affecting its traffic. This survey should include an examination of the physical design of the intersection itself as well as a painstaking analysis of the character and distribution of the traffic in the intersection.

TABLE IV—HOW BUILDING LINES INCREASE THE SAFE SPEED OF CROSSING INTERSECTIONS

	Width of Intersection Streets in Feet										
	40	50		60		80			100		
Setback, Ft.‡		Inside Line*	Outside Line†	Inside Line*	Outside Line†	Inside Line*	Intermediate Line‡	Outside Line†	Inside Line*	Intermediate Line‡	Outside Line†
Miles per Hour: (*a*) Buildings Set Back on One Street Only											
0	14.7	15.2	16.1	17.4	19.1	19.7	21.2	22.7	23.1	24.5	25.7
10	17.0	19.5	19.1	19.4	21.0	21.5	22.9	24.2	24.7	25.9	27.1
20	19.1	19.5	20.9	21.2	22.7	23.1	24.5	25.7	26.2	27.3	28.4
30	20.9	21.3	21.8	22.9	24.2	24.7	25.9	27.1	27.6	28.7	29.7
40	22.7	23.0	24.2	24.5	25.7	26.2	27.3	28.4	28.9	30.0	31.0
Miles per Hour: (*b*) Buildings Set Back on Both Streets											
0	14.7	15.2	16.1	17.4	19.1	19.7	21.2	22.7	23.1	24.5	25.7
10	19.1	19.5	20.9	21.2	22.7	23.1	24.5	25.7	26.2	27.3	28.4
20	22.7	23.0	24.2	24.5	25.7	26.2	27.3	28.4	28.9	30.0	31.0
30	25.7	26.0	27.1	27.3	28.5	28.9	30.0	31.0	31.3	32.3	33.3
40	28.5	28.7	29.7	29.9	31.0	31.3	32.3	33.3	33.6	34.5	35.4

* Inside Line: Vehicle approaching intersection on curb traffic line and cutting nearest line of cross traffic from the right or approaching on center traffic line and cutting nearest line of cross traffic from the left.

† Outside Line: Vehicle approaching intersection on center traffic line and cutting nearest line of cross traffic from the right or approaching on curb traffic line and cutting nearest line of cross traffic.

‡ Intermediate Line: Vehicle approaching intersection on intermediate traffic line and cutting nearest line of cross traffic from the right or nearest line of cross traffic from the left.

The particular subjects that would have to be studied and the relative importance of each would, of course, differ for different intersections. Among the matters which should be considered are the following:

A. Design of the intersection: (1) Angles of intersecting streets. (2) Width of entering streets. (3) Roadway and sidewalk widths. (4) Curb radii. (5) Physical obstructions in streets, such as trolley tracks, center standards, street lamps, parking strips, shrubbery, etc. (6) Grades. (7) Improvements on property surrounding intersection. (8) Pavements, kind and condition. (9) Roadway crown.

B. Character and distribution of traffic at the intersections: (1) Amount of traffic entering and leaving by several approaches to intersection. (2) Volume of through traffic, cross traffic, right and left-hand turns. (3) Traffic density during maximum period. (4) Origin and destination of traffic. (5) Number and duration of periods street is open and closed to traffic from several directions. (6) Speed of several kinds of traffic. (7) Turning radius of vehicles making right and left-hand turns. (8) Present traffic regulations. (9) Possible improvements in traffic regulations. (10) Comparative maximum traffic volumes under present and improved traffic regulations.

Recent British Concrete Road Practice

Two Courses of Different Mixtures Placed at Once —Surfaces Coated with Tar, Sprinkled with Stone Chips

By Major Johnstone-Taylor
Shrewsbury, England

MUCH attention is being paid in Great Britain to the use of reinforced concrete in connection with an extensive program of road construction. New roads are an urgent necessity, especially on the outskirts of the big cities, because new work was entirely suspended during the war period. At the same time the unemployment problem has been the means of local authorities getting substantial government assistance to cover part of the cost of big works, the most extensive of which is the new Liverpool-Manchester road which will be some 27 miles in length and cost several million pounds sterling, besides employing some 20,000 men for a considerable period.

London Road—The first section of this new route to the west is being built of reinforced concrete, is 7½ miles long and is 100 ft. wide between fences. There are two 16-ft. carriage ways. The reinforced slab has a total thickness of 8 in. of which the lower 5 in. is a 1:2½:5 and the remainder a 1:1:3, mixture.

The reinforcement is of a special kind, known as the Walker-Weston, consisting of a double-layer framework 5 in. deep made up of $\frac{3}{16}$-in. top and bottom bars with No. 6 s.w.g. annealed mild steel bars which connect the two layers, the total amount of steel used per super yard being 10 lb. and its price laid about 89c.

The concrete, which is machine mixed, is deposited to the full depth, leveled and consolidated by a petrol-driven mechanism tamper which is fitted with a cambered screeding beam followed by a cambered tamping beam giving a three-ton blow. After being laid the concrete is covered three weeks with damp soil kept moist and then finally is tarred and gritted. It is interesting to note that no expansion joints are provided.

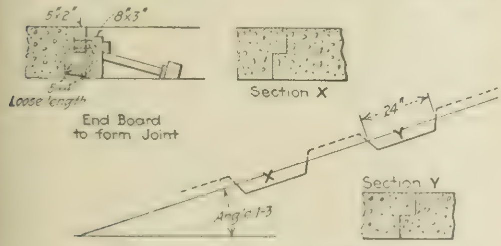


FIG. 1—PAVEMENT JOINT CONSTRUCTION

New System of Construction—The Walker-Weston Co., which, it was stated were responsible for the reinforcement of the London road, have introduced a new system of construction which adopts the principle of laying the concrete in alternate bays, allowing one set to contract before working on the other, while special forms are used to ensure that the edges of the bays are truly vertical. Thus in place of say 1 in. contraction in every day's work of 100 ft. there are straight joints $\frac{1}{16}$ in. wide, which, while acting as expansion joints will be covered by the tarred surface. Moreover, in place of laying the bays square with the curb they are laid at an angle so that at no time will a joint have more than one wheel of a heavy axle upon it. In addition to the edges being accurately vertical they are also locked so that the load at all times will be borne by two slabs in place of one. Details of the plan are given in Fig. 1.

This system provides for the whole depth of the concrete being laid at once so as to insure that the laitance scum will only form on top and from where it is carefully removed before tarring is attempted. Of course the laying of, say 49 ft. width of road in alternate bays provides no easy construction problem, but it has been satisfactorily solved by the use of a special form of cableway crane which spans the track and also provides for covering it in wet weather so that work can go on continuously. The crane runs on temporary tracks.

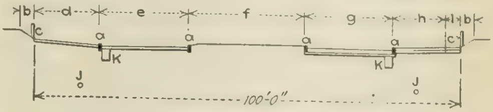


FIG. 2—CROSS-SECTION OF MANCHESTER ROADS

a, Concrete curbs 12 x 8 in. on 2½-in. concrete; b, slopes 45 deg.; c, reinforced concrete fence posts; d, 16-ft. section covered with 3-in. cinders; e, 20-ft. section covered with 6 in. cinders; f, space for street car tracks 28 ft. wide; g, finished road 20 ft. wide; h, footway 2½ in. artificial flags on ½ in. of sand on 3 in. of cinders; j, drains 11½ in. wide; k, catchpits; and l, 3 in. of gravel on 3 in. of cinders, 4 ft. 4 in. wide.

Manchester Roads—Strictly speaking these are not reinforced concrete roads, reinforcement only being used in the case of bad foundations and on embankments of which there are several owing to the network of railroads to be traversed. Reinforcement is also used over cross trenches of gas, water and electric mains.

The general section of these roads is shown in Fig. 2. Provided the foundation is capable of supporting 1½ to 2 tons per square foot, the carriage way is constructed as follows: Three inches of ashes or clinker are rolled and consolidated on the natural foundation, and after well watering the concrete is laid on this bed, one layer of 5 in. of 1:2½:5 and the other 2 in. of 1:1:2. The stone for the bottom course is good hard stone gotten locally and varying from 1½ in. to ¦ in. gage, but that for the top course is granite ¾ in. to ¼ in. gage and granite grit is used in place of sand. The alternate bay system was adopted, each bay being 14 ft. long and those placed first being allowed 14 days to set before the others were commenced. Each bay was completed without cessation of work and the top and bottom courses completed practically simultaneously, the upper surface being finished off with a wooden templet to a cross fall of 1 on 60, no trowelling being permitted.

The embankments, which owing to the urgency of the work, have not had time to consolidate thoroughly, are watered and rolled and the reinforced concrete laid on a well rolled foundation of ashes the depth of the concrete being 9 in.; otherwise the construction is similar to the rest of the work. As regards reinforcement, 1 in. of concrete is first laid and on this is placed the reinforcement which is 6 in. in depth and then concrete worked into the reinforcement to cover it to a depth of 2 in.

The concrete is of the same proportions and sizes as used on the other portion of the work but granite and granite dust are exclusively used. One length of the road passes over a mile of peat bog which, after 18 in. of excavation below formation level, is filled in with ashes and clinker rolled and filled up again as sinkage takes place. In most cases a weight of 2 tons per square foot could be supported after repeated fillings and rolling but in some cases wattle hurdles are necessary to assist the consolidation. Over this bog the concrete is 12 in. thick and the reinforcement is 9 in. deep, while the carriage way extends 30 in. beyond the curb for support to vehicles running near the roadside.

Protective Coatings—On the Manchester roads ordinary tar spraying has been tried and it has not been a success. It is now generally conceded, as far as conditions in Britain are concerned, that, in order to make concrete roads a complete success it is absolutely essential that some thin, strongly-adhesive coating cover the concrete surface and that it should be easy, cheap and quick to renew.

Covering is considered necessary in order to remove glare in the strong sun, act as a waterproof coat, give foothold for horses, and act as a buffer to iron tired vehicles.

Neither tar nor asphalt will adhere to a concrete surface unless the laitance scum is removed as the concrete is completed. This scum merely turns to fine dust and acts as would French chalk. Some experiments have been made and as a result it is recommended that the top surface shall be finished with larger aggregate than used, and the laitance scum washed off the day after setting. A rough pock-marked surface will result. The traffic is allowed to go over this for a week or so after which it is tar sprayed and sprinkled with granite chips. This has been found to provide a waterproof non-slipping surface in every way comparable with the best tar macadam, which it may be remarked is an unqualified success in Britain.

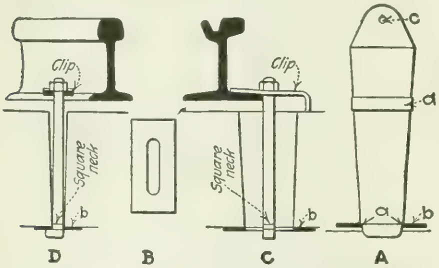


FIG. 3—ATTACHING STREET RAILWAY TRACKS TO SLAB

Fixing Street Car Tracks—These concrete roads which are being made in Britain are, as stated, located for the most part on the outskirts of the big cities and the question of fixing street car rails had to be given consideration. It was no easy matter to find a satisfactory solution of the problem but the arrangement shown in Fig. 3 has been found a good method. After the formation has been leveled off and the usual interlocked double layer of reinforcement placed in position the approximate position of the rails is marked out and on these lines wooden templets are fixed (Fig. 3 *A*) having a rabbeted end at *a* and a thin metal base *b*. When sufficient of these are set up the concrete is leveled up to the underside of band *d*, the top edge of this band being at the exact level of the underside of the rails to be put down.

The templets are then eased when the concrete has part set and removed when it is hard. This leaves holes in the shape of Fig. 3 *B* with the thin metal base *b* left behind. The rails are now packed up on the hard concrete and square neck bolts dropped into the holes as shown in views *C* and *D*. These bolts are then pushed down below the metal plate, given a half turn so that the neck fits in the slot of the plate allowing the nut to be tightened up without the bolt turning. The rail is then fixed by the slip shown.

As the nuts are screwed down the rails are tightened up against the packing pieces, the bolt holes are filled up with sand and concreting is resumed. No great accuracy is required in fixing the templets but the rod connecting them and passing through *c* (view *A*) must be carefully adjusted to rail level so that the grouting space under the rail will be uniform and a uniform length of bolt can be used. It will be noted that as lewis bolts are not used the rails can be renewed without renewing the bolts as the bolt holes are filled with sand only. It is usual of course to complete the road surface between the tracks and for 12 in. each side with granite setts run with tar so that when the tracks are renewed the concrete is undisturbed.

For and Against the Am. Soc. C. E. Joining the Federation

Abstract of the Opposing Views Prepared Each by Three Members of the Board of Direction to Accompany Referendum

Under date of Feb. 15, the American Society of Civil Engineers issued to its members ballots to be canvassed April 6, as to whether the society shall affiliate with the Federated American Engineering Societies. Accompanying the ballots are the arguments in favor of and opposed to the proposal, these having been prepared by two committees of the Board of Directors appointed for the purpose. For the information of those to whom copies of these arguments may not be available the following abstract of the major points is offered.

Arguments in Favor—Herbert Hoover endorses the F.A.E.S. and expresses the opinion that the Am.Soc.C.E. should join. The history of the federation movement shows that the several conferences and bodies that considered the subject all expressed a desire for a single comprehensive organization to effect engineering unity. The purpose of the F.A.E.S. is fundamentally sound and is approved by many who oppose it on other grounds. It is not a super-society and was organized to overcome the defects of Engineering Council, which was not sufficiently democratic or representative and was inadequately financed.

F.A.E.S. is representative and democratic. Engineering Council had only six member-societies and represented an aggregate membership of about 40,000, whereas the F.A.E.S. has twenty-eight member societies representing a total of nearly 50,000. If the Am.Soc.C.E. should join, this would be increased to 60,000. Two member-societies have been added and a third has voted to join. Three have withdrawn temporarily because of financial conditions. F.A.E.S. has increased in the membership of member-societies from 41,932 in 1921 to 49,587 on Feb. 1, 1923. The organization is representative, the Societies having in the council one member for each 1,000 members or major fraction thereof, with a minimum of one for each member-society. Of the 64 members of the council, many who represent local societies are members of one or more founder societies, so that the latter are represented by 79 memberships on the council. The executive board of the council consists of 6 officers and 24 members of whom 30 per cent are members of the Am.Soc.C.E. In the council 32 per cent are members of the Am.Soc.C.E.

Greater solidarity for the profession is obtained through F.A.E.S. than was possible through Engineering Council because the headquarters of the member-societies are distributed throughout the country in 24 cities. Membership in F.A.E.S. is voluntary and may be terminated at three months' notice. The Am.Soc.C.E. cannot be committed to membership for more than a year at a time. The organization is economically administered and its budget is not extravagant as compared with that of the former Engineering Council. F.A.E.S. does not undertake technical work within the purview of a founder society and does not undertake to give engineering advice without charge, as has been alleged.

A canvass of the local sections of the Am.Soc.C.E. during 1922 showed 16 sections in favor of joining the F.A.E.S. and 10 opposed, with 4 sections in favor when the finances of the society should permit. The 1923 budget of the Am.Soc.C.E. provides for an increased allotment to local sections from $1 to $2 per member, new allowance for technical divisions of $4,000, allotment to technical committees of $10,000 as against an expenditure of $4,023.51 during 1922, and dues for nine months membership in the F.A.E.S. amounting to $7,800; after which remains an unappropriated surplus of $653. The votes of the Board of Direction on Oct. 3, 1922, and on Jan. 16, 1923, sympathetic to joining the F.A.E.S. showed that all the affirmative votes were cast by directors representing other than District 1, and that in each case only one negative vote was cast by a director residing west of District 1. More than 70 per cent of the members in attendance at the annual meeting in January 1923 were residents of District 1.

A ballot canvassed in April 1920 showed a vote of three to one in favor of the Am.Soc.C.E. "becoming an active national force in economic, industrial and civic affairs" and "actively co-operating with other engineering and allied technical associations in promoting the welfare of the engineering profession." The society co-operated in creating Engineering Council to carry on similar activities and F.A.E.S. succeeded to these. If the Am.Soc.C.E. were in the F.A.E.S. a greater percentage of the council would be of its membership than was the case with Engineering Council.

Every engineer is obligated to the advancement of his profession, particularly in its service to the public. The Am.Soc.C.E. cannot hold aloof from joint activities of other engineering societies and be effective any more than a state could co-operate with the government of the United States without being in the Union. No more would it lose any of its individuality or prestige by reason of membership. In the settlement along right lines of certain national economic problems, as for example, transportation, reforestation, and the reduction in the cost of living, the viewpoint of engineers can be more helpful to the government than that of any other group of citizens. There is general agreement among engineers that a council of American Engineers is desirable. F.A.E.S. is designed to be responsive to its member-societies. The member-societies would gladly co-operate to make it even more so. The purpose being sound, the machinery may be changed from time to time to meet the needs of the member-societies. F.A.E.S. now has a committee engaged in revising its constitution and by-laws; if the Am.Soc.C.E. were in, it could mold these to the plan it thinks desirable. If the name "Engineering Council" is thought to be more desirable the change doubtless can be accomplished.

Arguments Against—There has been no change in conditions to justify a reversal of the 1920 verdict of the Am.Soc.C.E. by which it voted 3,278 to 2,330 and 13 districts to 9 against the proposal. The Am.Soc.C.E. is the only founder society that submitted the question to referendum. Participation by the society in the F.A.E.S. would be in violation of its cardinal principle that engineering prestige must rest on professional attainment and standing, for which no qualifications are prescribed for membership in the F.A.E.S.

The Am.Soc.C.E. is willing to co-operate to advance the profession and the public welfare but is unwilling to surrender its name or reputation for exploitation by any organization not within its control or responsive to its judgment. To join the F.A.E.S. would mean the delegation to an outside body, in which it would have an insignificant voice, of the right to speak on behalf of its members without respect for their views on any particular issue. Representation in the federation is inequitable, in that each society of more than 100 members is entitled to a vote whereas the national society of large membership and high standards is limited to one vote for each 1,000 members. The fact that representatives of local societies may be members of the national society does not alter this condition for no man, true to his trust, can represent more than one organization.

It has been demonstrated that the F.A.E.S. is not responsive, that the national societies have no control over its actions and that its management is tending toward the establishment of a super-society designed to control the public relations and policies of its constituent societies. The secretary has stated that no changes in organization are contemplated. If the Am.Soc.C.E. should join the F.A.E.S. by referendum it would require another to withdraw, whereas the other national societies are in by vote of their governing bodies only and can withdraw in like manner.

The record of the F.A.E.S. does not inspire confidence in its organization or management. While it has co-operated in a number of enterprises it is believed that the net results of its efforts have been exaggerated, that they could have been attained by joint committees of existing societies and that they have not been commensurate with their cost. Its legislative activities at Washington have been of questionable value. Although professing to speak for the engineers of the country it is not subject to referendum as are responsive federations, and there is danger of its becoming an instrument of propaganda susceptible to exploitation at the hands of a few. The publicity of the F.A.E.S. is of questionable value to the profession and there is danger that this too may lead to unworthy exploitation of the organization. The employment service inherited by the F.A.E.S. from Engineering Council was soon turned back to the founder societies.

Dissatisfaction has developed within the F.A.E.S. on the ground that the member societies have too little voice in the management and that there is a tendency toward the formation of a super-society. Although 66 societies were represented at the organization conference less than one-half joined. Last October two-thirds of the 27 member societies were in arrears for dues. Since then the Baltimore Engineers' club has withdrawn and others are reported to be on the point of doing so. The American Institute of Mining and Metallurgical Engineers has given notice of withdrawal and is being kept in the F.A.E.S. by private subscription. The Boston Society of Civil Engineers also has been kept in by private subscription.

After the Am.Soc.C.E. has paid its fixed expenses of administration it has $40,000 available for meetings throughout the country, committee work, promotion of technical activities and local sections. The F.A.E.S. dues must be found at the expense of these activities. At the normal rate of $1.50 per member these would be 40 per cent of the available revenue; at the present reduced rate they are 25 per cent. The $7,800 provided in the budget for this purpose was obtained by paring the appropriations until the technical committees are to receive only 60 per cent of their estimated needs. An effort to increase the yearly allowance to the local section by $10,000 was defeated for the same purpose. It is considered that the interests of the society would be better served by appropriating money to the local sections than by paying it to the F.A.E.S. It is believed that if the society should join the F.A.E.S. there will hereafter be a deficit of $11,000 (or, if the normal dues should be restored, $16,000), to the further detriment of the society's primary interests. The present proposal comes not from a general demand but because of the insistence of a small group associated with the F.A.E.S. as representatives of affiliated organizations. The Am.Soc.C.E. will best serve its members, its profession and the general welfare by declining to join the F.A.E.S. and by exerting its influence in co-operation with other societies of comparable standing and similar purpose without prejudice to its own independence or continued usefulness to its members.

Letters to the Editor

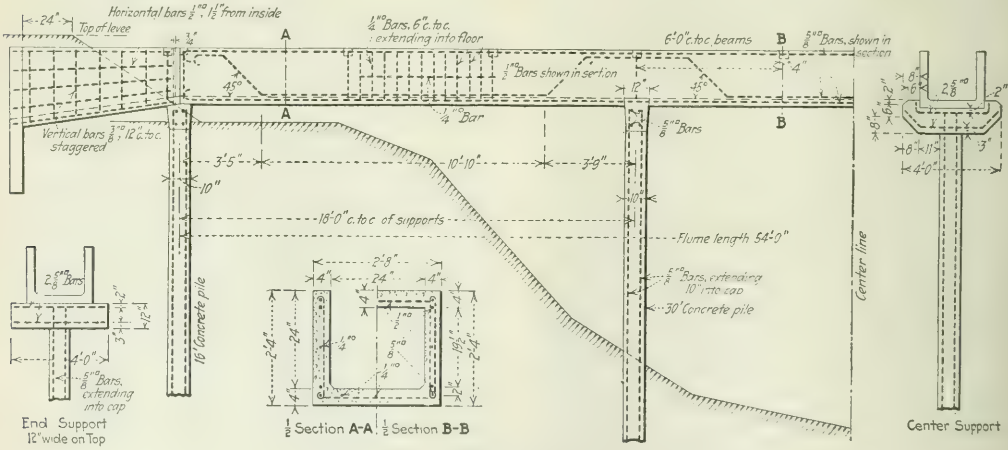
This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Design for Small Irrigation Flume

Sir—Herewith is a design for a small irrigation flume similar to the one shown in my article in your issue of Dec. 7, 1922, p. 967. We are preparing to build one of these flumes over a drain ditch some time this month (another corrugated pipe failed). The work will be done by force account instead of by contract as we figure that we can thus save a considerable amount.

This flume is designed to carry 6 sec.-ft. of water at a velocity of 2 ft. per second, with a total loss in head of 0.12 ft. Six second-feet will equal what we term three "heads" of water, and will be sufficient for small distribution laterals. By a head of water is meant the amount one good irrigator can handle efficiently.

The ¾-in. bars in the barrel of the flume are placed in the exact center of the concrete (seemingly at the neutral axis). We have found that a wall of less than 4-in. thickness is not economical; that is, we can build a 4-in. wall as cheap as a 3-in. wall, due to the fact that a very thin wall is extremely hard to pour without a number of rock pockets, and contractors will bid higher per yard on the thin-wall structures so that the saving in material is offset by the extra labor charge. By placing the ¾-in. bars in the center, we get a *d* of 2 in. and one set of bars will take care of both positive and negative moments.



IRRIGATION FLUME FOR SMALL LATERAL

Only one pile is used on each support. On the center bents we will drive 20-ft. piles, break off 20 in. to make the lap on the bars, and after forming pour to the required height. This will be done because the 30-ft. pile could not be handled without danger of breaking. The 1½-in. pipe reduced to 1 in. at the bottom is placed in the center of each pile, and the piles will be jetted instead of driven.

W. F. Heath,
Assistant Engineer, Cameron County
Water Improvement District No. 2.
San Benito, Texas, Jan. 19, 1923.

Effect of Integral Waterproofing Compounds on the Strength of Concrete

Sir—At the recent meeting of the American Concrete Institute considerable interest was shown in a discussion of the function of integral waterproofing compounds in concrete. We have recently made a series of tests to determine the effect of these compounds on the *strength* of concrete. The tests formed a part of a series of laboratory and field researches on concrete exposed to sulphate soils and waters.

Compression tests were made on 6 x 12-in. concrete cylinders, in which 11 different integral waterproofing compounds were used in 1: 3, 1: 4 and 1: 5 concrete mixtures, with aggregate graded up to 1½ in. In a number of instances, two or three percentages of the compounds were used.

The tests were made at the age of 28 days after curing the concrete in a moist room.

Without exception, the compressive strength of the concrete was reduced by these compounds. "Normal" concrete, that is without integral compounds, gave the following strengths: 1: 5, 3,010; 1: 4, 3,460; and 1: 3, 4,230 lb. per sq.in.

A soap solution of ¼ lb. per gal. of mixing water gave a concrete strength 57 per cent of normal; 5 per cent crude oil (both asphaltic and paraffin base), gave concrete strengths 73 per cent of normal.

Four different proprietary waterproofing compounds, used in the percentages recommended by the manufacturers, gave concrete strengths 74 to 87 per cent of normal; average about 80 per cent. A so-called alkali-proofing compound (patented) gave concrete strength 16 per cent of normal.

Little difference was found in the relative effect of integral compounds due to the quantity of cement within the range of the mixes used in these tests.

We have made no tests on the value of these compounds for waterproofing, and at this time no conclusions can be given with reference to their effect in concrete exposed to sulphates. However, users of such compounds should consider that the strength and probably the resistance of the concrete to destructive agencies may be seriously reduced thereby.

Duff A. Abrams,
Professor in Charge, Structural Materials,
Research Laboratory, Lewis Institute.
Chicago, Ill.,
Feb. 14, 1923.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Special Assessments Subject at Water-Works Meeting

C. M. Saville Summarizes Data Gathered by Him—Next Meeting to Be at Rochester, April 7

Following lunch and the transaction of business on Feb. 21, the New York Section of the American Water Works Association discussed the assessment method of paying for extensions to water mains. A vacancy on the Board of Governors of the section was filled by the election of Thaddeus Merriman, chief engineer Board of Water Supply of the City of New York. It was announced that the section will hold a meeting at Rochester, N. Y., on April 7, a feature of which will be a visit to the local water-works repair shop and yards.

The discussion on assessments was opened by Caleb M. Saville, chief engineer and manager of the water-works of Hartford, Conn., who summarized data thus far gathered by him for a paper to be presented to the annual convention of the association at Detroit, next May. Mr. Saville stated that more cities were levying assessments for water mains than he had supposed and that a variety of methods are in use, some of which are essentially guarantees of a stated percentage yearly revenue on the cost of the extension. Hartford operates under the guarantee plan. The Connecticut legislature, two years ago, placed municipal water-works accounting under the control of the State Utility Commission. Mr. Saville believes that the cost of main extensions should be charged tc capital.

Discussion

In the discussion, W. W. Brush, New York City, stated that with consolidation frontage charges in New York had been abolished. A change from established practice is likely to create a general feeling of injustice. Lack of protest against existing practice indicates public approval. Nicholas S. Hill, Jr., said that with the bringing of private water companies under the control of state utility commissions the former are no longer operated for profit, but merely to pay current charges and a fair return on the investment. Municipally-owned works should be run on the same plan. Allen Hazen remarked that so far as he knew there are only five large cities in this country that assess the cost of water main extensions on the abutting property: Philadelphia, Milwaukee, St. Paul, Seattle and Los Angeles. These cities have low water rates because so much of the cost of their water-works systems has been raised as stated. The assessment plan is logical, but if adopted should be continued in use.

M. N. Baker, New York City, stated that as a rule, assessments for water mains have not been made in accordance with the underlying principle of assessments for benefits, which puts the cost of the improvement on the property benefited, but have been on arbitrary front-foot charge, made necessary because of water main extensions into sparsely settled territory. Control of city growth through planning and zoning would lessen the number of such extensions. Robert B. Morse, chief engineer, Washington Suburban Sanitary District, outlined the plan of financing both water-works and sewers in use in the district named, which rests on the theory that the entire capital cost of these improvements should be met from (1) taxes and (2) property assessments, the latter chiefly for small water mains and sewers, in the form of a yearly charge covering interest and bond retirement charges, and terminating when the bonds are paid off (see *Engineering News-Record*, June 2, 1921, p. 944).

Southern Pacific R.R. Will Build 118-Mile Cutoff

It is announced by the Southern Pacific R.R. that following the approval by the court of the Interstate Commerce Commission's recent decision permitting the Southern Pacific to retain control of the Central Pacific, construction of the section of the Natron cutoff between Oakridge and Kirk, Ore., will be undertaken. The gap at present is 118 miles long over the Cascade Mountains and its closing will provide a new north and south line from Weed, Calif., to Eugene, Ore.

Experts Appointed to Make Plan for New York and Environs

The names of six city planners to make a study for a regional plan of New York City and vicinity covering some 5,000 square miles have been announced by the Committee on the Plan of New York and Environs, acting under the auspices of the Russell Sage Foundation. The six are Thomas Adams, of Adams & Thompson, London and New York, chairman; Harland Bartholomew, city planning consultant, St. Louis, Mo.; Edward Bennett, of Bennett, Parson, Frost & Thomas, Chicago (Mr. Bennett having been a partner of the late Daniel H. Burnham); George B. Ford, of the Technical Advisory Corp., New York City; John Nolen, landscape architect and city planner, Cambridge, Mass., and Frederick Law Olmstead, landscape architect, Brookline, Mass. Mr. Adams was formerly associated with the British Local Government Board; then was town planning adviser to the Canadian Conservation, and has recently opened offices in New York and London. He is lecturer on civic design at the Massachusetts Institute of Technology. A preliminary report is to be submitted by Oct. 1.

U. S. Chamber of Commerce Tackles Transportation

Will Appoint Committee Representing All Interests to Seek Effective Co-Ordination of Facilities

Following an informal meeting held recently in New York City at the call of Julius H. Barnes, president of the Chamber of Commerce of the United States, for the consideration of transportation problems, Mr. Barnes has taken steps to form the general committee recommended by the meeting. That meeting was attended by Herbert Hoover, who was present informally; Julius H. Barnes, president, Chamber of Commerce of U. S. A.; Carl R. Gray, of Omaha, chairman of transportation department committee; George A. Post, of New York, chairman of waterways committee of the Chamber of Commerce of U. S. A.; Samuel Rea, president, Pennsylvania System; A. H. Smith, president, New York Central Lines; Hale Holden, chairman, railway executives; Howard Elliott, representing Northern Pacific and N.Y., N.H. & H. R.R.; C. H. Markham, president, Illinois Central; Daniel Willard, president, Baltimore & Ohio; W. D. Storey, president, Atchison, Topeka & Santa Fe; A. J. Brosseau, president, Mack Truck Co. and director of Chamber of Commerce of U. S. A.; J. Walter Drake, president, Hupmobile Corp., and director of Chamber of Commerce of U. S. A.; Alvan Macauley, president, Packard Motor Car Co., of Detroit; A. H. Swayne, General Motors Corp., of New York; George M. Graham, Chandler Motor Car Co., of Cleveland, and C. P. Craig, Duluth.

All Interests Represented

The resolutions adopted at this meeting requested President Barnes to form a general committee composed of representatives of the railways, shipping interests, producers, motor industry, waterway operators and the public, which should consider the transportation problem with regard to governmental relations, possible railroad consolidations, and readjustments of rate schedules, proper co-ordination of railroads, motor transport and waterway service. The committee is to provide for contact with the Department of Commerce, the Interstate Commerce Commission and any other agency of government. It will convene at the call of the president of the Chamber of Commerce and probably will work through sub-committees for study and investigation leading to its reports and recommendations.

The Chamber of Commerce has announced progress in the organization of the general and sub-committees to study the various phases of the problem, and hopes to be helpful in working out a national transportation program that will care for trade expansion already in sight.

Further developments will be presented to the board of directors and the membership at an early date.

Wisconsin Engineers Hold Annual Meeting

Many Progressive Ideas Discussed—Joint Session Held With Drainage Association

Engineering News-Record Staff Report

A permanent society headquarters at Madison, a code of ethics, a state registration law for engineers, and a movement for closer co-operation of all technical associations in Wisconsin, were definite recommendations made at the annual meeting of the Engineering Society of Wisconsin, held at Madison, Wis., Feb. 22 to 24. Some of the sessions were held jointly with the Wisconsin Drainage Association and the annual dinner was held jointly with the Technical Club of Madison. An unusual publicity feature was a large advertisement of the dinner and the speakers, published in the local papers by the Technical Club.

PERMANENT OFFICES

The suggestion for permanent offices was made in the presidential address of Jerry Donahue (Sheboygan). The adoption of the code of ethics already recommended by a joint committee of the four national engineering societies was advocated by Daniel W. Mead (Madison), as preferable to the preparation of any new code. A proposed registration law was submitted by a joint committee representing five local technical associations and headed by K. H. Talbot (Milwaukee). As an argument for this law it was pointed out that Wisconsin is surrounded by States requiring registration, so that Wisconsin engineers cannot practice outside without passing an examination, while outside engineers are free to practice in that State. Although the bill provides for a "board of examiners of architects, engineers and surveyors" it does not specify what classes of engineers are to be included, so that apparently it would apply to mechanical, electrical and other engineers, while its special purpose appears to be the protection of civil engineers.

A review of Wisconsin's highway work by A. H. Hirst, state highway engineer, drifted into a general attack on the railroads, Mr. Hirst claiming that they have made no improvements in transportation for twenty years. Nobody undertook to puncture this soap-bubble, the purpose in blowing which was not clear. Tile drains placed directly below the edges of the paved roadway and having laterals to the side ditches were advocated by E. H. Rossiter (Chicago) as more effective than ditch drains, but Mr. Hirst considered that no tiling could provide for spring rains and floods.

LAND DRAINAGE AND SANITATION

Relations of land drainage to sanitation, as in the elimination of mosquitoes, yellow-fever and typhoid, were reviewed by L. K. Sherman (Chicago). He considered that the use of public water for sanitation should be considered before the rights of navigation and water power. Sanitation is a matter for engineers rather than medical officers of local boards of health. He advocated the New Jersey system by which land outside of drainage districts pays an assessment on account of sanitary benefits. Further, the county or State should pay a share of the construction cost of such districts for the same reason. In the discussion, C. M. Baker (state sanitary engineer) pointed out that drains should not be used as sewers, as has been done in some cases, with consequent pollution of streams.

That engineers are largely responsible for the generally neglected condition of sewage treatment plants was the opinion expressed by W. H. Copeland, chemist of the Milwaukee Sewerage Commission, in discussing a paper on "Effective Sewage Treatment" by Paul Hansen (Chicago). The plants are frequently too small and have too little provision for sludge disposal, so that they become a nuisance, but as the engineer locates these plants in outlying places the nuisance does not arouse public opinion to demand efficient operation. Mr. Copeland might have noted that in many cases public opinion would not permit such plants to be located in any but an outlying place. However, he considers the solution of the difficulty lies in educating public opinion as to sewage disposal by means of public addresses and articles in the local papers. As to sludge disposal, he considers that too much liquid is used in sludge digesting chambers and too little moisture in the drying beds.

With an attendance of about 300 at the annual dinner the attractions were an address by C. F. Loweth, chief engineer of the Chicago, Milwaukee & St. Paul Ry. and president of the American Society of Civil Engineers, and moving pictures illustrating the manufacture of cast-iron pipe.

Engineers Invited to Inspect New Niagara Power Tunnel

The Niagara Falls Power Co. has extended an invitation to all engineers and contractors to inspect the large power tunnel now nearing completion on the American side of the falls. Water is to be turned in about April 1, and the period of inspection has been set from March 20 to April 1.

This tunnel, described in *Engineering News-Record*, April 27, 1922, is the largest water-power tunnel yet built. It is 4,500 ft. long and has a horseshoe-shape section 32 ft. high and 32 ft. wide inside a 2-ft. concrete lining. At its entrance there is a wide and deep inlet excavated in the bed of the Niagara River terminating in a bell mouth portal to the tunnel. From that point the tunnel dips down to a depth of 120 ft., passing underneath the City of Niagara Falls, N. Y., and emerging at the canal basin near the brink of the Niagara Gorge about half a mile below the falls. At the outlet end of the tunnel is a forebay from which three penstocks will carry the water to the power house situated at the water's edge below the high bank.

Third Member Added to California Highway Commission

After some delay, Friend W. Richardson, Governor of California, has named Nelson T. Edwards, member of the board of supervisors of Orange County, as the third member of the California State Highway Commission. The other two members are Harvey M. Toy, San Francisco, chairman, and Louis H. Everding, Eureka.

New York Section, Am. Soc. C.E., Would Save High Bridge

Resolutions passed at the meeting last Friday of the New York Section, American Society of Civil Engineers, called for the appointment of a committee, members of which are socially versed in deep foundation and masonry arch design and construction, to investigate conditions at High Bridge, with a view to preserving the structure which, according to news accounts, is again in danger of being demolished as an obstruction to Harlem River traffic. Because its utility, historic importance and beauty are such as to commend its preservation this committee together with any other society committees which may be appointed is to study the situation, and to report (1) on the engineering and aesthetic feasibility of modifying High Bridge to make it meet legitimate needs of Harlem River navigation, and (2) on the approximate cost of such rehabilitation as against the cost of demolition and replacement by a new structure for carrying the aqueduct of the Croton water supply for New York.

The meeting also by resolution endorsed the proposed constitutional amendment in New York which would combine the offices of the state engineer with that of superintendent of public works, but went on record as emphatically opposing that provision of the amendment which simply provides that the combined offices be administered by a practical civil engineer. The section embodied in a resolution protests that the combined offices should be under a professional engineer with not less than 15 years experience and training in engineering work.

Discussion of the proposed benevolent fund for the society brought out the fact that many of the members were still undecided as to its merit. Motion was passed therefore that the chair appoint a committee of five members, including one or more members of the board of direction of the section, to prepare a concise statement to be presented to the section at the April meeting, at which time a vote may be taken.

The section held an informal debate upon the merits of the proposal now before the society that it affiliate with the Federated American Engineering Societies, in the course of which J. Parke Channing, a vice-president of the Federation presented a statement of why, in his opinion, the Am. Soc. C. E. should affiliate. Nelson P. Lewis, Lewis D. Rights and Col. J. P. Hogan presented arguments against the society's becoming a member-society of the Federation.

Memorial to B. F. Cresson, Jr., Held in Trenton

A memorial to the late B. F. Cresson, Jr., chief engineer of the New York Port Authority, was held at Trenton, N. J., Feb. 19. J. Spencer Smith presided and read a letter of appreciation of Mr. Cresson's work from Governor Smith. Speakers, all of whom eulogized the professional and private life of Mr. Cresson, included: Senator Clarence E. Case and Assemblyman Herbert Pasco, of the N. Y. Legislature; J. Hampton Moore, Mayor of Philadelphia; Lewis H. Pounds, W. L. Saunders, Richard C. Jenkinson and Thomas A. H. Hay.

Am.Soc.C.E. Board Directs Draft of Model License Law

It is announced by the American Society of Civil Engineers that the following resolutions with regard to the licensing of engineers were adopted at a meeting of the board of direction held on Jan. 19, 1923:

Whereas: Twenty-two states have recently passed laws for the registration or licensing of professional engineers and there are laws pending in the legislatures of more than five additional states, and while there are many engineers strongly in favor of such laws, there are many engineers opposed to such laws, therefore be it:

Resolved: That the society should recognize a tendency in the adoption of laws for the registration or licensing of professional engineers and while at this time it is not advisable to undertake to secure the passage of laws in states in which such action is not already contemplated, it should be its endeavor when such legislation is proposed, to advocate the adoption of uniform laws, properly drafted, for the protection of the public and the engineering profession; and it should also be its endeavor to secure such modification of objectionable features in existing laws so as to bring them into conformity with a uniform law approved by this society.

Resolved: That in order to meet the existing circumstances in states where such laws are proposed, this board advises the postponement of such proposed legislation pending a fuller agreement within the engineering profession in the matter of registration or licensing of professional engineers. And be it further:

Resolved: That the committee on registration of engineers be instructed to present for the consideration of the board at its meeting in New Orleans, April 16-17, 1923, a method of procedure by which this society may actively carry out the policy enunciated in this resolution and submit a draft of the law, which in its opinion, is desirable for general adoption.

Propose New Hudson River Tunnels as Business Venture

The incorporation of the Interstate Vehicular Tunnels Co. for the construction and operation of twin vehicle and pedestrian tunnels under the Hudson River, extending from some point on the New York shore between 23rd and 42nd Sts. to New Jersey, is contemplated in a bill that has been introduced into the New York and New Jersey Legislatures. The incorporators named in the bill are Frank M. Williams, formerly state engineer of New York; Darwin R. James, New York, and Newton H. Porter, of New Jersey.

Under the terms of the bill the tunnels would revert after fifty years to the cities that it is to connect, but the states or cities may recapture them five years after their completion. The cost is estimated at $30,000,000, which is very close to that of the Interstate vehicle tunnel now under construction.

The tolls fixed in the bill for passage through the tunnel vary from 5c for pedestrians to 80c. for automobile trucks and buses having a wheel base between 15 and 17 ft. in length.

Bill for Second Vehicle Tunnel Under Hudson River

A bill introduced in the New York State Legislature provides for the construction of a second vehicle tunnel under the Hudson River connecting New York with New Jersey, at about 125th St. in the Borough of Manhattan, New York City. Under the bill the new tunnel would be planned and its construction directed by joint action of the existing Interstate Tunnel Commission of New York State and the representatives of the State of New Jersey or of any properly constituted authority thereof. This bill responds to a certain amount of agitation in favor of a tunnel in the vicinity of the location described, which has been carried on during the past year. An appropriation of $1,000,000 toward the construction of the tunnel is carried by the bill. As in the case of the Canal St. tunnel, now under construction, all expenditures are to be shared equally by the two parties, and the completed tunnel is to be operated by the commissions as a toll tunnel. The tunnel is to be for the exclusive use of pedestrians and vehicles not operated by public service corporation.

Long Beach Reconstructing Sewage Screening Plant

Long Beach, Calif., has awarded a contract to the Water Supply Co. for the thorough repair of the existing Reinsch-Wurl screen and the installation ahead of it of another screen of the drum type to increase the capacity of the screening plant. These changes are preliminary to the installation of additional pumps of larger capacity, which, however will not be begun until the present disposal plant is reconstructed. Two results are to be accomplished by the present work, namely, the renewal of the badly worn screens which are now in service and the increase in the capacity of the plant by the use of the drum screen which is expected to remove the greater portion of the solids, leaving only suspended matter to be handled by the Reinsch-Wurl screen. During the repairs a bypass to be constructed around the plant will temporarily deliver the sewage to the ocean outfall. No extension of the outfall is contempleted at present.

Engineers Chosen for Kansas City Water-Works Extension

After considerable delay in the additional water-supply project for Kansas City, Mo., due to a court decision that the non-partisan water board was illegally created and the reversion of the control of the works to the fire and water board, the latter board has appointed George W. Fuller, of Fuller & McClintock, New York City, and Alexander Maitland, president of the Kansas City Bridge Co., as engineers for the new supply. Mr. Maitland was chairman of the non-partisan water board. Fuller & McClintock made a detailed report on water-works enlargements for Kansas City about two years ago and on April 1, 1922, water bonds to the amount of $11,000,000 were authorized by a 4 to 1 popular vote. (See *Engineering News-Record*, Oct. 28, 1920, p. 865, April 13, 1922, p. 626 and Dec. 21, 1922, p. 1089.)

Views of Coal Commission Begin to Take Form

Small Danger of Price-Control by Combination—Storage Seen as Important Factor

Washington Correspondence

Competition is so rampant in the production of coal that price control hardly would be within the range of probability, even were the operators inclined to attempt it. That the President's coal commission has reached that conclusion was clearly deducible from statements by Chairman Hammond and Commissioner Smith. For the next few weeks, the commission, would concentrate much of its attention on anthracite matters. It is clear also that the commission is not in sympathy with the agitation for an embargo on anthracite exports; that its sentiment is stronger than ever against the railroad practice of commandeering coal and that certain coal rail-rate structures need to be scrutinized carefully.

PRICE CONTROL

The comment as to price control followed a statement by Chairman Hammond to the effect that the commission intends to study coal prices over a period of several years. Mr. Hammond predicted that certain economies would be recommended, which will have an effect on prices, but he said there is no evidence that producers ever have considered any combination with the idea of bringing about higher prices for coal. On the contrary, he said, there is plenty of evidence of competition of the cut-throat variety. Dr. Smith added the opinion that, were operators to agree on a price for coal, some one of them would cut the price before he had been an hour out of the meeting. These points were emphasized to make it clear that the commission's exhaustive study of prices has as its objectives things other than the uncovering of a price-fixing conspiracy.

Chairman Hammond called attention to the far-reaching effect of railroad rate schedules on the coal problem as a whole. He was careful to point out, however, that the commission recognizes the Interstate Commerce Commission as the specialist on these matters and that no recommendation with regard to rate structures will be made until full advantage has been taken of the views of that body.

IMPORTANCE OF STORAGE

Chairman Hammond admitted that the importance which he attaches to storage amounts almost to an obsession. He strongly commended the public utility companies for the progress that they have made in establishing a policy whereby most of their plants provide ample storage reserves. Inducements will have to be held out, he said, to encourage such a policy among the coal consumers, but the commission expects to find a way that will result in large storage on the part of the railroads. He pointed out in no uncertain terms that there is no such thing as a "right" whereby railroads commandeer coal. It was revealed that Governor Marshall calls this practice "stealing." Other references made to coal commandeering indicate that sentiment against it is well crystallized among the commissioners.

Construction Division Men Resent War Fraud Charges

Former Officers Pass Resolutions Protesting Action as Treason Against an Industry

At a meeting held in New York last week of former officers of the Construction Division of the Army, a resolution was passed in which it was stated that the recent indictments against former officers of the United States Army and bills in equity against former war time contractors were considered as being directed as well toward the entire Construction Division of the Army charged with actual execution of the contracts.

The full resolution follows:

"Resolved that, the Construction Division Association is composed of engineers, architects and members of professions related to construction who volunteered for service during the war and were assigned to the Construction Division of the Army. This division was intrusted with the great task of building camps in time to train troops to get to France.

"Charges have been made in civil and criminal proceedings of treasonable conspiracy to delay and obstruct this work of vital necessity, and to defraud the government. Charged as we were with the execution of this work no such conspiracy could have existed without our knowledge. No such conspiracy could have moved one step without our connivance and active aid.

"Indictment of Treason"

"The indictment is an indictment for treason of the 1,500 officers and the thousands of men who were entrusted with this work. It is an indictment of the capacity of the nation in the time of its need to draw from the ranks of the technical professions and the construction industry a body of men who will not knowingly betray their country.

"In the mind of a large part of the public, not directly acquainted with this task, there has existed a complete misunderstanding of the facts as to the contracts under which work was done.

"At the outbreak of the war it was found that to wait until specifications could be drawn and detail plans worked out for the great cities that had to be built to house and train our troops would intolerably hold us back from fighting in the war.

"In this situation the ordinary peace time method of contracting could not be used. It is frequently said and believed that in this exigency contracts were made for construction under which the contractor was to receive as profit 10 per cent on all expenditures made, so that the higher the cost the greater the profit.

"Such contracts were in fact made by some governmental agencies, but not by the Construction Division of the Army. The contracts which are being attacked all contained a limitation on the amount of the fee to be paid. In the sixteen national army cantonment contracts the maximum fee was reached long before the work was completed and the gross profit on the whole work ran between 2 per cent and 3 per cent.

"The contracts gave the Construction Division control over the work, which, if we did our duty, required us to terminate the contract if the work were not done as efficiently and economically as the urgency permitted. We believe this was done. We know we gave all that was in us to perform this task. We believed that speed meant thousands of lives and that our Government and our civilization were in jeopardy.

"Accepting as we do these charges as equally directed at us, through whom the whole construction industry contributed its co-operation in the war, we resent them as a charge of treason.

"And be it further resolved that copies of this resolution be sent to the President of the United States, the Attorney General of the United States, the Chairman of the Senate Judiciary Committee and the chairman of the House Judiciary Committee."

A.A.E. Directors Condemn Cantonment Suits and Indictments

At its meeting Feb. 19-20, 1923, at Chicago, the board of directors of the American Association of Engineers passed the following resolution:

"Whereas; It has come to the attention through the press and in other ways that indictments have been presented and suits instituted against a number of contractors and others who built the various camps and cantonments during the war, and

"Whereas, The charges in the indictments, while general, are monstrous, in degree laying under heinous stigma not alone the defendants named but by implication many leading engineers and others engaged in the construction industry generally, who gave unselfishly of their time and skill towards the solution of handling the vast undertaking that confronted the United States at the opening of the war; therefore,

"Be it resolved by the A.A.E. that common justice demands immediate trial of these suits be brought, that these defendants, if innocent, may not longer rest under the odium of the grave charges and the good name of the engineering profession and those in the construction industry be cleared of any charge to conspire to defraud the government, and that copies of these resolutions be sent to the President of the United States, the Attorney-General, and the presiding officers of the Senate and House of Representatives."

Corrects Arguments in Am. Soc. C. E. Federation Ballot

As chairman of the committee of the Board of Direction of the Am. Soc. C. E. appointed to prepare the arguments against that society's joining the Federated American Engineering Societies, C. M. Holland has written to Gardner S. Williams in reply to a criticism by the latter concerning a statement in those arguments. Mr. Holland corrects an inaccuracy in the statement as to the traveling expenses incurred by the Federation. The figure given was $15,000 for 1922, whereas it should have been $16,445.74 for the past two years. He explains that the statement was made in good faith based on information believed to be trustworthy, and points out that the favorable arguments also are misleading on this point, in that they lead to the inference that only $6,600 was spent for travel during 1922, whereas the statement of the Federation shows that $8,417.65 was spent for that purpose.

Ohio Engineers Convention Supports Pending Bills

Included in important action taken at the forty-fourth annual convention of the Ohio Engineering Society held at the New Southern Hotel, Columbus, Feb. 8 and 9, was a resolution unanimously favoring Senate Bill No. 84 which provides for the registration of all engineers employed on public work. It was urged that such registration would raise the standard of the engineers so employed. Another resolution was unanimously adopted favoring House Bill No. 183 extending the tenure of county surveyors in Ohio from two to four years. The bill does not affect present officials, nor does it raise salaries.

Two other bills were given unanimous support: the public health bill, permitting municipalities or other political sub-divisions to make assessments on property to carry out sewage projects which have been approved by voters; and the bill proposing a tax of 1½ cents per gallon on all gasoline sold in Ohio, the proceeds to be used for road purposes.

Among convention speakers were: Clifford Older, state highway engineer of Illinois, who gave an interesting talk on "The Bates Road Tests"; C. B. Cornell, construction engineer on the Columbus Storage Dam project, who told of the progress of that work; R. N. Begien, general manager of the B. & O. RR. at Cincinnati, who spoke on railroad transportation; John Laylin, assistant director of highways and public works, stationed at Norwalk; Glenn R. Logue, chief engineer of the bridge department, Ohio Highway Commission; T. Glenn Phillips, consultant to the city planning commission of Detroit; and W. D. McKinney, secretary of the Southern Ohio Coal Exchange.

Officers for the coming year were elected as follows: John Leech, Steubenville, president; E. A. Lawrence, Columbus, vice-president and John W. Graham of Chillicothe, secretary-treasurer. The latter was re-elected while Mr. Leech succeeds Robert M. Waid of Columbus.

Sir Henry Thornton Names Executives for C.N.R.

Sir Henry Thornton, president of the Canadian National Railways, has announced the following appointments: S. J. Hungerford, vice-president in charge of operation and maintenance; W. D. Robb, vice-president in charge of natural resources, development and colonization, also express and telegraph departments; Major Graham A. Bell, vice-president in charge of finance; Gerald G. Ruel, vice-president and general counsel; R. C. Vaughan, director of purchases and stores.

Mr. Hungerford has had a long experience in railway affairs. He was born in Bedford, Que., in 1872 and 22 years ago joined the staff of the C.P.R., becoming superintendent of the C.P.R. shops and afterwards master mechanic of the Western Division. In 1910 he joined the Canadian Northern Ry. on which he held several important positions, and when the line was taken over by the government he became in 1920 vice-president over operating and maintenance, and later designated as acting president.

Metropolitan District of Chicago to Be Discussed

A metropolitan planning conference to discuss the development of the Chicago metropolitan district has been called for March 3 at the City Club of Chicago. Mayors of 14 cities, presidents of villages, chairmen of official boards and commissions, and representatives of civic and commercial bodies are included in the call. A comprehensive plan for the district extending from Waukegan to Gary is proposed and a permanent planning commission may be created. A survey is proposed to cover the industrial, commercial, civic, social, sanitary and governmental problems. Indicating the need is the statement that there are more than 300 local taxing governmental units, 14 cities, 83 villages, 191 school districts, 29 townships and 31 park districts. No less than 98 boards or engineers are independently planning and constructing sewers, 119 street or engineering departments are laying out and paving streets, highways and boulevards, 94 legislative bodies enact ordinances and regulate local transportation.

Engineering Societies

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 13-15.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

The San Francisco Engineers' Club on Feb. 14 listened to an address by E. J. Mehren, editor of *Engineering News-Record*, on "Impressions of the Present Trend In Engineering Progress."

The Colorado Society of Engineers at its recent annual meeting elected the following officers: President, W. M. McMechen; vice-president, F. C. Steinhauer; secretary-treasurer, C. M. Lightburn.

The Colorado Engineering Council recently elected the following officers for 1923: President, Prof. L. G. Carpenter; vice-presidest, R. W. Gordon; secretary-treasurer, C. M. Lightburn. The Colorado Section of the American Chemical Society was admitted to membership, making twelve member organizations.

The Wyoming Society of Engineers has elected the following officers: President, J. W. Wisda; vice-president, Z. E. Sevison; secretary-treasurer, H. G. Matson, Cheyenne.

The Denver Chapter American Association of Engineers, Feb. 5, elected officers as follows: O. F. Reedy, assistant state highway engineer, president; R. D. Hubbard, assistant engineer of the state reclamation service, vice-president; P. W. English, manager of the Denver Blue Print and Supply Co., secretary; V. F. Whitmore, office engineer for the Union Pacific R.R., treasurer.

Personal Notes

A. C. Lingley, who has been division engineer for Division 4 of the Missouri State Highway Dept., with offices in Kansas City, since last Spring, has been appointed construction engineer for the Highway Department with offices at Jefferson City. His successor is W. M. Spann, who has been acting construction engineer of Jefferson City.

Rollin J. Windrow has resigned as consulting engineer for the Missouri State Highway Commission and personal representative of Theodore Gary, chairman of the commission, to devote his time to personal business. Mr. Windrow is connected with the firm of Smith Bros., prominent general contractors of Dallas, Texas.

Thomas E. Mitten has resigned as president of the Philadelphia Rapid Transit Co. He will remain with the company as chairman of the board of directors in which capacity he will have charge of negotiations between the company and the city with regard to the operation of city-built rapid transit lines.

J. Rowland Bibbins has resigned as manager of the transportation department, Chamber of Commerce of the United States, to engage in consulting practice in transportation and its related economic and civic problems, including traffic surveys, railway terminal and transit developments, valuations and franchise arbitrations, and transportation aspects of city planning work. Mr. Bibbins was previously associated with the Bion J. Arnold Engineering Association of Chicago, and in this work studied intensively the transportation problems of some twenty cities of the United States and Canada with regard to rapid transit, railroad and port terminals, civic development, valuation, and the economic policies involved therein. During the two years he has been in Washington he has devoted special study to the whole group of transportation agencies—railway, traction, highway, waterway, airway, and marine, and their relative status and possibilities of co-ordinated development. Mr. Bibbins will make his headquarters in Washington, D. C.

J. Waldo Smith, consulting engineer and formerly chief engineer of the New York Board of Water Supply in charge of the construction of the Catskill aqueduct, left New York on the "Adriatic" Feb. 24, for a two months' trip to Europe. He will arrive at Naples March 12 and after visits to Rome and other Italian cities, will go to Switzerland, France, Belgium, and England, returning to New York early in May. John H. Cook, hydraulic engineer, East Jersey Water Co., and F. B. Rogers, of George W. Rogers & Co., were passengers with Mr. Smith.

W. L. Thompson has opened an office in the Weinberg Building, Greenville, Miss., for the general practice of civil engineering. Mr. Thompson has had a wide experience in flood control, drainage and related works, highways and foundations, as well as an intensive service of over eight years in the most active period of Panama Canal.

E. B. Parsons, who has been associated with E. G. Orbert at Milwaukee, Wisconsin, has opened an office at Jefferson, Wisconsin, where he will practice municipal engineering. Mr. Orbert will maintain an office at Milwaukee.

Oscar Claussen, who retired from the position of city engineer of St. Paul the first of the year, after fourteen years' service, and J. E. Carroll, assistant city engineer for the last eleven years, have formed the Claussen & Carroll Engineering Co. and opened offices at 406 Metropolitan Bank Bldg., St. Paul. They will engage in general service as consulting engineers, including waterworks, sewers, paving and power plants, and valuations.

Homer M. Matthews, until recently office engineer for the Mexican Light & Power Co. of Necaxa, Pueblo, Mexico, is now engineer of the bridge department of the Texas State Highway Department.

James G. Roney is now assistant in the engineer corps, Eastern Division, of the Pennsylvania R.R. Co., having but recently left the Texas & Pacific Ry., where he was employed as assistant engineer.

A. G. Briggs, until recently resident engineer with the North Carolina State Highway Commission, has entered private practice, being located at Locust Dale, Va.

Philip O. MacQueen, until recently assistant engineer with the Frazier-Ellms-Sheal Co. of Cleveland, has opened offices in Washington, D. C., for the practice of civil engineering. He will pay particular attention to water-supply purification, sewerage and sewage disposal, and real estate developments.

Herbert E. Ross is now inspector in the construction division of the New York Telephone Co., Brooklyn, N. Y., having but recently left the J. J. Guinan Contracting Co., where he was employed as superintendent of construction.

James M. Angle is now highway bridge engineer with the U. S. Bureau of Public Roads and stationed in Washington, D. C., having but recently left Pittsburgh, Pa., where he was employed as a special draftsman in the Allegheny County engineer's office.

E. F. Bushnell, formerly a structural designer and detailer with the Ingalls Iron Works of Birmingham, Ala., has become associated with the U. S. Engineer's Office at Florence, Ala. He is a junior engineer employed on the construction of the Wilson dam.

[illegible] is now a resident [illegible] City, N. C., for William C. Olsen, consulting engineer of Kinston, N. C. He was formerly with the firm of George R Morris of Baltimore, Md.

J. Roscoe Sharp, formerly employed in various capacities with Stone & Webster, Inc., engineers and contractors, Boston, has joined the U. G. I. Contracting Co. of Norristown, Pa. Mr. Sharp's position is that of office engineer.

John D. Cruise, who for some time past has been employed in the bridge department of the North Carolina State Highway Commission, has become associated with the Michigan State Highway Department, where he is employed in similar work.

G. E. Hesselbacher has become a partner in the engineering and contracting firm of Hesswin Co., Elkins Park, Pa., Mr. Hesselbacher formerly was engineer with the U. G. I. Contracting Co. of Philadelphia.

L. J. Sverdrup, until recently a designer in the Minnesota State Highway Department, has become assistant bridge engineer for the Missouri State Highway Department.

Obituary

Capt. H. C. C. Walkem, M. C., died at Gananoque, Ont., February 8, after a brief illness. Capt. Walkem graduated at the Royal Military College, Kingston, Ont., and during the war served with the Royal Engineers of the Imperial army, being awarded the military cross as a recognition of distinguished service. Since the war he has been engaged on engineering work with the Department of Public Works.

Gustave Kaufman, consulting engineer, contractor and a prominent figure in the development of the Ferris wheel, died recently in New York, aged 64 years. After graduation from Rensselaer Polytechnic Institute in 1880 Mr. Kaufman was engaged in railroad work, being first employed by the Pennsylvania R.R. Co. Five years later he was made chief engineer with the Pittsburgh & Western R.R., now part of the B. & O. Later he formed a consulting engineering partnership with G. W. G. Ferris under the firm name of G. W. G. Ferris & Co. Mr. Kaufman entered the contracting business in New York about 25 years ago, some of the important work he handled having been the Brooklyn piers of the Manhattan Bridge, Atlantic Avenue subway, and various structures on Staten Island and Long Island.

Merrill Watson, one of the pioneers in concrete and fireproof construction work, died last week at his home in East Orange, N. J., aged 72 years. One of the first fireproof buildings erected in New York City was constructed by Mr. Watson. He was a graduate of Ohio Wesleyan University, thereafter entering newspaper work. For thirteen years he served as editor and manager of *Age of Steel*, of St. Louis. After leaving technical editorial work he became interested in expanded metal, and for ten years was manager and treasurer of the N. Y. Expanded Metal Co., and secretary and treasurer of the Associated Expanded Metal Companies.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Test Liquid Oxygen for Blasting Purposes

Adolph Messer, German Manufacturer, Demonstrates Method at West Virginia Quarry Before Federal Officials

Liquid oxygen as a blasting explosive was given its first public demonstration in the United States on Feb. 7 at the quarry of the Kelley Island Lime & Stone Co., near Martinsburg, W. Va., when Adolph Messer, head of the German firm of Messer & Co., conducted tests under arrangements made by the U. S. Bureau of Mines. George S. Rice, the Bureau's chief mining engineer, attaches great significance to the Martinsburg tests as showing that liquid oxygen may be successfully used in deep holes—16 to 20 ft. An appropriation will be available July 1 for a further study of liquid oxygen explosive by the Bureau of Mines.

In line with these developments announcement has just been made that a liquid oxygen explosive plant is now being completed at the iron mining property of the Witherbee-Sherman Co. at Mineville, N. Y., and will be placed in service in the mining operations of the company within a few weeks. This is the first commercial plant to be built by a newly formed organization in which the Air Reduction Co. and the Ingersoll-Rand Co. will co-operate.

The liquid oxygen explosive is made by soaking sticks of carbon in liquid oxygen on the spot where blasting is to be done. The holes are then loaded with the saturated cartridges as quickly as possible and blasting follows with a minimum loss of time, as the oxygen evaporates rapidly. Most of the cartridges used in the Martinsburg test were 40 x 300 mm., each containing 75 grams of pure lampblack. Immediately after soaking they weighed about ¾ lb. each, indicating a ratio of absorption of about 3½ to 1. The program included the blasting of one round of two holes, one round of three holes, one block shot, and two mud caps. The holes were 16 and 20 ft. deep.

The results of these tests and other recent developments indicate that the practical application of oxygen to blasting operations is beginning. It is understood that orders have been placed for more than fifty of the German machines, most of these, however, being in plants where oxygen is used in welding operations.

Portland Cement Association has opened offices in New Orleans, with John E. Tate as district engineer. He will have supervision of Louisiana and Mississippi. Mr. Tate comes from the Atlanta office of the association, where he was field engineer. Prior to this he was resident engineer of the Maryland State Roads Commission and served also with the Delaware State Highway Department as assistant engineer.

To Increase Production of Pipe Cast by Centrifugal Process

The United States Cast Iron Pipe & Foundry Co., Burlington, N. J., is more than doubling the capacity of the unit for the manufacture of deLavaud centrifugal pipe at its North Birmingham, Ala., works.

The original unit, consisting of four centrifugal machines, making 6, 8, 10 and 12-in. pipe, was placed in operation in August, 1922. On account of the increasing demand for this pipe it has been found necessary to add five more machines, which it is expected will be in operation by midsummer.

In addition to the pipe manufactured by the U. S. company, the National Cast Iron Pipe Co. of Birmingham, Ala., also has a license for the manufacture of centrifugally cast pipe, and expects to have in operation by midsummer an entirely new plant, consisting of four or more machines, with the necessary annealing ovens.

The U. S. Cast Iron Pipe & Foundry Co. is now working on plans for a new unit to be erected in connection with its Burlington, N. J., works, which will consist of ten machines.

Lumber Associations Merge

A merger of the National Wholesale Lumber Dealers' Association and the American Wholesale Lumber Association has been recommended by a joint committee of the two bodies and approved by their boards of directors. To this end both organizations are planning to hold their annual meetings in Pittsburgh, March 21 and 22, at which time the membership of both associations will be asked to ratify the action of their respective boards, thus bringing into existence a new wholesale lumber association with a membership of about 700. The enlarged organization is to be known as the National-American Wholesale Lumber Association, with headquarters in New York City and a branch office in Chicago.

L. R. Putnam, directing manager of the American Wholesale Lumber Association, has resigned and will not be connected with the merged association. On April 1 he will become a member of the Ferry-Hanly Advertising Co. at Chicago, as head of the building materials department, which handles several important accounts, including the Southern Pine Association, the Long Bell Lumber Co., and others.

To Co-operate in Manufacture of Electric Locomotives

The General Electric Co., Schenectady, N. Y., and the American Locomotive Co., New York City, announce that they have entered into an arrangement providing for close co-operation between the engineering organizations and manufacturing facilities of the two companies in the design and manufacture of electric locomotives for use on steam or electric railways.

Pelton Wheel Tests Show High Efficiency

Tests on the 20,000 hp. Pelton single overhung reaction turbine at Cedar Falls Extension Plant of the City of Seattle have just been completed. This plant was placed in service in June 1921, but for reasons beyond the control of either the city or the manufacturer, final testing was delayed until a few days ago. Notwithstanding having been in service for more than a year and a half, the unit was found to be in perfect operating condition the absence of vibration being particularly noticeable. Water measurements were made by a weir installed permanently as a part of the power plant equipment. A satisfactory efficiency curve was obtained, the maximum exceeding 92 per cent.

To Reduce Varieties of Doors and Window Sashes

As the result of a conference held Feb. 20 under the auspices of the Division of Simplified Practice of the U. S. Department of Commerce, representatives of the millwork industry, expressing the opinion that approximately 30 per cent of the sizes of doors and window sashes now made could be eliminated, decided to submit the suggestion to the manufacturers in May. If the proposal is approved a survey of the industries affected will be made to determine the percentages of the various types and sizes manufactured during the last three years so as to determine those in least demand.

This conference was the outgrowth of one held in February, 1922, by architects, builders and engineers regarding dimensional simplification of building materials, the subject of millwork subsequently having been considered by the major associations of the industry.

Reasons for Variations

N. L. Godfrey, secretary of the Wholesale Sash & Door Association, explained the reasons for the variations in demand as existing in the different sections of the country, due to weather conditions, tradition and other factors. He stated that panel doors are made in 35 sizes, sash doors in 10 sizes, French doors in 15 sizes and window sashes in more than 200 different sizes. He expressed the opinion that there is considerable room for simplification.

W. A. Durgin, chief of the Division of Simplified Practice; Dr. John M. Gries, chief of the Division of Building and Housing; and E. W. McCullough, manager of the Fabricated Production Department of the Chamber of Commerce of the United States, explained the benefits of simplification and standardization within their experience. The representatives of the industry engaged in a general discussion of the subject. It is probable that whatever is done in this field will be undertaken as a sectional proposition, due to the varying demands of the different parts of the country.

Among others attending the conference were: W. H. Ham, Bridgeport Housing Co.; S. W. Jones, American Institute of Architects; Joseph N. Harding, Chas. Filen & Co.; E. J. Curtis, Curtis Companies, Inc.; E. F. Hunt, Eastern Wood Workers; and John H. Derr, Sash & Door Manufacturers Association.

Allied Machinery Co. to Manage Domestic Sales

The Allied Machinery Co. of America, which has hitherto confined its activities to export trade, has taken over the management of the sales in New York City and vicinity of the Clyde Iron Works Sales Co., Duluth; the Austin-Western Road Machinery Co., Chicago; the Austin Manufacturing Co., Chicago; the Lakewood Engineering Co., Cleveland; and the Universal Crane Co., Elyria, O. The company, in its domestic business, will follow the same methods used in building up the export trade of these and other important American manufacturers of construction machinery and equipment. S. T. Henry, vice-president of the Allied organization, will direct the new sales program.

Men from the factories of the manufacturers named above will be resident in New York City to give customers expert service. Stocks of machinery and equipment will be maintained in New York to insure prompt deliveries. Repairs also will be carried in stock.

Offices will be continued at the Allied Construction Machinery Center, 139-149 Center St., New York City, where these manufacturers and several others have, for some years, maintained the largest permanent exhibit of this kind of machinery and equipment ever undertaken.

Standardization and Simplification

From the report of the Committee on Methods presented at the annual convention of the Associated General Contractors in Los Angeles, Cal., Jan. 30-Feb. 3.

The elimination of unnecessary varieties of materials and the simplification of dimensions is being urged by your committee wherever such standardization appears practicable. Your association, through Noble Foster Hoggson, of Hoggson Bros., is represented in the Division of Simplified Practices, U. S. Department of Commerce, which is making special studies of mill work, plumbing, heating, interior wall construction, hardware, lighting fixtures and clay products. Considerable progress has already been made in eliminating sizes and varieties. The association is also represented on the special committee of the American Engineering Standards Committee to approve and sponsor future developments in the field of standards. Membership is also held on the advisory board of the Bureau of Mines to consider the question of treatment of drill steel and on the consulting committee of the Central Lumber Standards Committee, which is the council of manufacturers and consumers of lumber actively carrying out the establishment of standard sizes and quality.

The efforts of different associations in the field of standardization have become fairly well co-ordinated, so that there is little duplication of effort, and within the next year or so the practical application of many standards in the basic industries supplying construction will have been put into effect. Your association has taken an active part in this work and has received a gratifying measure of recognition in the national councils of industry.

D. A. Decrow, Waterworks Pump Specialist, Dies

As Manager With Worthington Corp. He Designed and Installed Plants in Largest Cities of U. S.

David A. Decrow, manager of the waterworks department of the Worthington Pump and Machinery Corp., New York, died in East Orange, N. J., Feb. 15. He designed and installed waterworks pumping machinery for many of the largest cities in the United States, including Buffalo, Detroit, St. Louis, Columbus, Cincinnati, Louisville, Boston, Cleveland and Philadelphia.

Born in Bangor, Me., in 1859, he was graduated from the college of mechanic arts, University of Maine, in 1879 and taught school for a year or more in a lumber camp in Maine. While in college he was prominent in athletics and as pitcher of the university baseball team, was one of the first to use a curved ball.

He went from Maine to Lockport, N. Y., in the early '80s and became associated with the Holly Manufacturing Co. as a mechanical draftsman. Here his engineering and business ability was evident from the start and his promotions were rapid. In 1893 he was made designing engineer, in 1900 chief engineer, and in 1903 secretary of the Holly company. During his connection with that plant he built up a national reputation as a waterworks engineer continued as a specialist in that line to the time of his death.

Some years ago the Holly Manufacturing Co. was combined with the Snow Steam Pump Works at Buffalo, New York, as part of the International Steam Pump Co. Mr. Decrow went to Buffalo at the time of this change and took charge of the pumping machinery manufactured by both companies.

The International company was succeeded by the Worthington Pump and Machinery Corp. in April, 1916. Soon thereafter Mr. Decrow was called to the head office of the Worthington in New York as manager of the waterworks department and continued in this position until his death. It is significant that he remained with what was, to all intents and purposes, the same organization from the time he began his professional work until the close of a successful career.

Mr. Decrow was active in the affairs of the American Society of Mechanical Engineers and chairman of the committee for the revision of test code for reciprocating displacement pumps. He had been president of the Buffalo Club, President of the Park Club at Buffalo, and member of the American and the New England Waterworks Associations.

Slag Association Meets

At the fifth annual meeting of the National Slag Association in Cleveland, Feb. 16, officers elected were:

President, C. L. McKenzie, Duquesne Slag Product Co., Pittsburgh; vice-president, C. E. Ireland, Birmingham Slag Co., Birmingham; secretary-treasurer, H. J. Love, Cleveland.

At the afternoon session A. T. Goldbeck, chief, Division of Tests, U. S. Bureau of Public Roads, discussed with the [illegible] the investigation of slag as an aggregate in concrete which the Bureau has practically completed.

Claim Infringement in Placing Concrete Pneumatically

Alleging infringement of patent rights, the Concrete Mixing & Conveying Co., Chicago, has brought suit against the Ulen Contracting Corp. for the use of the Cox-Webb pneumatic placing machine on the Shandaken tunnel of the Catskill Aqueduct for New York City's water supply. This tunnel, on which the last pair of headings was holed through on Feb. 13, is the longest in the world, covering 18.1 miles. It has a finished section 10 ft. 6 in. by 11 ft. 3 in. and will be lined throughout with concrete.

Steel Locker Manufacturers Plan Reduction of Varieties

As the result of a preliminary conference with officials of the Division of Simplified Practices of the U. S. Department of Commerce, manufacturers of steel lockers have appointed a committee to survey the industry and report at a subsequent meeting on the practicability of eliminating some of the sizes which now are supplied.

It was stated at the conference that more than 100 sizes of lockers are being manufactured and the representatives present agreed that this number is considerably in excess of real needs. Style of lock, ventilation and other features, it was stated, have more influence upon sales than minor variations in sizes.

The committee on survey will not only canvass the situation among manufacturers and distributors but will take up the subject with architects and others who control specifications. C. S. Berger of the Berger Manufacturing Co., Canton, Ohio, was chosen chairman of the survey committee.

Business Notes

SAUERMAN BROS., Chicago, manufacturers of dragline cableways and power scrapers, announce the consolidation of the various departments of their business at 426-440 South 10th St., where the warehouse and shop are located. The general offices will be moved to the new location from the Monadnock Block, where they have been maintained for seventeen years. The company recently appointed as its agent Alfred J. Forschner Co., Philadelphia, for the territory in eastern Pennsylvania, Delaware, and Maryland. Provision has been made also for the carrying of a complete stock of repair parts by three Pacific Coast equipment dealers: Smith, Booth, Usher Co., Los Angeles and San Francisco; Feenaughty Machinery Co., Portland, Ore.; and the Pacific Derrick & Hoist Co., Seattle, Wash.

KANSAS CITY BOLT & NUT CO., Kansas City, Mo., announces the election of W. L. Allen, formerly vice-president and general manager of the Laclede Steel Co., St. Louis, as its president, effective Feb. 1. George T. Cook, who has served for some time as chairman of the board, becomes chairman of the executive committee. Solomon Stoddard, who has been active head of the company as its president for a number of years, becomes chairman of the board.

HUBBARD-FLOYD CO., New York City, has been appointed as distributing agent for the cranes manufactured by the Northwest Engineering Co., Chicago. Stocks of repair parts will be kept on hand to provide for a 24-hr. service.

EUGENE D. WILLIAMS, formerly purchasing agent of the city of San Diego, Cal., heads the Williams-Black-Penn Co., a new organization in that city, selling agents for pipe, tanks, culverts, water meters, etc., with offices at 425 A St.

JOSEPH T. RYERSON has been elected president of Joseph T. Ryerson & Son, Inc., manufacturers of iron, steel and machinery, succeeding Clyde M. Carr, who, on account of ill health, has been unable to take an active part in the management of the organization for the past two years. Mr. Carr, who entered the service of the Ryerson company in 1890, will continue as a director. The newly elected president is the grandson of the company's founder, Joseph T., and brings to his duties a background of 22 years in the steel business. Born in Chicago in 1880, he was graduated from Yale in 1901 and went to work for the American Sheet Steel Co., now the American Sheet & Tin Plate Co., at its mill in Vandergrift, Pa. In October, 1902, he started with the Ryerson organization at Chicago and in 1904 was elected treasurer. He became vice-president of the company in 1911.

J. T. RYERSON

CLYDE M. CARR

JOSEPH A. BOUCHER was appointed sales manager of Gifford-Wood Co. at a recent meeting of the board of directors of that organization. Mr. Boucher for more than fifteen years has served the company, first in its office at Hudson, N. Y., and eventually joining the sales force, later being asigned to the New York office. Mr. Boucher will be located at the company's main office in Hudson. The Gifford-Wood Co. are manufacturers of elevating and conveying machinery, ice tools, etc.

L. D. GRISBAUM, formerly district manager of the Dravo-Doyle Co., Indianapolis, has left that position to become the vice-president and active head of the Dravo Equipment Co. This is a new corporation, organized for the sale of construction and road builders' equipment, with general offices in New York, Philadelphia, Chicago, and Cleveland. Among others, this new selling organization represents the Marsh-Capron Co., manufacturers of concrete mixers, and the Hotchkiss Steel Products Co., manufacturers of steel forms for concrete road, sidewalk, curb and gutter construction.

LESLIE GARLINGHOUSE has been transferred from the main office of the Blaw-Knox Co. in Pittsburgh to the Birmingham, (Ala.) office. There he will act as sales engineer in assisting the Birmingham manager, P. V. Kelly, and will co-operate with the Southern agencies which are handling Blaw-Knox products.

L. V. WALSH, for twenty years treasurer and general manager of sales of the Pittsburgh Shovel Company, Pittsburgh, has resigned. C. B. STEFFY, since 1917 secretary of the company, has been appointed general manager of sales, and also retains his office as secretary.

H. J. KRANZ has been appointed as of Jan. 1, assistant general manager of sales of the Laclede Steel Co., with headquarters in St. Louis. Until his connection with Laclede company early in 1922 he was the Kansas City representative of Carnegie Steel Co., Tennessee Coal, Iron & Railroad Co. and Illinois Steel Co.

S. R. TYLER has been elected secretary of the Laclede Steel Co., St. Louis, Mo., effective Jan. 1. His first connection with the steel industry was with the Republic Iron & Steel Co., at Moline, Illinois, and afterwards at the various other plants of the Republic company throughout the country. He was later employed in the operating department of the Laclede Company, and in 1917 was made purchasing agent.

H. L. HURST who has been assistant general manager of the General Motors Truck Co., Pontiac, Mich., has been elected vice-president of the company, according to an announcement today by W. L. Day, president and general manager. Mr. Hurst has been with the truck company for the last 10 years in various capacities. In his new position Mr. Hurst will be the second officer in charge of the truck company at the factory, while O. E. Stoll, manager of the New York branch and a vice-president of the company will continue in charge of the eastern territory.

H. E. MARKS CORP., manufacturer of gypsum roofs, Pittsburgh, Pa., announces the opening of a New York sales office at 18 West 34th St., in charge of E. P. Cadwallader, and of a new Philadelphia branch office at 703 Harrison Building, in charge of T. R. Galey.

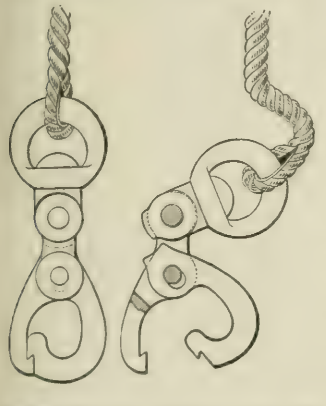
W. H. WINTERROWD has resigned as chief mechanical engineer of the Canadian Pacific Ry. to become assistant to the president of the Lima Locomotive Works, Inc. Mr. Winterrowd's early railway service was with the Lake Shore & Michigan Southern, as assistant mechanical engineer, a position which he left in 1912 to join the staff of the C.P.R., as assistant to Chief Mechanical Engineer H. H. Vaughan.

G. LOISSEAU, the Paris distributor of GMC trucks in France, and W. L. Sherman, formerly General Motors Truck company export man at Paris, were among the visitors at the Pontiac, Mich., factory during the last week. M. Loisseau said that American trucks were coming more and more into preference abroad and predicted that as soon as tariff was revised by foreign countries sales would take a big increase.

Equipment and Materials

Hoisting Accidents Prevented by Closed Safety Hook

To insure safety in hoisting heavy loads with cranes or derricks on construction work a hook equipped with a locking device has been developed by the Yankee Safety Appliances Co., New York City. It is an adaptation of a device designed for detaching lifeboats from ships at sea. The locking principle of the hook is illustrated in the accompanying drawings. It cannot be attached to a load unless it is locked in position and cannot be unlocked until the load is safely landed and the hoisting line slack. The drawing at the left shows the hook locked and in position to carry a load; the one at the right indicates how the hook may be unlatched when the tension on the hoisting rope is released.

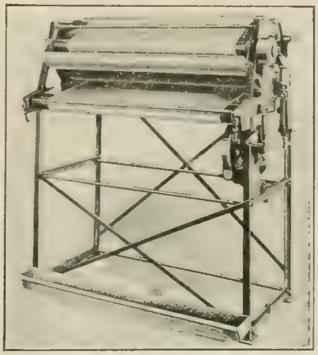


These hooks are made in five sizes with capacities respectively of 2, 5, 10, 15, and 25 tons. On the two larger sizes a handle is provided to facilitate the unlatching of the safety device. The bearing pins are of Monel metal. If desired, a ball-bearing swivel can be provided for the 20- and 25-ton sizes.

Blueprints Dried by Machine With Heated Copper Drum

In the new blueprint dryer perfected by the C. F. Pease Co., Chicago, as accessory equipment to its blueprinting and washing machines, wet sheets are drawn by an endless canvas belt around a heated copper drum, dried at the rate of 8 to 9 ft. a minute and delivered free from wrinkles. Before entering the machine the wet prints pass over a brass roll, which acts as a squeegee, and the traveling apron carrying the sheets is inclined slightly so that surplus water drains away. The dried paper, it is claimed, does not adhere to the copper cylinder, but peels off automatically.

A special feature of the equipment is a patented thermostatic control used when the dryers are heated with gas. When heated electrically the thermostat is replaced by a series of switches, enabling the operator to throw in sufficient current to maintain the proper temperature.



For centering the traveling canvas belt the same arrangement is employed on the dryer as has been in use on the Peerless continuous blueprinting machine. A hand-wheel on either side of the belt enables slight adjustments to be made quickly and accurately. To prevent high maintenance costs, due to the rotting of the canvas bands by constant wetting and overheating, an asbestos apron is provided with the machine. This apron is run into the machine and around the cylinder just before the motor is stopped, providing protection for the belt while the cylinder is cooling off.

The drying machine is suitable for widths of paper up to 42 in. Gear changes offer two ranges of speeds—8 to 9 ft. and 4 to 5 ft. of paper per minute. The equipment is operated by a ⅓-hp. motor.

Elevating Loader on Tractor

The latest design in truck loaders brought out by the George Haiss Manufacturing Co., Inc., New York, consists of a bucket elevator mounted with three-point suspension on a Fordson tractor, as shown in the accompanying photograph. The elevator is equipped with feeding propellers.

The mechanism is controlled by an operator occupying the driver's seat on the tractor, the elevator being driven from the side shaft on which is installed a sprocket connected by chain to a counter-shaft. A clutch makes possible the propelling of the machine without running the elevator. The tractor has a speed of 2 miles an hour backwards and three speeds forward of 2½, 5 and 8 miles an hour. The total weight of the equipment is 6,000 lb. The rig is intended for use in loading trucks or unloading hopper bottom cars at a number of widely separated points.

Publications from the Construction Industry

Spiral Riveted Pipe—AMERICAN SPIRAL PIPE WORKS, Chicago, has issued a new illustrated catalog and price list covering 75 p. In manufacturing this pipe a strip of sheet steel is wound into helical shape with one edge overlapping the other for riveting the seam, the latter process being done by squeezing under pressure and not by percussion or hammering. The several steps in the process of manufacture are described and succeeding pages illustrate notable installations of this pipe within the past 20 years for both high and low pressure. Several pages are given over to a collection of hydraulic tables and charts. A wide variety of special steel fittings also is illustrated. Reference is made to the company's more recently developed lines, including all types of forged steel flanges, large diameter forge welded pipe, and corrugated steel furnaces.

Hard, Dense Concrete — GENERAL CHEMICAL Co., New York, describe its Hard-N-Tyte engineering service for making concrete and stone resistant to wear, water and weather, in a 16-p. illustrated booklet. The foundation of this service is a metallic fluosilicate compound which is introduced into the water used in mixing the concrete. The material is not sold by the pound or barrel, but at a stated price per square foot for the particular result desired. As a general rule, it is stated, the cost does not exceed 3 cents per square foot.

Concrete Foundations — PORTLAND CEMENT ASSOCIATION presents data on the use of concrete for foundation walls and basement of houses in a 19-p. illustrated booklet just issued. The text deals with poured walls and walls built of precast block. Information is given regarding correct concrete mixtures, methods of construction and waterproofing. There are also tables indicating the quantities of material required.

Traction Ditchers—BUCKEYE TRACTION DITCHER Co., Findlay, Ohio, is distributing an illustrated booklet containing performance data on trench excavators. The general description of the Model C machine emphasizes the new rotary auxiliary cutter by means of which a variety of trench widths may be cut with a single machine.

Combined Shovel and Crane—PAWLING & HARNISCHFEGER Co., Milwaukee, in a 16-page illustrated booklet feature the versatility of its ¾-yd. power shovel and crane. By means of interchangeable booms the same machine can be put to eight uses: as a power shovel, a dragline, a clamshell or orange peel bucket crane, a backfiller, a piledriver, a block-and-tackle crane, a skimmer scoop.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

February Contracts Heavier Than Year Ago

More Than Double Value of Awards In Same Month Last Year—Number of Jobs Greater Also

Contracts awarded on important engineering projects in the United States and Canada totaled $123,742,000 for February, as against $142,599,000 for the preceding month, and $123,143,000 during December.

Deducting the Canadian awards for the month, valued at $1,377,000 and consisting mainly of streets and roads, industrial works and buildings, leaves a total of $122,365,000 for entire U. S.

Although the February total shows a seasonal drop of 13 per cent in money value and over 12 per cent in number of projects from the preceding month, it also shows an increase of over 136 per cent in value and 45 per cent in number compared with the same month in 1922.

Minimum costs observed in Construction News on each class of construction are as follows: Water-works, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings $150,000.

The actual number of large contracts in the various classes of construction, together with the average cost per job, compared with January of the current year, are as follows:

Water-works — Thirty-one projects averaging $88,000, as against twenty-six with an average value of $181,000.

Sewers—Twenty-six contracts averaged $82,000, compared with twenty-three, averaging $144,000.

Bridges—Twenty-six jobs averaging $104,000, against thirty-one with an average value of $222,000.

Excavation, Drainage and Irrigation —Number of jobs the same, with average value smaller than in January.

Streets and Roads—Eighty-four projects averaging $223,000, as against 131 with an average value of $165,000.

Industrial Works — Ninety-seven awards with an average value of $95,000, compared with ninety-eight, averaging $253,000.

Buildings—Contracts for 145 averaging $536,000 each, against 162 averaging $41,000.

Federal Government Work—Twenty-three jobs averaging $177,000 compared with twenty-four with an average value of $229,000.

Miscellaneous — Thirty-six projects with an average value of $161,000, against twenty-four averaging $192,000.

Engineering News-Record Construction Cost Index Number

March, 1923	205.25
February, 1923	197.40
March, 1922	162.04
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number advanced 7.85 points since last month, due to higher steel, lumber and cement prices, and stiffening in labor rates. Steel rose to $2.25 from $2.10 per 100 lb., Pittsburgh mill. The average rate for common labor is now 49c. Thus, general construction cost is 26 per cent higher than one year ago and 25 per cent under the peak; it is 105 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
February, 1923 (*4 issues of E. N.-R.*)	**105**
January, 1923 (*4 issues of E. N.-R.*)	126
February, 1922 (*4 issues of E. N.-R.*)	100
1913	100
Yearly	
1922 (entire year)	130
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 105 for the month of February, and 130 for the whole of 1922, as against 100 for 1913. This means that the actual volume of construction in 1922 (not the mere money-value of the contracts let that year) is 30 per cent above the volume of construction for 1913. Our monthly volume number, 105 for February, 1923, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

State Road Programs

Massachusetts appropriations not yet made by the Legislature. Will probably be made by middle of March and are expected to reach $9,000,000.

Rhode Island appropriations total $2,671,844.99, divided as follows: Appropriation, $300,000; motor vehicle registrations (estimated), $1,000,000; Federal Aid allotments for fiscal years 1922 and 1923 are $609,375; special state highway tax to meet Federal allotments, $600,000; unexpended balances from 1922 amount to $162,469.99.

Maryland will have available approximately $3,500,000, and $1,600,000 for maintenance.

Ohio has appropriated about $15,000,000. Awards in the first two months of this year aggregate approximately 43 miles, estimated to cost $1,300,000.

West Virginia has no specific program for 1923 as yet. About $9,000,000 worth of work carried over from 1922 will be completed and paid for this year. This amount is the balance of the $15,000,000 appropriated for road work. There has recently been appropriated $15,000,000 additional to be expended during 1923 and 1924. Of this amount, about $6,000,000 will be let to contract this year.

North Carolina plans to place under contract this year approximately 800 miles, of which 500 miles will be hard

Next week—Road programs of several other states, as per those given in this issue.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING FEBRUARY, 1923

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Canada	Total
Water-works		$481,000	$155,000	$743,000	$1,311,000	$40,000		$2,730,000
Sewers		769,000	157,000	475,000	579,000	151,000		2,131,000
Bridges	$429,000		332,000	370,000	1,552,000	40,000		2,723,000
Excavation, drainage and irrigation		25,000			102,000	238,000		365,000
Streets and roads	647,000	294,000	3,330,000	7,897,000	4,383,000	1,972,000	$258,000	18,781,000
Industrial works	530,000	2,904,000	130,000	3,994,000	778,000	568,000	400,000	9,304,000
Buildings	1,850,000	24,506,000	5,289,000	23,349,000	11,342,000	10,866,000	615,000	77,817,000
Federal Government		895,000	588,000	293,000	171,000	2,126,000	....	4,073,000
Miscellaneous	90,000	2,559,000	1,500,000	238,000	1,232,000	95,000	104,000	5,818,000
Total	$3,546,000	$32,433,000	$11,481,000	$37,359,000	$21,450,000	$16,096,000	$1,377,000	$123,742,000

surface construction, and the remaining 300 miles sand clay, top soil, gravel and macadam. The next letting will probably be in the latter part of March. The stringent material situation existing last fall has been relieved by the establishment of several large stone quarries.

Vermont—Legislature has not yet made appropriations.

Maine—Program not yet approved by the Governor and Council.

New Jersey—Program not available until approved by the State Highway Commission, which has been appointed by the Governor but not yet confirmed by the Senate.

New York—Program will be completed in a few days.

Labor Rates and Conditions Throughout the Country

Industrial conditions have shown continued improvement since the first of the year. Cotton manufacturing has developed greater activity recently than at any time in the history of the industry. Copper also occupies a stronger position than at any time during the last two years. The output of automobiles and trucks has established a new high record. Steel mill operations are at maximum capacity considering the limited labor supply and inadequate transportation facilities.

Latest Department of Labor Reports indicate an increased demand for labor in virtually every state in the union. Manufacturing industries report shortages of both skilled and unskilled operatives. Many mining districts were similarly affected, although production was held up by car shortage. Scarcity of men is reported at lumber mills as well as in the woods. Agricultural and food industries and some of the seasonal vocations, however, show labor surpluses of a purely temporary nature. New England textile mills are running overtime with shortage of skilled help. The building industry was shown to be unusually active throughout the country, considering weather conditions in certain northern sections. Labor shortage, particularly of bricklayers and plasterers, threatens seriously to handicap spring construction projects soon to be under way.

The common labor rate for the nation as applied to pick and shovel men in construction operations, is placed at 49c. per hr. as against 48c. for the preceding month, according to *Engineering News-Record's* figures. Local building conditions are as follows:

Baltimore—Scarcity of bricklayers and hodcarriers, normal supply of other trades. Carpenters strike in progress. Union carpenters' rate 90c.; non-union men receive 80c. per hr.

Birmingham—Growing scarcity of common labor, skilled men apparently plentiful.

Boston—Building activities light on account of recent cold weather but building rush expected in early spring. Just about enough hoisting engineers and hodcarriers available; scarcity of good common laborers. All other trades plentiful.

Chicago—Chicago labor rates based on Landis Award but in many cases higher rates are paid because of labor shortage. Bricklayers for past year have been receiving in many cases $1.50@$1.75 per hr. Plasterers were awarded 78½c. under Landis Award and in several instances are now receiving $10 to $15 per day.

Cincinnati—Supply of bricklayers and carpenters about normal; plenty of other crafts.

Dallas—Small surplus of bricklayers and carpenters. More than enough of most of the other trades. Excessive numbers of common laborers.

Detroit—No change in labor rates announced by Associated Building Employers. Building construction is increasing in volume and demand for men in all trades is brisk.

Kansas City—Labor plentiful in all classes.

Minneapolis—Regular rate for bricklayers $1 per hr. but men receive $1.12½ in many cases because of scarcity.

Montreal—Plenty of hodcarriers and non-union common laborers; no union for latter class. Ample supply of other building trades mechanics. Roofers, electrical workers and painters receive 65c.; plasterers 80c. per hr.

New Orleans—Labor plentiful; no complaint of shortage.

New York—Shortage of bricklayers and plasters may prove handicap to big construction program about to open up in early spring. Manhattan builders fear that plasterers, who are receiving $10 with bonuses of $2 and $4 per day, may demand $16 to $20 per day as is the case at the present time in Brooklyn. Contractors have practised taking men from each other by offering $2 to $5 per day higher than the amount received.

Philadelphia—Scarcity of bricklayers, hodcarriers and common laborers. Shortage of carpenters easing slightly because of recent freezing weather. Fair supply of structural iron workers; plenty of hoisting engineers and pile drivers.

Pittsburgh—Enough building trades mechanics but scarcity of steel-mill workers.

St. Louis—Shortage of bricklayers, being paid $1.37½ per hr. and up, will demand $1.50 May 1. Scarcity of carpenters; premiums being paid, will demand $1.25 per hr. effective May 1. Hoisting engineers rate of $1.12½ expires June 1; will then demand $1.25 per hr. Some carpenters being paid latter rate at present time. Hodcarriers will demand advance of 15c. per hr. to $1 effective May 1. Pile drivers will also ask increase to $1.25 from present rate of $1.12 on and after May 1. Few structural iron workers receiving less than $1.25 per hr., will make scale $1.25 effective Mar. 1. Union common laborers to ask rate of 67½c. per hr. as against 57½c. effective Mar. 1.

San Francisco—Weather conditions good; all construction active.

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90	$0.70	$0.70	$0.30	.	$0.65	$0.30@.35
Baltimore	1.25	.80@.90	.80@1.00	.87½	$0.65	.80@1.00	.30@.45
Birmingham	1.00	.75	.50@1.00	.15@.25	....	1.00	.20@.25
Boston	1.25	1.00	90@1.00	+.80	1.00	1.00	+.60
Cincinnati	1.25	+1.00	+1.00	..+.77½	1.00	+1.00	+.40@.60
Chicago	1.10	1.00	1.10	......	1.10	1.05	.72½
Cleveland	1.25	1.10	1.10	.75	.91	1.10	.75
Dallas	1.37½	1.00	1.00	.40	.87½	1.00	30@.50
Denver	1.25	1.00	1.00	.75@.81¼	1.00	1.03⅛	.35@.50
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	+1.17½	1.00	1.00@1.25	.80	1.00	1.00	+.40@.50
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.50@.62½
Minneapolis	1.00	.80	.80	.65		.80	.35@.50
Montreal	.90	.65	50	—.30	.50		.25
New Orleans	1.00	.85	.90	.60	.80	1.00	.35@.40
New York	1.25	1.12½	1.25	.87½	1.00	1.12½	.50@.60
Pittsburgh	1.30	1.12½	1.00	.90	1.00	1.00	.50
St. Louis	1.25	1.10	1.12½	.85	1.12	1.12½	.40@.50
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.56¼
Seattle	1.12½	.87½	.87½@1.00	.75	1.00	.90@1.00	.50@.60
Philadelphia	1.25@1.37½	.90@1.00	.90@1.00	[illegible]	[illegible]	.90@1.10	.40@.65

Freight Loadings High for This Time of Year

Although freight loadings show seasonal decline due to severe weather conditions, car movements still maintain record totals for this season of the year. During the week ending Feb. 10, 853,289 cars were loaded with revenue freight according to the American Railway Association. This shows a falling off of more than 12,000 cars from the week of Feb. 3. An increase, however, is shown in comparison with the corresponding week last year.

The following table shows a comparison of freight loadings for the same weeks during the last three years:

CARS LOADED DURING SIMILAR WEEKS SINCE 1921

Week Ending	1923	1922	1921
Feb. 10	853,289	777,791	687,867
Feb. 3	865,675	747,895	699,718
Jan. 27	871,164	740,386	701,605
Jan. 20	865,578	731,109	708,658
Jan. 13	873,251	714,191	715,855
Jan. 6	770,303	599,433	697,641

Lumber loadings totaled over 64,000 cars, a drop of about 5,000 from the week preceding, but heavier by 12,000 cars than the same week in 1922.

It is noteworthy that since January, 1923, not fewer than 853,000 cars have been loaded each week; whereas at no time during the years 1921 and 1922 did loadings exceed 777,000 cars in one week. Complaints of car shortages are still heard, particularly from building materials manufacturers and dealers.

Business Briefs

Public contracts in February in the United States amounted to 42 per cent of the total, as follows: first two weeks averaged $13,745,000; third week, $13,906,000; fourth week, $9,410,000. Commercial buildings and industrial works totaled $88,000,000; streets and roads, $18,523,000.

Summing up conditions: "Were the entire financial and business history of the week to be summed up in a single phrase," says *The Annalist*, "it might be said that conditions in the United States, unfettered by the difficulties surrounding them in many countries of Europe, have improved materially. The wheels are turning faster than at this time, say, a month ago and the developments on each week are more or less the addition of new business, the resumption of long idle plants here and there, backed by the inflow of orders for goods and services, which as yet show no signs of diminution."

Money rates have stiffened from 4 per cent to 4½, which is the first advance since the successive declines which lowered the rate from 7 per cent in June, 1920, to 4 per cent in June, 1922.

Sterling advanced to within 14c. of par, a gain of 8c. since the end of January. The principal factor was Great Britain's acceptance of United States terms for the payment of her wartime debt obligations, and the tentative confirmation by Congress.

Contract Prices on Some Large February Contracts

Bridge lumber — 420 pieces bridge lumber, 3x12s, totaling 30,240 ft. b.m., $82.50 per M ft., Minneapolis, Minn.

Crushed stone—3,000 tons at $2.40, Dallas; 6,000 cu.yd. crushed traprock at $4.94, New York; 1,000 tons limestone dust at $5.80, New York.

Cement—Minneapolis bought 120,000 bbl. from four local dealers for $2.52 per bbl., net, f.o.b. cars.

Monthly Prices of Construction Materials

Ups and Downs of the Market

GENERAL upward tendency in basic building materials due to large quantity buying. Pig iron gains strength; steel at minimum of $2.25 per 100 lb., f.o.b. mill as against $2.10 last month; cement undergoing unprecedented demand, prices higher in Mid-West; lumber up $2 in New York, $3 in San Francisco and $4 per M ft. in Chicago, mills shipping as fast as materials can be turned out; steel pipe up; tendency higher in sand, gravel and crushed stone; all paint materials advanced; brick steady in North but rising in South due to labor demands in plants now operating.

Pig Iron—Market gaining strength. Coke price tending downward, but advances in finished steel, due to heavy demand, affecting pig iron prices upward. No. 2 foundry iron up 50c. in Pittsburgh; $1 per ton in Birmingham, Cincinnati and Chicago, during month.

Railway Supplies—Light rails higher at Pittsburgh mills, but maximum on rerolled $2 per ton lower. Standard spikes at minimum of $2.90 as against $2.75 and track bolts $3.85 as compared with $3.75 per 100 lb., f.o.b. Pittsburgh one month ago. Railway ties steadily advancing in Canada, empty cell creosote fir ties up 10c. in San Francisco.

Pipe—Wrought iron pipe discounts on Pittsburgh basing card down four points on black and six on galvanized since last month. Recent reduction in wrought-steel pipe discounts at Pittsburgh reflected in similar lowering in New York warehouse discounts. Following rise in pig iron, cast-iron pipe advanced $1 per ton in San Francisco, St. Louis and Chicago during month. Clay drain tile higher in Dallas; sewer pipe advanced in Pittsburgh, New York, Boston, Cincinnati, Baltimore and Kansas City.

Road and Paving Materials—Seasonal dullness still pervades road oil and asphalt markets. Despite several recent advances in crude oil, asphalt, both bulk and package, declined $3.10 per ton in Minneapolis. Bulk dropped 50c. and package $1.50 per ton in Kansas City. Boston, however, quotes rise of 50c. per ton in both bulk and package asphalt. Granite paving blocks up 15c. per sq.yd. in Boston and $5 per M in Philadelphia. Wood blocks higher in New York, New Orleans, Philadelphia and St. Louis due to lumber advances.

Sand, Gravel and Crushed Stone—Freezing weather and impeded shipments keeping prices up. St. Louis advanced sand and 1½ in. gravel 5c.; Cincinnati, 10c. per cu.yd.; Philadelphia quotes rise of 5c. per cu.yd. in gravel. Both Kansas City and Baltimore, however, report declines. Crushed stone ¾ in., up 5c. in Philadelphia, 20c. in Dallas and 25c. per cu.yd. in Cincinnati; down in Kansas City.

Lime—Hydrated finishing down 40c. per ton in St. Louis, heavier reduction in Kansas City; $1 higher in Cincinnati and up $3 per ton in Boston. Hydrated common down 20c. in St. Louis, sharp decline in Kansas City; up $1 per ton in Boston. Lump finishing declined in Kansas City, rose 50c. per bbl. in Boston and $1 in St. Louis. Common lump lime declined in Kansas City and Minneapolis, rose 12c. in Boston and $1 per bbl. in St. Louis.

Cement—Following mill rise of 10c.@15c. per bbl., adances of 10c. reported, f.o.b. Pittsburgh, Cleveland, Duluth, Minneapolis, Baltimore, Kansas City and St. Paul; 15c. in Chicago, Indianapolis, Toledo, Milwaukee, Peoria, Cedar Rapids, Davenport and Cincinnati; 14c. in Detroit and 25c. per bbl. in Atlanta during month. Unprecedented demand for cement. Western advances expected to be followed by higher prices in the East.

Structural Steel—Demand heaviest since 1920. Plates quoted at $2.20@$2.40 per 100 lb. in large tonnages; small, carlot sales at premium prices, as high as $2.50. Structurals at ruling minimum of $2.25; bars, $2.20@$2.25. Mills heavily booked, but handicapped by car and labor shortage in satisfying demands of consumers. Car materials, oil-tank plates and structurals for spring building season, form bulk of demand.

Brick and Hollow Tile—Common brick rose 50c. in Detroit; $1.15 in Dallas; $1.20 in Baltimore, and $2 per M in Atlanta since February 1. Declines of $1 per M reported in Philadelphia and St. Louis.

Lumber—Market active with all items in good demand. Heaviest mill bookings since 1916. Heavy production rate but shortage of cars. Structural timbers (yellow pine) up $2 per M ft. in New York; Douglas fir advanced $3 in San Francisco. Pine boards, dimension lumber and timbers up $1 in Minneapolis and Philadelphia; $1.50 in St. Louis; $2 in Atlanta; $4 in Kansas City and $5 per M. ft. in Denver since February 1. Hemlock and spruce also reported higher.

Scrap—Market very strong due to demand for finished steel; higher in New York and St. Louis. Quoted prices merely nominal.

Explosives—Few price changes during month; St. Louis about ¼c. per lb. higher on 40@60 per cent gelatin dynamite.

Linseed Oil—Stiffening prices reflect general upward tendency in nearly all paint materials. Raw oil up 8c. in New York and 9c. per gal. in Chicago since last month. Higher prices in Dallas, Minneapolis, Denver and San Francisco.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Mar 1	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	**$29 05**	$20.50
Northern Basic	**29.77**	21.02
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	**30 27**	22.52
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	**33.44**	26.26
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	**25.00**	16.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	**30 14**	21 76
Virginia No. 2 (silicon 2.25 @ 2.75)	33.17	27.74
Basic	**28.50**	19.84
Gray Forge	**29.00**	21.50
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	**30.00**	20.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	**31.01**	22.67
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	**28.50**	21.96
Basic	*28.50*	19.96
Bessemer	29.27	21.46

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh				
	Mar. 1	One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$40 00		$43 00	43.00
Standard openhearth rails	43 00	40.00	$43 00	43 00	43 00
Light rails, 8 to 10 lb.	43@45	28@30	2 00*	43 00	43 00
Light rails, 12 to 14 lb.	43@45	28@30	2.00*	43.00	43.00
Light rails, 25 to 45 lb.	43@45	28@30	2.00*	43.00	43.00
Rerolled Rails	28@30	1.45@1.50*	...	...	....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1 50	$1 65
Chicago, Hardwood and Red Oak	1.25	1.40
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco...... Green Douglas Fir	.84	*1 14*
San Francisco, Empty Cell Creosoted, Douglas Fir	**1.70**	2.25
St. Louis, White Oak	1 30	1.55
St. Louis (creosoted) (zinc treated)	1.70	2.05
St. Louis, Red Oak, plain	1 15	1 40
St. Louis, Sap pine-cypress	1.05	1.30

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					
	Mar. 1	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅜-in. and larger	$2 90	$2 20@2 25	$3 00	$3 60	$4 4[illegible]	$3 29
Track bolts	3 85@4 50	3 25	4 00	4 70	[illegible]	4 29
Standard section angle bars	2 75	2 40	2 75	3.45	4.10	2.94

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	64	52½	¾ to 1½	30	13

LAP WELD

2	57	45½	2	23	7
2½ to 6	61	49	2½ to 4	26	11
7 to 8	58	45	4½ to 6	28	13
9 to 12	57	44	7 to 12	26	11

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	62	51½	¾ to 1½	30	14
2 to 3	63	52½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	55	44½	2	23	9
2½ to 4	59	48½	2½ to 4	29	15
4½ to 6	58	47½	4½ to 6	28	14
7 to 8	54	41½	7 to 8	21	7
9 to 12	48	35½	9 to 12	16	2

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	**54%**	62½%	57%
2½ to 6 in. lap welded	**51%**	59½%	54%
	Galvanized		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	**41%**	48½%	44%
2½ to 6 in. lap welded	**38%**	45½%	41%

Malleable fittings, Classes B and C, banded, from New York stock sell at list less 1%. Cast iron, standard sizes, 29% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York Mar. 1	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	**$49.00**	*$61.00*	$50.50	**$58.20**	$54.60	**$61.00**
6 in. and over	**45.00**	*56 50*	47.30@48.30	**54.20**	50.60	**57.00**

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Mar. 1	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45 00	$40 00	$40 00	$62 50	....	**$73 00**
4	55.00	50.00	40 00	75.00	$76.50	**83.00**
5	80.00	80.00	75.00	100.00	97.75	**108 00**
6	105.00	100.00	75.00	175.00	127.50	**133.00**
8	170.00	150.00	170.00	187.50	212.50	**199.00**

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0 15	$0 108			$0.15	$0 12	.....
4	15	108	$0 10	$0.0875	.15	.15	$0.12
5	21	162	.125	.	.23	.18	.16
6	.21	.162	.150	.1225	.23	.21	.1855
8	35	252	225	20	35	.30	.30
10	515	378	.2925	28	53	.42	.441
12	656	486	.3825	36	68	.54	.567
15	1 07†	[illegible]	.5625	.60†	.90	90	.819
18	1 56†	90	.765	.84†	1.25	1.32	1.071
20	1 87†	1 08	1.0125	1.12†	1.50	....	.....
22	2 496†	1 44	1.2375	.....	2.00	.....	1.44
24	2 808	1 62	1.4625	1.44†	2.25	2.16	1.89
27	4 68†	2 83	.	2.45†	4.69†	3 00	3.34
30	5 20†	3 168		3.00†	5.94†	3.60	4.06
33	6 76†	4 23		3 55†	6 88†	......	4.99
36	7.80†	4 8175	..	3 95†	7.50†	......	5.42

	3	5	8	12	24	36
[illegible]	$0 125	$0.19	$0 30	$0 578	$1 90†	$5 75†
[illegible]			40	72	2.55	5.66†
[illegible]	.135*	.18*	.27	.47	1 7[illegible]	
[illegible]	[illegible]	.	.36	.72	2 60	
[illegible]			.		......	.....
[illegible]	.112	.168*	.28	.476	1.18†	.....
[illegible]	.14	.215	.34	.66	2 25	4.92†
[illegible]	.108	.162*	.27	.459	1 7[illegible]	
Montreal, *delivered*	[illegible]	[illegible]	.70	1.35	4 50†	....
Detroit	.10[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6 15†
Baltimore	.12	.18	.28	.54	1 80	5.2275
Kansas City, Mo.	[illegible]	[illegible]	.54	.90	[illegible]	
Philadelphia	.12	.18	[illegible]	[illegible]	1 80†	4.00†

*4-in., 6-in., 9-in [illegible] special

ROAD AND PAVING MATERIALS

ROAD OILS—[illegible] are prices per gallon [illegible] minimum f.o.b. place named

New York, [illegible]	[illegible]	[illegible]	$0 [illegible]
[illegible]		[illegible]	.046
[illegible]		.06	.06
[illegible]		[illegible]	[illegible]
[illegible]		[illegible]	.06
[illegible]		[illegible]	[illegible]
[illegible]		[illegible]	
[illegible]		[illegible]	.05
[illegible]			[illegible]
[illegible]		.04	[illegible]
[illegible]		.048	[illegible]
[illegible]		[illegible]	[illegible]
[illegible]		[illegible]	[illegible]

[illegible]

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Mexican*)	$20.00	$16.00
Boston (*Mexican*)	20.00	16.50
Chicago (*Stanolind*)	22.25	16.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	17.00*	11.00*
Dallas, (*Texas*)	23.00	15.00
Seattle, "*D*" *grade* (*California*)	21.25	11.00†
Denver (*California*)	40.00	
Minneapolis *f.o.b. Twin Cities* (*Stanolind*)	22.35	16.00
St. Louis (*Mexican*)	27.50	19.75
Baltimore (*Standard Oil*)	21.00	15.00
Los Angeles, *at factory, Bakersfield* (*California*)		
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	22.00	16.50
Detroit (*Mexican*)	23.65	18.95
Cincinnati (*Kentucky Rock*)	22.50	19.50
Maurer, N. J. (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	18.00	15.50
Philadelphia (*Mexican*)	20.00	16.00
Kansas City (*Texas*)	27.30	22.30

*Freight to San Francisco, 80c. per ton.

†F.o.b. Richmond, Cal.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York	5-in. granite, 30 blocks per sq.yd.	$4.45 per sq.yd.
Chicago	About 4x8x4 dressed	3.60 per sq.yd.
	About 4x8x4 common	3.15 per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M
Boston	5-in. granite	2.25 per sq.yd.
Atlanta	Granite	2.10 per sq.yd.
Detroit	5-in Granite	3.00 per sq.yd.
	4-in Granite	3.25 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	100.00 per M
New Orleans	Granite, 4 x 8 x 4	3.25 per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	4x8x4 dressed	3.10 per sq.yd.
	4x8x4 common	2.90 per sq.yd.
Kansas City	Granite	3.75 per sq.yd.
Philadelphia	Granite	135.00 per M.

FLAGGING—

New York	Bronx, 4 ft wide	$0.22 per square
	Manhattan, 4 ft. wide	.22 per square
	Queens, 5 ft. wide	.24 per square
Chicago	6x24-in. cross-walk	1.00 lin.ft.
	18 in. wide	.99 lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 75c.; 5 x 20 in., Queens, 85c. *St. Louis*: Class "A" straight, delivered, 5 x 16 in., $1.40 per lin ft. *Chicago*: 5 x 18 in., delivered, $3 per lin.ft.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2.47
New York (*[illegible]*)	3½	16	3.04
Boston	3½	16	2.35
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50
St. Louis	3½	16	2.75
St. Louis	4	16	3.10
Seattle	4	16	Off market
Minneapolis	3½	16	2.09
Atlanta	3½	16	2.30
New Orleans	3	16	2.10
New Orleans	3½	16	2.30
New Orleans	4	16	2.60
Dallas	4	18	3.90
Baltimore	3½	16	none used
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	2.38
Kansas City	4	16	2.65
Philadelphia	3½	16	2.50

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel				Sand	
	1½ In.		¾ In.			
	Mar. 1	One Year Ago	Mar. 1	One Year Ago	Mar. 1	One Year Ago
New York	$2.00	$1.75	$2.00	$1.75	$1.00	$1.00
Denver	1.90	2.50	1.90	2.50	1.00	1.10
Chicago	2.25	2.00	2.25	2.00	2.25	2.00
St. Louis	1.45†	1.25†	1.65†	1.30†	1.45†	1.20†
Seattle	1.00	1.50	1.00	1.50	1.00	1.50
Dallas	2.25	2.00	2.25	2.00	1.87½	2.00
Minneapolis	1.75*	1.50	1.75*	1.50	1.00	1.00*
Cincinnati	1.50†	2.00	1.50†	2.00	1.25†	1.69
San Francisco	2.15	2.25	2.15	2.25	1.50	1.50
Boston	1.40†	2.40	1.40†	2.40	1.10†	1.65
New Orleans	2.85	2.08½	2.85	2.08½	1.35	1.35
Los Angeles	..	1.50†	..	1.50†	....	1.35†
Atlanta	1.75†	1.85†	1.75†	1.85†	1.24†	1.15†
Detroit	2.25	2.00	2.25	2.00	2.00	2.00
Baltimore	1.86	1.40	2.06	1.60	0.70†	2.00
Montreal	1.25†	1.25†	1.50†	1.50†	1.25†	1.25†
Birmingham (Crushed slag used instead of gravel)					1.25†	1.25†
Philadelphia	1.75	1.50	1.80	1.55	1.70	1.60
Kansas City	1.60†	2.00	1.60†	2.00	0.66*	1.20

New York—Grit, $1.75 per cu. yd.

Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.

* At pit.

† Per ton.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In.		¾ In.	
	Mar. 1	One Year Ago	Mar. 1	One Year Ago
New York	$1.65	$1.75@1.85	$1.75	$1.75@1.85
Chicago	2.25	1.60	2.25	1.60
St. Louis *delivered*	2.00	1.65	2.10	1.65
Dallas	2.00	2.93	2.00	2.93
San Francisco	2.15	2.25	2.15	2.25
Boston, *delivered*	1.85*	3.00*	1.85*	3.00*
Minneapolis, *at plant*	2.00	2.00	2.25	2.25
Kansas City	1.60	2.10	1.50	2.10
Denver	3.50	3.50	3.50	3.50
Seattle *delivered*	3.00	3.00	3.00	3.00
Atlanta	2.00*	1.90*	2.00*	1.90*
Cincinnati	1.75*	2.37½	2.25*	2.08
Los Angeles	.....	1.75*	.....	1.85*
Detroit	1.90@2*	1.90*	1.90@2*	1.90*
Baltimore	2.37	1.75*	2.43	1.65*
Montreal	1.80*	2.00*	1.90*	2.10*
Birmingham *delivered*	3.20	3.20	3.10	3.10
Phildelphia	1.80*	1.70*	1.65*	1.55*
Pittsburgh	2.85	....	2.85	....
Cleveland	3.00*	....	3.00*	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
East Canaan, Conn.	1.25	1.35	4.00	1.00
Easton, Catasaqua, Pa.	1.00	1.00	2.00	0.90
Birmingham, Ala.	1.00	1.00	1.00	1.00
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.20	1.20	....	1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2.00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$16.80@$17.10	$13.10	$3.75*	$3.00@$3.25*
Chicago	20.00	20.00	1.50†	1.50†
St. Louis	22.00	19.00	18.75‡	18.75‡
Boston	21.00	14.50	4.40*	3.12*
Dallas	22.50		....	2.50†
Cincinnati	16.80	13.30	....	10.75‡
San Francisco	22.00	16.00	....	1.75†
Minneapolis	25.50	21.00 (white)	1.55†	1.25†
Denver	24.00	....	....	2.70†
Detroit	19.50	17.50	....	18.25‡
Seattle *paper sacks*	24.00	.....	2.80†	.....
Los Angeles	.....	....	....	.....
Baltimore	22.00	16.25	....	.....
Montreal	21.00	21.00	15.00‡	11.00‡
Atlanta	23.00	20.00	2.25†	1.85†
New Orleans	.....	17.25	2.40†	....
Philadelphia	15.50	14.50	13.00‡	12.00‡
Kansas City	20.00	16.00	13.00‡	13.00‡

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.55, Sheboygan $1.45. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Mar. 1	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.50	1.60
Atlanta (Magnolia)	11.00 per ton	11.00 per ton
Cincinnati (Utica)	1.72	1.93
Boston (Rosendale)	2.60	0.85 per bag
St. Louis (Carney)	1.75	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Mar. 1	One Month Ago	One Year Ago
New York, del. by truck	$2.60@2.70	$2.60@2.70	$2.30
New York, alongside dock to dealers	2.30	2.30	2.00
Jersey City	2.48	2.48	2.12
Boston	2.75	2.75	2.50
Chicago	2.20	2.05	1.94
Pittsburgh	2.24	2.14	2.02
Cleveland	2.46	2.36	2.26
Detroit	2.47	2.33	2.17
Indianapolis	2.41	2.26	2.21
Toledo	2.48	2.33	2.20
Milwaukee	2.37	2.22	2.13
Duluth	2.14	2.04	1.95
Peoria	2.41	2.26	1.98
Cedar Rapids	2.48	2.33	2.11
Davenport	2.43	2.28	2.06
St. Louis	2.35	2.35	2.20
San Francisco	2.71	2.71	2.73
New Orleans	3.30	3.30	3.20
Minneapolis	2.39	2.29	2.24
Denver	2.85	2.85	2.90
Seattle	2.90	2.90	2.94
Dallas	2.25	2.25	2.40
Atlanta	2.75	2.50	2.39
Cincinnati	2.54	2.39	2.32
Los Angeles	....	....	3.30
Baltimore	2.61	2.51	2.50
Birmingham	2.40	2.40	2.27
Kansas City	2.45	2.35	2.40
Montreal (*delivered*)	2.88	2.15	2.40
Philadelphia	2.41	2.41	2.21
St. Paul	2.39	2.29	2.24

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind	$1.95	La Salle, Ill.	$2.05
Universal, Pa.	2.00	Hudson, N. Y.	2.20
Steelton, Minn.	1.95	Leeds, Ala.	2.20
Fordwick, Va.	2.20	Hannibal, Mo.	2.10
Mitchell, Ind.	2.05	Lehigh Valley District	2.10
Iola, Kan	2.10	Wyandotte, Mich.	2.05
Mason City, Ia.	2.05	Alpena, Mich.	1.85

TRIANGLE MESH—Price per 100 sq.ft in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh. Mill	Warehouse New York	Chicago	St. Louis	Dallas	San Francisco
032	22	$0 89	$1 17	$0 96	$0 98	$1 09	$1 03
049	28	1 13	1 49	1 23	1 25	[illegible]	1 34
068	35	1 38	1 83	1 50	1 53	1 61	1 68
093	45	1 78	2 35	1 93	1 97	[illegible]	2 10
126	57	2 19	2 85	2 38	2 44	[illegible]	2 60
153	68	2 62	3 39	2 85	2 91	[illegible]	...
180	78	3 00	3 85	3 27	3.34	[illegible]	..
245	103	3 97	5 25	4 32	4 41	[illegible]	..
287	1[illegible]9	4 58	6 14	4 98	5 09	[illegible]	5 43
336	138	5 31	7.05	5 78	5 90	[illegible]	
395	160	6 16	8 13	6 70	6 85	[illegible]	....
PAVING							
036P	17	$0.68	$0 88	$0.74	$0 75	[illegible]	...
053P	24	96	1 19	1 04	1 06	[illegible]	.....
072P	31	1 21	1 58	1 32	1 34	[illegible]	....
097P	40	1.56	2 08	1 70	1.73	1 84	....
049R	24	96	....	1.04	1.06	[illegible]	. .
067R	31	1 21	....	1.32	1 34	[illegible]	
089R	40	1.56	..	1.70	1.73	1 84	

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27Dia.	2.3	$22 00	$20 39	$20 72	$20 00	$25 50
26 "	2.5	22 00	21 93	22 39	[illegible]	27 58
25 "	3.0	22 00	24 45	24 93		30 71
24 "	3 4	24 00	26 33	27 10	[illegible]	33 16
22 "	4.33	27 00	31 06	32 27		35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut New York	Chicago	St. Louis	Dallas	San Francisco
¾ and larger ...	$2 00	$2 35	$3 19	$3 07½	$2 90	$3 15	$3 30
⅝....	2 05	2 45	3 24	3 12½	2 95	3 20	3 35
½	2 10	2 55	3 29	3 17½	3 00	3 25	3 40
⅜....	2 25	2 60	3 34	3 32½	3 15	3 40	3 55
¼.... .	2 50	2 65	3 69	3 57½	3 30	3.65	3.80

Includes 15c charge for cutting to lengths of 2 ft and over

Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¾ and larger	$2 10	$2.60	$2 85	⅜	$2 35	$2 85	$3 10
⅝ in	2 15	2 65	2 90	¼ ...	2 60	3 00	3 35
½.......	2 20	2.70	2 95	....	....	..	

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common Mar. 1	One Month Ago	One Year Ago	Paving Block 3-inch*	4-inch*
New York (del.). . .	$23 50	$23.50	$21.40	$42 00†	$50 00†
New York (at dock)..	20.00	20 00	18.00		
Chicago...........	11 00	11 00	11 00	34 00	42 00
St. Louis, salmon...	[illegible]	16 00	17 00	36 50	[illegible]
Denver, salmon ..	12 00	12 00	14 00		.
Dallas.............	11 00	9 85	11 00	33 00	.
San Francisco	15 50	15 50	15 50		.
Los Angeles (del.)...	.		15 00	[illegible]	
Boston. . .	20 00	20 00	16 00	72 00	72 00
Minneapolis (del.)...	17@19	17@19	15.00	.. ..	43 00
Kansas City........	14 50	14 50	14 50		......
Seattle	13 00	13 00	14 00	50 00	
Cincinnati . . .	18 00	18.00	17 00	43 00	43 00
Montreal	16 00	16 00	16 00	100.00‡	68 00
Detroit (del.).....	16 50@17 50	16 50@17	16 50	38 50	41 50
Baltimore (del.).....	19 20	18 00	20.00	40 00	45.00
Atlanta...........	12 00	10 00	8 25	39.00	......
New Orleans......	15 75	15 75	12.50	.	......
Birmingham .. .	12 50	12 50	10.50		...
Philadelphia	[illegible]	20@28	16.00	40 00	48 00
Pittsburgh (del.)	16 00	16.00	.		
Cleveland	16 00	16.00			

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † f.o.b. ‡Imported

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York Mar 1 on Trucks*	New York One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J. Factory*
4x12x12	$0 123	$0 1112	$0 0674	$0 12	$0 [illegible]	$0 [illegible]	
6x12x12	1844	1667	0926		.11	[illegible]	
8x12x12...	2305	2084	1263	1875	15	244	$0 2147
10x12x12			1621	. .	.18		[illegible]
12x12x12			1853	..	22		3448

* 5 per. off for cash

	4x12x12	8x12x12	[illegible]
Boston	$0 11	$0 21	
Minneapolis (f.o.b. cars)	[illegible]	[illegible]	[illegible]
Minneapolis (delivered) .	0836	[illegible]	[illegible]
Cincinnati	[illegible]	[illegible]	
Kansas City	083	145	
Denver	065	123	[illegible]
Seattle (delivered)	11	25	
Los Angeles (f.o.b. [illegible])		...	
New Orleans	12	23	[illegible]
Detroit (delivered)	09	175	[illegible]
Montreal	115	225	[illegible]
Baltimore .	10	.215	
Atlanta . .	[illegible]	.1615	.
Dallas	115	.	
Birmingham	11	18	
Pittsburgh (delivered)	068	[illegible]	172
Cleveland	08	[illegible]	

San Francisco, Philadelphia, Atlanta, New York and [illegible] partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill , Pittsburg and Birmingham together with quotations per 100 lb. from warehouses at place named

	Pittsburgh, Mill	Birmingham Mill	Warehouse New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$2 15@2.25	$2 40	3.29	$4 40	$3.00	$3 05	$3.35
Channel, 3 to 15 in.	2 15@2.25	2 40	3 29	4 40	3.00	3 05	3 35
Angles, 3 to 6 in., ¼ in thick	2 15@2 25	2 40	3.29	4 40	3 00	3 05	3 35
Tees, 3 in and larger	2 15@2 25	2 40	3 29	4 40	3 00	3 05	3 35
Plates, ¼ in. thick and heavier	2 15@2.25	2 40	3 29	4 40	3.00	3.05	3 45

RIVETS—The following quotatiens are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	Warehouse New York Mar. 1	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
¾ in. and larger	$3 00	$3 85	$3.50	$3 75	$3 85	$4 75	$4 95
CONE HEAD BOILER							
¾ in and larger.	$3 10	3.95	3 60	3 85	3.95	4.85	5 05
⅝ and 11/16........	3 25	4.11	3 76	4 00	4.10	5.00	5.20
½ and 9/16.... ...	3 50	4.35	4 00	4.25	4.35	5 25	5.45

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.........	$2.80@3.00	$3 45	$4 10	$4 [illegible]	$3.14	$4 95
Cut...........	3.20@3.25	5.50	5.80	5.75	3.24	5.00

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.10 per roll in carload lots and $2.70 for smaller quantities f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.50 per square (sufficient to cover 100 sq.ft.) in carloads; $5.75 in smaller quantities, f.o.b. Philadelphia Strip shingles (4 in 1) f.o.b. Philadelphia. l c.l., $6.05.

ROOFING MATERIALS—Prices f.o.b. New York, in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton............... ...	$73.50
Tar pitch (in 400-lb. bbl.), per 100 lb.	1 62½
Asphalt roofing (in barrels), per ton, f.o.b. plant*.....................	37.00
Asphalt felt (light), per ton, f.o.b. plant*............................	67.50
Asphalt felt (heavy), per ton, f.o.b. plant*...........................	67.50

* Delivered in Metropolitan Dist., $3,00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base [illegible]

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10.....	$2 50@2.75	4.10	$4.00	$4 35	$4 19
No. 12.............. .	2.60@2.85	4.15	4 05	4 40	4 24
No. 14	2 70@[illegible]	4 20	4 10	[illegible]	4 29
No. 16	2 90@[illegible]	4 30	4 20	[illegible]	4 39
Black					
*Nos. 18 and 20......	3 20@3.35	4.65	4.70	5 70	4 70
*Nos. 22 and 24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
*No. 26...	3 30@3.45	4.75	4 75	5 80	4.80
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Galvanized					
No. 10........... .	[illegible] 3 75	[illegible]	[illegible]		[illegible]
No. 12...............	3 45@3 85	4.95	4 95	5.85	5.00
No. 14	[illegible] 3 85	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] 4 15	[illegible]		[illegible]	[illegible]
[illegible] 24	[illegible] 4 30	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] 4 45	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] 4 75	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

LINSEED OIL—[illegible]

	[illegible] Mar. 1	[illegible]	Chicago Mar. 1	One Year Ago
[illegible]	[illegible]	[illegible]	$1 07	$0 91

WHITE AND RED LEAD—Base price in cents per pound:

	Red				White	
	Mar 1		1 Year Ago		Mar. 1	Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	**14 25**	**15 75**	12.25	13.75	**14 25**	12.25
25 and 50-lb. kegs	**14 50**	**16 00**	12 50	14 00	**14 50**	12 50
12½-lb. keg	**14 75**	**16 25**	12 75	14.25	**14 75**	12.75
5-lb. cans	**17 25**	**18 75**	15 25	16 75	**17 25**	15.25
1-lb. cans	**19 25**	**20 75**	17.25	18 75	**19 25**	17.25

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional.

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	**$38 00**	**$39 00**	**$40 00**	**$43 00**
3x6 and 8	**38 00**	**39 00**	**40 00**	**43.00**
4x4-6 and 8	**38 00**	**39 00**	**40 00**	**43 00**
3x10 and 12	**38 00**	**39 00**	**40 00**	**43.00**
3x14	**40 00**	**40 00**	**42 00**	**44 00**
4x10 and 12	**38 00**	**39 00**	**40 00**	**43 00**
4x14	**40 00**	**40 00**	**42.00**	**44.00**

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	**$40 00**	**$42.00**	**$44 00**
6x14	**40 00**	**42 00**	**44 00**
8x10	**40 00**	**42.00**	**44 00**
8x14	**40 00**	**42 00**	**44.00**

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22–24 Ft.	20 Ft. and Under	22-24 Ft.
3x 4 to 8x8	**$51 00**	**$52 00**	**$54.50**	**$56 50**
3x10 to 10x10	**54 00**	**55.00**	**57.50**	**59 50**
3x12 to 12x12	**58 00**	**59 00**	**60 50**	**62 50**
3x14 to 14x14	**64 00**	**65 00**	**65.50**	**67 50**
3x16 to 16x16	**71.00**	**72.00**	**70.50**	**72 50**
3x18 to 18x18	**84.00**	**85.00**	**82.50**	**83.50**
4x20 to 20x20	**94.00**	**95.00**	**93.50**	**95.50**

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under				12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	**$67 00**	$125.00	$65.00	**$65 00**	**$90 00**	$140 00
Seattle	.....	28 00	.....	.....	.....	**29 00**
New Orleans	**40 00**	.....	.....	35.00	**45 00**	.....
Baltimore	35.00	**53.00**	**53 00**	60.00	50.00	53.00
Cincinnati	**45 00**	**51.50**	**51.50**	**51.50**	*45 00*	**53 50**
Montreal	50.00	50.00	40.00	38.00	**95 00**	90.00
Los Angeles	.....	.....	.....	.....	.....	.....
Denver	.....	41 00	44.00	**41.00**	.....	**51.00**
Minneapolis	**46 50**	**43.75**	41.00	.....	**49.00**	44.75
Atlanta	33 00	.....	.....	.....	**37 00**	.....
Dallas	**48 00**	.....	.....	.....	**53 00**	.....
Kansas City	**43.75**	.....	.....	.....	**56 75**	.....
Birmingham	32.00	.....	.....	.....	40.00	.....
Philadelphia	45.00	**40.00**	40.00	44.00	**56 00**	**40 00**
Detroit	46.75	48 25	.....	.....	55.75	48.25
St. Louis	*44.00*	.....	.....	.....	**51 00**	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	$50.00	$85.00	$50.00	**$60 00**	$100 00
Seattle	.....	24.00	.....	.....	26 00
New Orleans, at mill	**85.00**	.....	.....	39.00	.....
Baltimore	65.00	**44 00**	**44 00**	**37.00**	55.00
Cincinnati	*60.00*	**82.00**	**82 00**	35.00	*78.00*
Montreal	60.00	50.00	37.00	45.00	45.00
Los Angeles	.....	.....	.....	.....	.....
Denver	.....	**37.25**	**37 25**	.....	36.25
Minneapolis	48.50	**42.50**	38 50	43.75	**41.25**
Atlanta	17 00	.....	.....	27.00	.....
Dallas	**48 00**	36.00	.....	**51.50**	.....
Kansas City	**78 00**	**60 00**	.....	*44.20*	**47.50**
Birmingham	28 00	.....	.....	32.00	.....
Philadelphia	**35.00**	**41.50**	40.00	55.00	**40.00**
Detroit	48 00	40 00	.....	46.50	41.50
St. Louis	*45 50*	.....	.....	*35.50*	.....

Birmingham—Quotes carload lots, f.o.b. sidings. $1.50 additional per M. ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractors on large projects.

St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M. ft. additional.

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M. ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0 315	Detroit	$0 295
Birmingham	.69	Kansas City	.735
Boston	.365	New Orleans	.515
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.50†
Cincinnati	.295	Philadelphia	.325
Cleveland	.215	St. Louis	.43
Denver	1.275*	St. Paul	.595

* Minimum carload, 40,000 lb.

†Minimum carload, 50,000 lb., structural steel only; 80,000, lb. for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Mar 1	One Month Ago	One Year Ago
$2.15@2.30	$2@2.05	$1 80

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	25%
Patent flattened strand, special and cast steel	25%
Patent flattened strand, iron rope	10%
Plow steel round strand rope	40%
Special steel round strand rope	35%
Cast steel round strand rope	27½%
Round strand iron and iron tiller	10%
Galvanized steel rigging and guy rope	12½%
Galvanized iron rigging and guy rope	+7½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ⅝-in., 8 ft., ¾-in., 6; ⅞-in., 4½; 1-in., 3½; 1⅛-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0 16¼	New Orleans	**$0 18¼**
New York	**18**	Los Angeles	...
Chicago	18	Seattle	18
Minneapolis	.20½	St. Louis	**.20½**
San Francisco	.16	Montreal	.30
Atlanta	.18¼	Detroit	.19
Denver	**.22**	Baltimore	.18
Cincinnati	.20	Kansas City	**.21½**
Dallas	.129	Birmingham	20½
Philadelphia	.18		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin	
	40%	60%
New York	$0.27	$0.30
Boston	.23	.25
Kansas City	.2225	.2525
Seattle	.165	.195
Chicago	.22	.25
Minneapolis	.189	.2094
St. Louis	**.2225**	**.2525**
Denver	.2025	.2325
Dallas	.29	.375
Los Angeles	....	.....
Atlanta	.23	.26
Baltimore	.215	.225
Cincinnati	.22	.25
Montreal	.195	.235
Birmingham, *delivered*	.20	22
New Orleans	.235	.265
San Francisco	.1625	.1925
Philadelphia	.25	.28

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.13	$0.17½
12 in.—2 ft. from butt.	6 in.	50 to 59 ft	0.17½	0.22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.19¼	0.24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.25	0.34
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	**$17 00**	$11 50	$16.00
Stove plate	**16 00**	12.00	16.50
No. 1 machinery cast	**20 00**	16.50	20.00
Machine shop turnings	**13 00**	4.00	**10 00**
Cast borings	**14 00**	5.50	11.00
Railroad malleable cast	**19 00**	12.50	18.50
Re-rolling rails	**19 00**	13.00	20 00
Relaying rails	**28 50**	30.00	**28@32**
Heavy melting steel	**17.50**	....	....

SHIP SPIKES—Current prices per 100 lb.:

	San Francisco		Seattle
In.	Galv.	Black	Black
¼	**$8 25**	**$6.25**	**$8.00**
⅜	**7.30**	**5.80**	**7.75**
½	**7 15**	**5.65**	**7.70**

Pittsburgh base in lots of 200 kegs or more, $3 50.

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

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For Railway Engineers—and Others

ONCE a year there meets at Chicago a representative group of the engineers who are building and maintaining the railways of this country, there to discuss the problems of their work. This issue of *Engineering News-Record* is directed not alone to the men who meet at Chicago but to the large body of men of their type, for the entire group of such men many times outnumbers the few who can attend the A. R. E. A. convention. Future possibilities and past performances are both represented in the articles that follow. It is to be hoped that they will be read and appreciated not only by the engineers in railway work but by all the engineering profession, for while railway engineering is specialized many of its lessons are applicable to the whole field of engineering practice.

Southern Road Building

AROUSED by the success of North Carolina in developing at high speed an excellent state road system following its loan of $50,000,000 for construction, the other Carolina to the south and Tennessee at the west are conducting promising campaigns for large bond issues for public roads work. The amount contemplated in South Carolina is $60,000,000 and in Tennessee is $75,000,000. With a further issue of $15,000,000 by North Carolina and the $60,000,000 borrowed by Missouri this northern tier of southern states has in mind an expenditure of over a quarter of a billion dollars for highway construction. Evidently the "awakening of the South" to the importance of good roads and the inauguration of its states into the list of fast spending road-building states, are not to suffer in comparison with any similar activity of the North. There is something a little finer in this spirit which is urging these states to great highway expenditures than in the willingness of the states of the North to assume large debts for transportation facilities. While the northern states have built for traffic in hand these states of the South are borrowing money to develop a country and its road transport. None of the states named have had roads in the sense that they have existed in New York and New Jersey for a score of years. They are involving their credit to create out of their network of trails a system of modern highways. This is a bolder task than enlarging highway facilities for a traffic that already exists. The South in the next few years is likely to win the record of great mileages per annum of highway construction now held by the middle western states.

A Proper Rebuke

WHATEVER be the breach of the ambassadorial proprieties in George Harvey's speech last week on the British loan it was a useful reminder not only to the British people but to a whole continent of Europe which is too easily falling into the acceptance of the United States as the sole beneficiary of the war. So long as they believe over there—as most of them do now believe—that this country was a usurious money lender during the war and a demanding creditor today, thus long will be withheld those desirable friendly relations the world now needs and that desirable commercial comity which is necessary to a full development of foreign trade. The antagonism to the United States of an individual purchaser is not important nor is even group antagonism serious now when there are few with money enough to buy, but sooner or later Europe will begin to come back to a purchasing basis and then good feeling toward the United States may shift the balance toward a successful foreign business. Ambassador Harvey was a little brusque in reminding some distinguished Englishmen of the limits to which domestic politics led one of their equally distinguished fellows, but brusqueness has before this proved to be an admirable feature of American diplomacy. A few more such plain statements, a few fair but not boastful references to the vast volume of international charity originating here, all properly broadcast from Wales to Lithuania, may impress the Europeans that this country resents the rôle in which most European politicians would cast it, and better still may serve to disabuse the European people of some popular misconceptions of the United States.

Multiplying Railway Terminals

RAILWAY terminal planning in Chicago has reached a point of obvious conflict of prospective facilities. Independent projects for the reconstruction of certain stations include provision for accommodating the roads now using other stations. In other words, each of two or more projects proposes to make the other project unnecessary. Where railways own valuable property and have large investments in facilities for their own use it may not be easy to persuade them to become tenants of other stations, but careful study might show real economy in the sale of present property, or its utilization for revenue-producing purposes, with the consequent reduction in fixed charges and overhead expenses. Such a policy of co-operation and combination might be favored also in view of the large cost of reconstruction of all the stations. In any case it would be unfortunate to perpetuate three costly new stations practically side by side, which would be the result if all the projects were carried out. If the groups of railroads now occupying the present three stations whose reconstruction is proposed should be combined in one new station or partly distributed among existing stations, Chicago would have all its railways combined in not more than four great stations. To distribute passenger terminals in separate traffic centers is proper foresight, now that city congestion looms so large as a municipal problem. In a city so large as Chicago—or even in one the size of Cleveland—one station would be a monstrosity but there is a limit to the multiplication of terminals.

Charging for Garbage Collection

GARBAGE collection is one of the services that every city and town should render its householders. Preferably collections should be made by the municipalities but a well drawn and supervised contract service may be warranted under some local conditions. Unless a municipality is in a bad way financially the service should be free. Where cities are in dire financial straits (as many are in Ohio, under legislative restrictions on both taxation and bond issues) it may be wise to charge householders for garbage collection, in the hope that it will be temporary only. Bucyrus, Ohio, has recently passed an ordinance for municipal collection with a monthly charge of 50c. a house, payable quarterly in advance, and with a requirement that the householder must carry the garbage can to the street or alley. Here are two petty annoyances to the householder: Paying $1.50 four times a year, and carrying the can to the street. In addition, the city must do much bookkeeping and collecting, all of which would be obviated if the cost of the service were included in the general tax levy. With a condition and not a theory confronting Ohio cities the Bucyrus plan has justification. Presumably the citizens of Youngstown, Ohio, would pay a collection charge rather than have their garbage accumulate as it began to do on Feb. 1 because there were no longer funds to pay the contractor for collection and disposal. Both these cities show at least a will to do better for their people than large and wealthy San Francisco, where garbage is still collected by private scavengers.

Work Ahead

INSISTENT attention is once more directed to the serious problem of railway track. The third report on track stresses brings out much more sharply and clearly than the previous ones how dangerous a tax is placed on the rail. Stresses are reported than run far beyond 50,000 lb. per square inch, and even to 75,000. Such stresses are ample reason for the frequent failure of rails. So long as they continue to occur, track conditions will be abnormal and unsound, and the track problem—the problem of track safety and operating economy—will remain an unsolved, disturbing problem.

There is work ahead in dealing with this problem. It is one in which track builder and locomotive builder are jointly concerned, and only their joint study will bring results. Up to the present, each has gone his own way, one in developing the track, the other in developing the loads that are carried by this track. The time has come when this independent progress is no longer satisfactory; what it leads to may be read from the Track Stress committee's researches. The traditional system of railway organization is responsible for keeping the engineering and motive power men apart; it is time to see what can be done when the two departments work together instead of separately.

In another article in this issue the views of an experienced railway man on coming railway engineering needs are set forth. Among other things he declares that the development of railway motive power has followed a doubtful course, and that the ultimate cost of operation with the heavy, unbalanced engines of today is quite unknown. He calls for a working together of the engineers concerned with track and vehicles. Precisely this demand speaks from the figures revealed in the report of the Track Stress committee..

In a general way the dangerous condition of track resulting from bad locomotive counterbalance and other mechanical imperfections of the engine as a vehicle were set forth in the preceding report, the second report of the committee. The three years of investigation since that report fully confirm and reinforce its teachings in this respect. They go much farther, however, and by their figures on lateral stresses and curve actions they demonstrate that the lateral stresses existing on straight track as well as the vertical and lateral effects on curves increase the seriousness of the condition to an extreme degree.

In particular, the study of curve action makes the picture of track phenomena now complete in its broad outlines. The erratic action of railway vehicles on curves is disconcerting to those who hope for rational and safe track engineering; the vertical load effects are abnormally different from what calculation would indicate, and the lateral thrust and blows are quite alarming. But the significant part of the whole story is that these dangerous effects occur under some locomotives and not under others. With the same wheel loads, some locomotives are easy on the track, while others are a constant menace to the integrity of the track and the safety of trains that run over it. This is the condition that first of all calls for remedy.

It should be remembered that there is no field of construction in which engineers venture to stress material of even the highest quality to the extent that rails are stressed. Even in purely static service, and with metal whose strength is double that of rail steel, as in the cables of suspension bridges, the stresses do not exceed those which we tacitly accept in railway track service. Given a metal like that of rails, and service involving such concentrated pressures and such tremendous blows as are exerted by locomotives and cars, no sane engineer would think for a moment of designing or building on the basis of stresses between 50,000 and 75,000 lb. per square inch; and if, in a structure in service, he found such stresses existing he would immediately reduce the load or proceed promptly to strengthen his structure.

The fact is that railway engineers have been working for years to strengthen their track structure. Heavier rail has been laid, better track fastenings used, deep ballast put in—and yet the high stresses exist. Endless discussion also has been waged over rail quality. Every one concedes that better rail steel is needed, the dispute being over how it shall be improved; but even with perfect rail steel, the track problem will not approach a solution while stresses of the present magnitude are permitted. They must be reduced, and, as the track builder alone cannot reduce them, he must have the co-operation and help of the locomotive builder and motive power man.

Present railway track has reached a point of development where no marked increase in robustness or carrying capacity can be expected for a considerable time to come. The track, therefore, is one of the data on which the method and devices of railway operation must be based. Locomotive construction must be based on the available strength of the track, in other words. This is the fundamental view, we believe. It is not new, but it has been only a subconscious thought in the railway mind. With detailed facts on track stresses available, it should now become definitely conscious, and be made the controlling view in dealing with the joint problem of railway vehicles and track.

Still a Place for the Railway Engineer

BECAUSE of the recent decline in railway construction and expansion and the resulting limitation of the field of employment for railway engineers, there has been a tendency to become discouraged over the outlook for their future. This is but natural; yet such an attitude fails to take into account a number of counter influences, some of which are suggested by the interview with W. S. Kinnear, reported elsewhere in this issue.

In the early days of railway building the locating engineer was close to the heart of the enterprise and developed both the science and the art of his profession to a noteworthy degree. Then, during the period of unrestrained and all too often unscrupulous competition, came the day of the traffic man, who, in the role of "business getter," became an important figure in the transportation industry. With the coming of increased governmental supervision, with more restricted competition, and with uniform rates and regulations, came the need for increasing efficiency in the conduct of the transportation business, with increasing emphasis upon the work of those charged with operation. We are still living in this period, but, as indicated by Mr. Kinnear, there is need for a new attack by the engineer upon the railway problem; this time to readjust his transportation structure to the changed conditions under which it must now function, and to tackle anew some of the problems that many have looked upon as being quite settled and standardized.

Some railway engineers already have read the signs of the times and have applied themselves to their new responsibility. This, of course, has been most evident in the field of maintenance, which has continued under the charge of the engineer and which has been profoundly affected by modern operation. So harassing has this problem become that relief is being sought either in a reduction of the loads to be cared for or in new designs for the track structure that will decrease the heavy and continuing maintenance charges. Under these conditions maintenance work no longer can be regarded as a mere routine performance, for it has become a challenge to the ingenuity and resourcefulness of the engineer of the highest type.

In addition to more complicated requirements in the maintenance of way and structures, the emphasis on more efficient operation has been reflected in the work of the engineer by the vast amount of "additions and betterments," which have been undertaken to provide more ample and more economically operated facilities for handling increasing traffic. New freight yards, freight houses, engine terminals, yard extensions, double tracking, bridge renewals, shop construction, and revision of line and grade, all are in this class, and all these will demand increasing study on the part of the railway engineer who is to deserve his proper place in the railway scheme of things.

Be it noted, however, that in approaching these tasks there is need for a generous measure of the research spirit and for a scientific outlook that will regard them as engineering problems demanding analysis clear back to the fundamental principles involved, and the working out of solutions that will be based upon fact and reason rather than upon mere precedent or custom. The exchange of experiences between engineers engaged in similar work always is decidedly worth while, but its real value lies in its power to stimulate originality rather than in the opportunity it offers for substituting ready-made solutions for independent engineering thought. Standardization of practice likewise is valuable in many fields because of the economies that can be effected by uniform practice, but eternal vigilance is necessary lest excessive standardization become a drag upon progress and discourage independent thinking. In an industry in which so much of the engineering work has in recent years become largely a matter of standards and routine administration, there is grave danger of permitting the questionnaire to usurp the place of research and an over-developed respect for prevailing practice to stifle the exercise of original thought and engineering judgment. The problems that now beset the railway engineer and that will demand his attention in the days just ahead of us will not yield to such treatment.

Engineers for Railway Track Work

ALTHOUGH the supervision of modern track maintenance is requiring more and more of technical skill and knowledge, it is a strange fact that few railways or railway engineering departments offer much opportunity or encouragement for the young engineer desiring to make a specialty of maintenance-of-way or to acquire personal experience with the details of the work. This is not new statement, but the situation is called to attention anew by the article on another page reviewing engineering opinions on various phases of maintenance and showing how little recognition appears to be given to the practical and economic value of engineering knowledge in relation to track maintenance.

It is hardly necessary to say that a man may be a competent engineer of maintenance without having the ability to drive a spike straight or to surface a stretch of track. But of necessity he will have a better grasp of the higher duties of his department and a better understanding of the working conditions of his forces if he has had some experience in—and perhaps responsibility for—the routine and exceptional or emergency work on the track.

It appears to be general practice to train an engineer in railway service by making him a rodman or an axeman, then an instrument man and then up through successive stages in the engineering department, including perhaps both construction and maintenance work. During this course he will naturally pick up some knowledge of track work. But this is very different from personal experience and responsibility or a definite specializing in this class of work. It is true that some experiments in training young men in the track department have not proved successful. But in some cases the failure may be attributed to the fact that the railways have demanded too much in the way of hard work and have given too little in pay, promotion or promise of permanent employment.

Track design and maintenance need men of technical knowledge seasoned with practical experience. The young engineer is well grounded in the former, yet there is at least a passive resistance to the man who may be attracted to this particular field and who desires to familiarize himself with it or to make it his specialty, as another man might specialize in bridge work. It seems certain that appreciable economic results can be realized through a policy of developing engineers specially skilled in the design, construction and maintenance of track.

The Railroad Engineer and the Needs of Tomorrow

Survey of the Problems that Lie in the Foreground of Railroad Development and a Plea for a Policy that Will Help the Engineer to Solve Them

An Interview with
W. S. Kinnear
Consulting Engineer, New York

MINDFUL of the confusion visited upon the three friends who sought to comfort Job in his afflictions, the prudent might well shrink just at this time from any temptation to advise or condole with the railroad engineer. He has been having a hard time of it. Day after day he has been facing the ever present and ever more exacting task of keeping his property abreast of the demands that have been made upon it, and all this with resources that have been meager indeed. He has risen splendidly to his heavy responsibilities—more splendidly than ever he will have credit for—and only now he is beginning to breathe more easily and to feel a relaxation of the pressure that has borne upon him so heavily during the last few years. So it would seem to be courting a just and indignant wrath for any one, however friendly and well intentioned, to offer him at this particular juncture a word of counsel and admonition concerning the work that lies just ahead of him.

Yet some bold spirit must brave the chance, for there is great need that the engineering staffs of our railroads and those from whom they must derive their inspiration and authority should readjust their viewpoints just as quickly as may be practicable to suit a radical change in their economic objective. For the last few years they have been compelled to work on a close-up basis. Of necessity they have lived from hand to mouth, each day bringing its own measure of harassment pressing insistently for relief. Often the rule of sheer and desperate expediency has prevailed. Unremitting and intensive in his application to detail, putting forth every energy to "hold what he had," the railroad engineer for several years has had his eyes fixed upon the task immediately in front of him.

But with the relaxing of this pressure he now must turn to meet a new demand, none the less exacting, none the less urgent, yet so different in scope and character as to require a material readjustment of mental focus. The new problems demand long vision rather than close application; a broad view, rather than intense scrutiny. He must, in short, take stock of the problems that lie in the foreground of railroad engineering development, recognize them, analyze them, evaluate them in terms of their significance to the transportation needs of the nation, and then tackle them with a vision and an energy that is just as necessary today as it was in the pioneer days of railroad building. He must turn on the one hand to the solution of new problems and on the other, to a constructive and forward-looking re-valuation of old ones, so that the needs of tomorrow may be met on a basis of ultimate economy, rather than of desperate expediency.

Many engineers who have been looking ahead doubtless have well-conceived opinions as to the solution of these problems, and Mr. Kinnear's views are here set forth, not in a spirit of dogmatic pronouncement but rather in one of helpful suggestion, reminder, and stimulus. Some of the matters here dealt with are beyond the scope and authority of the engineer; still they are not hopelessly beyond his influence, and certainly they are not without an important bearing upon the net result of his efforts.

Organization—Broadest, perhaps, and most fundamental of the problems that confront many engineering departments is that of their plan of organization. The net worth of the service that can be rendered to the community by any corps of engineers, however skillful and accomplished, is profoundly affected by the scheme of organization under which they must work. In assigning to the engineer a place in the machinery of organization, it must be remembered, therefore, that the chief engineer of a railroad and his assistants must assume responsibility for the intelligent investment of great volumes of capital and for the conservation of huge property investments. It is recognized, to be sure, that the function of a railroad is to provide transportation and not to set up an exercise in engineering. Yet it should never be forgotten that next in importance to a skilled and loyal personnel, the backbone of the transportation machine is the physical property of which it is composed. And however loyal the personnel and however resourceful may be those charged with operation, it is obvious that so huge and so intricate a property as a modern railroad cannot be unskillfully built or maintained without far-reaching, incessant and irretrievable waste—waste that will sap both the substance and the revenues of the railroad itself, of its individual stockholders and of the community at large. And it must be obvious also that the men charged with responsibility for this phase of the transportation industry cannot be regarded as hired hands subject to the beck and call of an operating executive if they are to do justice to the peculiar and inevitable responsibilities that rest upon them.

From this it appears that continued study and effort should be applied to obtaining for the engineering staffs of our railroads a measure of authority and recognition comparable with their grave and basic responsibilities. It is not too much, for example, to ask that the chief engineer of a railroad be given the standing of an elected officer of the company and the opportunity to participate in the deliberations of its supreme managing body; and leaping to the other end of the scale, it is not too much to ask that division engineers be made co-ordinate in standing and authority with the division officials responsible for operation. Their tasks are of co-ordinate importance. The engineer is—or should be—the custodian of the fixed assets of the company; the operating official is charged with the wise administration of its working capital. These men are partners in the conservation of the resources and earning capacity of the property, and from each of them should be expected original and progressive thinking with regard to his own department's problems.

Such a partnership encouraged by the general management can be of immense benefit not only to the property itself because of the encouragement that would be given to the creative instincts of its engineering staff, but also, viewed from another aspect, to the property and the individual engineer jointly. Such a partnership between operating and engineering officials is bound to develop in the operating man a keener appreciation of the problems and the viewpoint of the engineer, and in the engineer the broader understanding of the whole transportation problem that will better fit him for advancement in the railroad service. Feeling a co-ordinate responsibility with the operating officials for the production of safe, adequate, and efficient transportation, he is much more likely to become imbued with the spirit and to develop the outlook that make the all-round transportation man, of far greater value to himself and to his road than if he be rated simply as one gear in a machine that is managed exclusively by an operating executive.

While on the question of organization it may be well to consider also a policy of systematic inspection trips by railroad engineers over other properties. To obtain the maximum of benefit, such trips should be taken by division operating and engineer officials together, so that in sizing up the other man's methods they may have an opportunity to exchange ideas with regard to their respective fields. Aside from the technical knowledge and stimulus that result from such an experience, this practice operates also to develop a greater community of interest between the engineer and the operating officer; that is to say, rather than looking at transportation problems from an engineering viewpoint as against an operating viewpoint or vice versa, they are led to regard them from the viewpoint of "our road" as against the "other fellow's road." Such association, therefore, systematically carried out and intelligently administered should, in time, make for a higher morale in both branches of the service and an increased tendency to view home problems more from the standpoint of the railroad and its interest than from that of a certain department or special service.

While it may be that on some railroads all this is an old story, the fact remains that on too many roads that ought to know better there is a tendency toward self-sufficiency and narrowness of outlook, first, with regard to each of the individual services or departments, and, second, with regard to the road itself. The natural and inevitable outcome of this tendency when left unchecked is to promote an inbreeding which may be depended upon eventually to make for the injury of the property. Although in the engineering service such a condition is considerably remedied by the collaboration of individual engineers on the committees of the various engineering and railroad societies — and the technical benefits derived from these are not to be undervalued—the broader purpose cannot be thus attained because of the lack of participation by the co-ordinate operating departments of the transportation service.

Yards and Terminals.—Although few railroad engineers are not conversant with the generally accepted principles of yard design—the necessity for keeping cars in motion always in one direction, the avoidance of unnecessary storage and delay, and the other basic principles—there still is room for improvement in their application. Yards and terminals are looked upon today as being the factors that limit the capacity of a railroad, and with the increasing expansion of traffic it is but reasonable to expect that the engineers on each division must study everlastingly the daily experience of the operating department in order to provide against the day when new and improved yards may be demanded.

Each divisional or terminal yard is, of course, a problem in itself, subject to local topography and local operating conditions. An appropriate design for a new yard or a betterment of an existing yard cannot, therefore, be based upon an indiscriminate application of general and standardized principles supplemented by a hurried survey and a superficial study in the face of stern and imminent necessity. Sound engineering and sound railroading alike demand that facilities of this sort grow out of accumulated observation, analysis and reflection by the engineer over a long period, coupled with a close and continuous association with the division operating official. Every snarl that jams a yard, every traffic crisis that crowds its capacity is replete with lessons to be noted on the spot, interpreted by the operating officer and digested by the engineer, against the day that he may be given the opportunity and the resources to carry out the improvement.

Although in the design of new yards much thoughtful study is devoted to securing an ideal plant, these observations bear particularly upon the period just ahead of us when we are bound to see more and more a demand for thoroughgoing revision of existing yards, which in many cases are frightfully complicated and congested as a result of patching a little here and fitting a little there, until operation has become very expensive and the entire transportation process has been slowed down. In the design of new yards and terminals and in the modernizing of existing facilities, there will be ample scope during the next ten or fifteen years for the best engineering and operating skill that can be made available, and for the sort of partnership between engineering and operating officials that has been outlined in another paragraph.

Scope will be offered also for considerable railroad statesmanship with respect to terminals at the more important centers, for it is scarcely to be doubted that, wherever possible, joint facilities will be demanded in the interest of more effective service to the transportation-buying public. The policy by which each individual railroad has its own independent terminal at such centers, thereby duplicating needlessly many costly facilities, may have been permissible and necessary in the early days of railroad development, but it is clear that we have passed that stage and that railroad managements must inspire their engineers to attack the terminal problem from a new angle; that of determining just how far joint facilities can be developed for more effective service to all. It is time to stop and ask ourselves whether we are not wasting our substance in working out costly and duplicate schemes in an effort to win for each property an all too questionable advantage over the others.

Another terminal problem that will demand more and more thought of the railroad engineer is that of collection and delivery of less-than-carload freight. An increasing number of those who have studied this question thoroughly lean to the opinion that such a service based upon the use of motor trucks or similar equipment might well be undertaken by the railroads with advantage to themselves and to the communities they serve. So far this subject has been chiefly in the hands of general executives as constituting a question of policy, but before any plan can be carried into consummation, even upon an experimental scale, the engineer will be called upon to work out the details upon which will depend the efficient operation of the plant.

One special case of this general problem is that of motor handling of interchange traffic between the terminals of various railroads entering the large city, and another is the use of motor-driven cars for passenger operation over branch and feeder lines. It is not impossible that this experiment now under way in the passenger service may lead into a similar tryout for the handling of freight, using motor vehicles either on highways or on existing branch-line track. It would be just as well, therefore, for the engineer to commence now a study of these problems so that when he is called upon he may be able to bring to their solution a seasoned judgment, and avert the need for hasty contrivance, always so likely to result in a makeshift.

Closely related to the terminal problem is that of the through traffic that should be routed to avoid terminals and their attendant congestion—that should be kept out of terminals rather than worried through them. Belt lines for such traffic have already been provided at some of the larger centers, but there are many more that are worthy of study now. It is not too much to ask at the very least that the several roads entering each of the chief railroad centers of the country should get together now, agree upon the principles involved, and work out tentative plans for the provision of bypass lines around those centers, so that when the opportune moment for final decision has arrived the diverse interests all will have been reconciled, complicating physical factors will have been studied, and the plan will represent that mature judgment which alone can insure a minimum investment of capital for a maximum return in efficiency of operation and convenience to the shipping community. Here, again, is involved the cardinal principle that must govern the major portion of the terminal improvement work to be done hereafter; i.e., co-operation of interested carriers in joint efforts for solution of their common problems.

Track Structure—A committee of the American Railway Engineering Association is now engaged in studying designs for a possible 150-lb. rail. This is but symptomatic of the continually increasing weight of rail and track structure that has been required to keep pace with heavier and heavier wheel loads. It is not necessary to recount here the story of the "tonnage train" and the spread of the policy that we must have heavier and heavier motive power to draw heavier and heavier trains. Promulgated by Hill in the Northwest, this policy has become firmly established in the minds of transportation officials, and for years past the railroad engineer has been hard put to provide a foundation structure that would be equal to its demands. This process has been carried on so consistently that there is grave doubt today as to whether any one actually knows the cost of producing and conducting transportation, that is to say, the true cost, which would take into account in addition to the ordinary operating costs a proper share of the investment that has been made in way and structure, ordinarily considered as additions and betterments.

If we are irretrievably committed to the policy of heavier and heavier trains and units, if maintenance costs continue to grow as they have been growing, if rail failures continue to call for increasingly heavy sections, if ballast is to grow continually heavier and heavier, it is time for the railroad engineer to make sure that we should not turn to a new and altogether different design for track. In the present standard designs the heavier rail is needed as a girder to effect a better distribution of the load on the ballast, which, in turn, is designed to effect a better distribution to the subgrade. Is it not worthwhile, then, to overhaul this whole theory and to make sure that on the roads of heavier traffic we are not ready for a permanent foundation, probably of concrete, using short ties embedded therein to serve as cushions for the rail? Perhaps some other design entirely may be the answer, but it is becoming evident that if we must carry the continually increasing loads, we sooner or later will be forced beyond the question of heavier rails and thicker ballast to consider radical changes in the design of the entire track structure. The minds of maintenance engineers all over the country are agitated as to what we are going to do to hold our track, and this is one of the big questions that looms in the near future. It is time to ask ourselves whether we have not gone too far in the direction of heavy train loads, for it stands to reason that if we cannot afford to pay for a track that will stand up under these loads without excessive maintenance we have gone too far in increasing the loads.

Train Loading—This opens up, then, an entirely new question, one which properly comes within the purview of the operating department, but which nevertheless has a profound influence upon the work of the engineer. Some railroad executive with the requisite courage and capacity should tackle this whole question of train loads. The situation calls for a resurvey in the light of present conditions to determine whether the ultimate transportation economies effected by the most powerful locomotives we can build, hauling the heaviest trains that they can move, could not in many cases be equaled or exceeded by the savings that would result from the operation of lighter trains at higher speeds, involving less maintenance of track, less wear and tear on equipment, less loss of running time for high-priced motive power, fewer delays from equipment and engine failures, less overtime for road crews because of these and other incidental delays, and all the other benefits that would accrue from such operation. This, be it noted, merely poses a question, and does not pretend to state a fact; neither does it assert that what may be the fact in one case would be true in general. It indicates simply that in the minds of many the answer to the question is not so clear as it may appear to some, and suggests that a policy which might be sound in one region of the country for a certain type of traffic may not be the policy that should dominate the railroad systems of the country. The whole question needs to be ventilated and when the day of ventilation arrives the engineer should be a party to the process; and his judgment as the conservator of the railroad property value should be given due weight with that of the operating and motive power official who is primarily concerned with day-to-day operating results.

This consideration brings us back once more to the old question concerning the ultimate traffic capacity of a given railroad. Much of the double tracking, the three tracking, and the four tracking of our lines has grown up piecemeal as a result of a demand for local relief, which often has been followed by a series of more-or-less haphazard extensions rather than by any systematic and planned analysis of traffic requirements. Here, too, is an opportunity for organized study which should involve the civil engineer as well as the signal engineer and the operating official. Closely related to it is the problem of automatic train control which now has been brought sharply into the foreground by the action of the Interstate Commerce Commission and which will engage the attention of railroad engineers and operating officials until some answer has been found.

Water Supply—Another problem that has engaged the attention of some of the larger systems, and that in the course of time probably will become more acute rather than less is that of an adequate and satisfactory water supply to meet the increasingly exacting demand of heavy and costly motive power. Development of water sources and of necessary processes for its treatment must be systematically studied in the interest of economy as to the cost per gallon supplied, and of decreased maintenance expenses and loss of time in service for locomotive boilers, which have been set down by one authority as a very weak link in the transportation chain.

Electric Traction—The place of electric traction in the transportation scheme will continue to demand the best thought of railroad engineers and executives for a long time to come. It has been demonstrated that where special conditions prevail, where large sources of power are at hand, where mountain grades of considerable length must be overcome and where congested traffic and terminal conditions govern operation, the use of electric motive power will effect economies and solve operating problems beyond the capacity of the steam locomotive. Yet, in the present state of the art there is little ground to hope for a sweeping transformation in this respect. In general discussion of the subject, it is often forgotten that the practical problem is not whether electric service is better than steam; the question to be answered by the transportation man is: Is electric service sufficiently better to justify the scrapping of equipment already in existence, or, if the project is to be tackled gradually, are the savings to be realized from electric operation on one division sufficient to compensate for a loss of flexibility involved in having that division organized with regard to motive power along entirely different lines from the others? It may turn out that electric operation may make possible the handling of lighter trains at higher speeds and enable us to pass over our lines an even greater volume than at present, at equal or less cost when all factors are considered. It is possible, therefore, that this development may have a far-reaching influence on several of the questions that have been discussed, but this, too, is merely a statement of a problem to be worked out by the railroad engineers of the country.

In many other respects the forward-looking railroad engineer will find opportunity to effect increased economies in operation. Some of these have to do with the thoroughness of maintenance work. Track that is out of line and grade not only subjects itself to rapid destruction, but involves also considerable increase in the cost of moving trains over it. A collateral phase of this matter concerns itself with the increasing use of mechanical devices to save labor on maintenance work. Another contemplates the installation of appliances for operating switches at a distance in order to expedite the movement of trains at passing track. These are but typical of many opportunities in almost every field of railroad engineering, which for some years to come will challenge the best skill that can be brought to bear upon them.

It will be obvious to all that many, if not all, of the suggestions here advanced deal with matters in which the engineer will be powerless without the encouragement and the resources that can be given to him only by sympathetic managements and executives; but if the executives are to rise to the responsibilities that lie ahead of them and are to satisfy the American people that they are willing and able to grapple with their transportation problems, they must call increasingly upon the skill, the training, and the constructive instincts of the men who make up their engineering staffs. Whether it be justified or not —and in most cases we all know that it is not—the opinion prevails with a large section of the American people that American railroad managements today have become hidebound, that they have settled down into a routine day-to-day occupation, that the chief executives too often are mere clerks or impotent figureheads, and that there is lacking the vision to see, the genius to grasp, and the energy to attack the essentials of our transportation problems. With this state of mind so prevalent and with the problems daily becoming more insistent, it is worth the while of railroad executives to ask themselves whether they are making the most effective use of the engineering skill that is at their disposal.

Cost of Remedying Deficient Sewers

HAPHAZARD sewer construction with little regard for the future development of the community served leads eventually to conditions summarized as follows by W. E. Stanley, assistant engineer, in a paper presented recently to the Iowa Engineering Society: (1) Frequent surcharge; (2) inability to make extensions; (3) difficult house connections; (4) high cost of sewering low areas a considerable distance away from available outlets; (5) undue increase in stream pollution; (6) intercepting sewers difficult to build.

ESTIMATED COST OF PRESENT CONSTRUCTION REQUIRED TO REMEDY VARIOUS SEWER SYSTEMS

City	Est. Pop. 1922	Comprehensive Sewerage Plans for Year	Population	Estimated Cost of Present Construction Required Total	Per Capita
Streator, Ill.	15,500	1960	[illegible]	$725,000	$46.80
Portsmouth, Ohio	40,000	1970	85,000	[illegible]	[illegible]
Washington Court House, Ohio	8,200	1970	15,000	[illegible]	[illegible]
[illegible], Ky.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible], W. Va.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rhinelander, Wis.	7,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Totals	[illegible]		[illegible]	[illegible]	[illegible]

* Includes plant for partial treatment of sewage.

The first consideration in meeting such conditions is an extensive and thorough engineering investigation and the making of a comprehensive plan which will utilize the present sewers to the best advantage and provide relief sewers for critical areas for 40 to 45 years in the future.

Mr. Stanley gave the estimated average per capita costs of such extensions for six cities as $21.60, ranging from $9.60 to $46.80, as shown in more detail in the accompanying table.

Grade Reduction and Widening on Illinois Central RR.

Novel Feature Is Use of Dragline Excavator in Widening Cuts—Contractor's Trains Handled on Busy Main Line

IN GRADE REDUCTION and roadbed widening for three and four tracks on the Illinois Central R.R. from North Junction to Monee and Matteson, Ill., a distance of about twelve miles, special features of the work were the use of a dragline excavator in place of a steam shovel for the long cut through the Monee hill and the adoption of construction methods which avoided interruption to heavy main-line traffic, even with all excavated material hauled over the main line. This is said to be the first case in which a dragline machine has been used for widening cuts on an operated line. A general view of the excavator at work on the large cut is shown in Fig. 1. An incidental but important item of the work was the moving of two grain elevators across the main tracks.

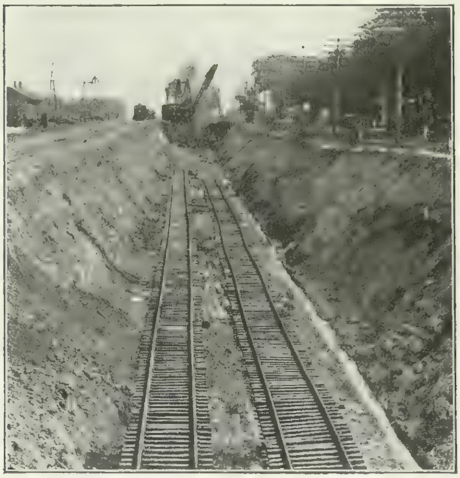


FIG. 1—DRAGLINE EXCAVATOR WIDENING CUT

The improvement work now in progress on the 54-mile division between Chicago and Kankakee provides for a maximum grade of 0.3 per cent, but at Monee there was a summit or hump with a northbound grade of 0.425 per cent rising from a level stretch and then descending at 0.44 per cent. This was the most serious obstacle to traffic and occasionally it was necessary to split a heavy northbound train in order to handle it over the grade. In the revised profile not only is the summit eliminated but also the entire northbound ascending grade. From the profile, Fig. 2, it will be seen that the new line continues on the level for some distance and then has a descending grade of 0.2 per cent followed by 0.3 per cent, the latter running out to the old subgrade elevation.

It will be seen also that this change in grades involves heavy excavation, the main cut being about 9,000 ft. in length with an average depth of 20 ft. and a maximum depth of about 30 ft. Beyond this was another cut of about 4,400 ft. in length and 30 ft. maximum depth. A storage reservoir for railway water supply, in the sag between these two cuts, was drained to another reservoir further south and its site was crossed by a fill. The total amount of excavation will be about 1,000,000 cu.yd., consisting mainly of stiff blue clay having a few sand pockets but very little water.

Since the subgrade had to be widened to about 100 ft. to provide for additional tracks, advantage was taken of this feature to facilitate construction work and keep the work clear of traffic. The successive construction steps are shown in Fig. 3, from which it will be seen that the new cut has a bottom width of nearly 100 ft. to accommodate four main tracks and a passing track. At the south end of the track there will be three main tracks. The first operation at the long cut was to excavate a double-track cut along the east side of the roadbed, with the bottom conforming to the new profile and having a width of 32 ft. Two main tracks were laid in this cut, the rail head keeping close behind the excavation, as shown in Fig. 4. As soon as this first double track cut was finished the track connections were made and new tracks put in service without delay to traffic.

Excavation Procedure—This first cut was made by the dragline excavator working northward. The second step was with the excavator returning south on the west side of the right-of-way and making a cut of about 10 ft. deep as a widening of the old roadbed for a distance of about 3,000 ft. The third and final cut was made with the excavator working north again, traveling along the old roadbed and widening its first cut to the full 100 ft. width of the new subgrade for about 3,000 ft. Beyond this a modified method was adopted owing to the lateness of the season and the expectation of bad weather. Instead of making cut No. 3 its full width, a widening of 25 ft. was made first to prevent the possibility of material sliding onto the new main tracks in cut No. 1. This is shown by the line *A-B* in Fig. 3. When cut No. 1 had been widened in this way, the excavator moved south 3,000 ft. and then again worked north to complete cut No. 3 to its full width.

The use of a dragline excavator was adopted on account of the depth of cut, since with depths of 20 to 30 ft. steam shovel work would have necessitated making seven successive cuts, each wide enough for a dump-car track beside the shovel track. The dragline machine was operated on the surface and took out the cut to its full depth at one move. It loaded the material into cars on the old northbound track alongside the cut, this track being given up to the contractor and a new temporary second main track being laid on the west side of the old roadbed.

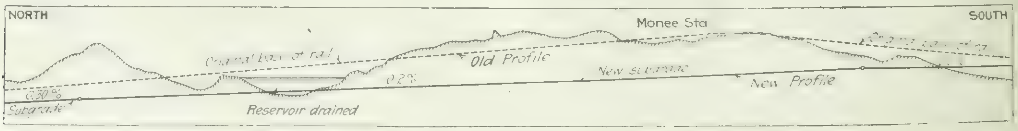


FIG. 2—PROFILE OF GRADE REDUCTION AT MONEE, ILL.

In Fig. 4 the machine is shown making the first cut, in which the two temporary main tracks are being laid. At the left is the surface track for the contractor's trains (being the old northbound track) and beyond this is the double-track main line. In Fig. 1, the machine is making the third cut of about 60 ft. bottom width, widening the first cut (at the right) to full subgrade width. In this novel method of widening an existing railway cut the contractor used a Bucyrus dragline excavator with 100-ft. boom and 5-yd. Page bucket, as shown in Figs. 1 and 5. This machine, weighing about 145 tons, moved on rollers on stringers and blocking. To haul itself back from the work it was revolved to put the boom forward and the bucket was lowered so as to dig into the ground and form an anchor. Then by hauling in on the bucket cable or dragline the machine was moved forward to the new position.

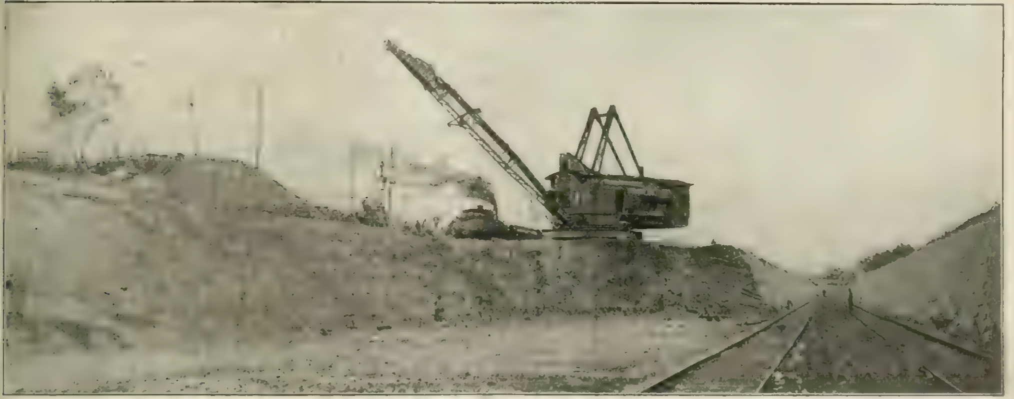


FIG. 4—EXCAVATOR MAKING FIRST CUT FOR GRADE REDUCTION

New double-track main line was laid in cut so as to be ready as soon as excavation was finished and track connections made. With traffic turned onto the new tracks the cut was widened for four tracks. Contractor's track at edge of cut, with old double-track main line beyond. Public street at right of cut.

Trains of fifteen air-operated dump cars of 12- and 16-yd. capacity are handled by the contractor's locomotives, but are in charge of the railway company's conductors since the trains are moved on main tracks. These dump-car trains enter the main line at an interlocking plant about one mile north of Monee and are operated as extras under orders from the train dispatcher. All loaded trains move north and with the engine at the rear end. Most of them have a haul of about six miles to Matteson, where the material is used for a fill in track elevation work which eliminates two railway grade crossings. About 25 per cent of the trains, however, have a haul of some twelve miles to Homewood, where the material is placed as filling for the new Markham freight yard. The contractor operates ten trains of fifteen cars each in this service, and notwithstanding the heavy main-line traffic, averaging about thirty passenger trains and sixty to seventy freight trains daily, the dragline excavator moves about 4,500 cu.yd. per twenty hours, working two 10-hour shifts. Its monthly performance ranges from 70,000 to 96,000 cu.yd. It can load a train of fifteen dump cars (averaging 12 cu.yd. per car) in twenty-five minutes.

On the long cut two steam shovels were operated before the dragline excavator was installed. These machines, with 2½-yd. dippers, started opposite ends of a cut 12 ft. deep along the east side of the right of way, this depth enabling them to load cars on a surface track. After the dragline machine had been put at work in the larger cut, one of the steam shovels was used for the widening of the smaller cut, since the width of right-of-way at this point did not admit of using the dragline machine. A bench for a loading track was made about half way up one slope of the cut and the shovel made one lift at this level. A second lift with the shovel at roadbed level then finished the widening on that side. Two similar lifts on the opposite side completed the widening.

Auxiliary Works—Four steel girder highway bridges and one steel footbridge will be built across the cut at Monee. Steel signal bridges one mile apart will span the tracks and carry electric-lamp signals, no semaphores being used. Just south of Monee where the four-track line is reduced to three tracks, an interlocking plant is being installed at a cost of about $20,000. Since part of the edge of the new cut is along the side of a village street and main highway the street is protected by a fence

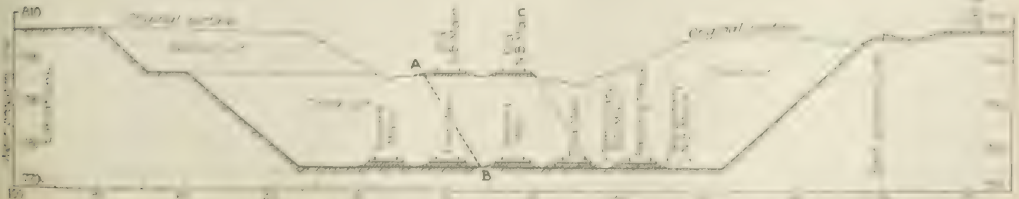


FIG. [illegible]—CROSS-SECTION OF FOUR-TRACK CUT ON GRADE REDUCTION consisting of tall concrete posts carrying low concrete slabs or panels surmounted by wire fencing. Where the track elevation near Matteson intersects a public road, a new concrete road will be built along the right of way for about ¾-mile, thus avoiding the construction of a subway. Subways with concrete abutments and bents and concrete slab decks will cross two railways. There is a small interchange yard at the crossing of the Elgin, Joliet & Eastern Ry. and an incline track connection from the new elevated tracks to the low-level intersecting tracks of the Michigan Central R.R. At Matteson there will be a new station and yard for the suburban trains, this point being the southern terminal of the Chicago suburban service (see *Engineering News-Record*, Nov. 16, 1922, p. 841). All tracks are laid with 90-lb. rails.

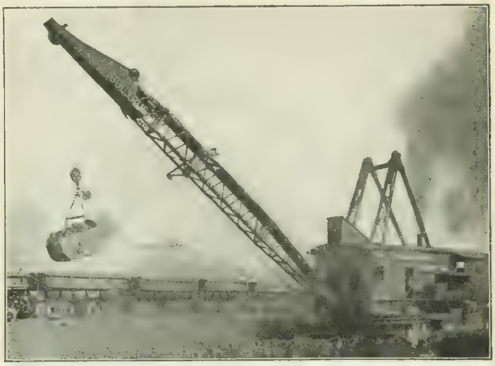


FIG. 5—EXCAVATOR WITH 5-YD. BUCKET LOADING CARS

Moving Elevators—Moving three buildings across this busy double-track main line was carried out successfully. The one-story frame station at Monee was moved across from the east side and turned around so as to face east. This move was accomplished in about twenty minutes, traffic not being blocked at all. The other two structures were 60,000- and 65,000-bushel grain elevators of frame construction, weighing approximately sixty tons each. The first elevator, in 32 minutes, was moved 150 ft. east across the tracks, and was then turned around and moved north 2,200 ft. The other in 1 hr. 54 minutes was moved 150 ft. across the tracks and then 500 ft. north. Both elevators were landed on new foundations at the top of the cut, with a high retaining wall forming the support along the track side. They were then united to form one structure.

Engineers and Contractors—The grading and tracklaying on this 12-mile improvement was let to the Walsh Construction Co., Davenport, Iowa, but owing to labor shortage the railway has done much of the tracklaying with its own extra-gang forces. W. A. Durkin was superintendent for the contractor. The buildings, including brick interlocking tower at Monee, were let to Joseph E. Nelson & Sons, Chicago, who sublet the moving of buildings to W. H. Brown & Co., Chicago.

All the work was planned and carried out under the direction of F. L. Thompson, chief engineer of the Illinois Central R.R.; F. W. Armistead, assistant engineer; T. H. Robertson, assistant engineer in charge, and G. C. Harris, resident engineer. It is expected to have the work completed in May, 1923.

Survey of Railway Conditions in Continental Europe

Slow Recovery from War Due Largely to Political Exploitation—Hope Lies in Return of Trained Technical Control

This is the first of three articles on the European railway situation by the London correspondent of ENGINEERING NEWS-RECORD.

THE foreign observer, investigating railway traffic conditions in Europe, is struck first by the fact that, with very few exceptions, the systems seem to have made no appreciable improvements since the close of hostilities. The service generally throughout Europe is well below pre-war standard, the rolling stock is depreciated, the fuel, especially in France, is shocking, and interference with travelers has been multiplied a hundred-fold. The freight traffic arrangements are primitive.

These facts are all the more remarkable when one comes to consider that, with the exception of the Belgian lines and some of the northern and eastern French systems, the railways were not interfered with or damaged to an extent which would account for their inefficient operation four years after the armistice. In endeavoring to dig up some reason for a very apparent laxity in Continental railway operation, if one questions any responsible railway executive the invariable answer is, *"c'est la guerre."* One accepts this in principle, but it is in getting down to "brass tacks" that one finds difficulty in accounting for systems whose efficiency has so obviously deteriorated.

Variety of Explanations—First, if one travels in France on any but the recognized "crack" routes one is struck by the awful quality of the locomotive fuel—usually briquettes. The Frenchman says that this bad fuel must be used because the Germans destroyed the French coal mines in the north. Quite so. But in spite of that the German reparation deliveries of coal have been so much in excess of French requirements that France has been selling it back again to German industrial plants. If you ask the Austrian why his railway freight service is so bad he will tell you that he was obliged to suspend rolling stock renewals during the war, and that he had to cede large numbers of cars and other rail stock to the Allies. Yet the European central states have an abundance of stock for the present industrial demands and the existing volume of freight traffic. In other cases parts of systems have passed from the control of one state to another and the new owning state complains of the lack of experienced railway executives. This argument is found a great deal in Czechoslovakia. In spite of this there is actually no shortage of qualified executives, and numbers of Czechoslovakians filled important posts on the railway systems of what was formerly Austria-Hungary.

On top of these inconsistencies one is struck by the fact that the most progressive of the European systems are those most damaged by the war, namely in Belgium and north and eastern France. Here the entire devastation seems to have energized the railway forces to an amazing extent, and if one wishes to see what can be done in the way of reconstruction the systems mentioned afford the best examples available. Against this background of almost feverish activity in one section of Europe the indifference of the remainder is all the more sharply defined. Europe, to all intents and purposes, appears to have adequate trackage, railway stock and a sufficiency of operators, yet something is lacking.

The Human Factor—That "something" can be attributed largely to the post-war outlook of the average railway employee. On the continent as well as in Britain, the main object six years ago was to win the war, so that any labor trouble which seemed to prejudice a successful issue was tided over to keep the services going. In this way extravagant promises of shorter hours and higher wages were made to pacify railway employees. After the war matters were different. Wages could no longer be periodically raised merely by turning out paper money. Similarly the rigid discipline during the war in the European armies left behind it a reaction against authority in any form. This fact no doubt accounts for the prolonged system of military control of a large number of lines after the war was over.

Unfortunately, so as to be able to get on with the business of war the politicians were forced to make to the workers, including the railway men, promises of a new heaven and a new earth, which could not possibly be fulfilled. Hence the labor difficulties.

Changes of government systems also played their part. The railwaymen had somehow been led to imagine that under republican government discipline was eliminated from the dictionary, whereas they found it was just as essential as under a monarchy. This disappointment was the foundation of the succession of railway strikes in most of the European states, but especially in the central European republics. Again, wartime railway expenses were enormously increased and receipts dwindled not quite, but very nearly, to zero. This deficit could only be met by state taxation. Keeping the railway systems going by state taxation meant the politician's opportunity, of which he was not slow to take advantage.

In this way the practical railway operator, unaccustomed to arguing but only wishing to hold down his job, did not make the same appeal to the public as the hare-brained political theorist, who gradually assumed control.

The peace treaties were also not without their effect. Germany had employed her railway systems as a political force and Europe would have no more of it, but the restrictions imposed by the politicians were framed without expert consultation and the results were nil. On the other hand, when conferences have taken place between European railwaymen and some concrete results obtained, the respective governments have usually refused to sanction them.

Little Technical Improvement—As might be expected from the rather uncertain atmosphere in which the European railways have found themselves laboring, little technical improvement has taken place since the war. Railway engineers in Europe developed a passion for electric traction but that seems to be passing. The reason for the cooling of this enthusiasm is due to the lack of the finances necessary to change over from coal to electricity. Those countries where cheap waterpower is available, notably in Switzerland, Scandinavia and parts of France, are pushing ahead with electrification schemes. But the majority have decided that steam is cheaper for the time being than electricity and are resigning themselves accordingly. This applies especially in the flatter countries like Holland and Belgium.

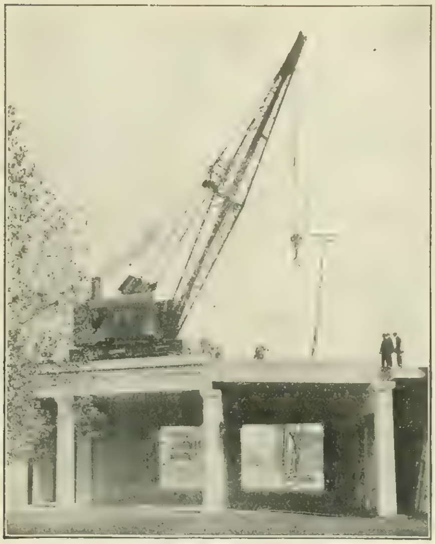
European railway engineers are not being slow, however, to experiment with various types of traction. Just now the Ramsay turbo-electric locomotive is being tried out on the Continent and promises well. In the Ramsay design the turbine is coupled with a three-phase generator having a pressure of 350-600 volts. There is also an auxiliary turbo-generator set with a d.c. generator of 75 kw. The tractive effort at the wheel rim at 60 m.p.h. is 6,000 lb., and at starting, 22,000 lb. The distinguishing feature, however, is the condensing equipment. This consists of brass tubes fastened in two circular tube plates. The whole unit revolves in a shallow tank of water which is fed from the main cooling tank. The water tubes are cooled by air forced through the tubes by an axial fan, the air leaving the tubes radially. This locomotive has already been tried out on the London and North Western Ry. on yard work, and has shown a coal economy approaching 50 per cent of that of the ordinary steam locomotive. Various European systems are experimenting with turbine locomotives. Norway is trying out a Ljungström turbine locomotive, Belgium has a Cockerill condensing engine on test and Switzerland is experimenting with Diesel-engined locomotives.

Aside from some of the main lines the passenger and freight rolling stock in Europe is very badly in need of repair or renewal. France is still using stock surrendered by Germany after the war with the original German distinctive marks untouched, and the cars also apparently untouched in any other way. All Europe needs new rolling stock and better care for the permanent way. On some of the country lines in France, for example, the permanent way is in a shocking condition, and one who is accustomed to British railway conditions wonders how the trains hold the track. Sometimes they don't, and derailments and collisions are very frequent on the Continent.

Europe's greatest trouble, in railway as well as other matters, is the politician. He has been allowed (in fact he could not be prevented) to get his finger into the railway pie and is very loath to withdraw it. When the technician and the trained railway executive again assume control the European railways will present a very different complexion.

Jubilee of the First Underground Railway

The sixtieth anniversary of the first underground railway or rapid-transit subway, which was the Metropolitan Ry., of London, was celebrated in January. This first section of the line was only 3¾ miles in length, from Bishop's Road to Farringdon St. It was of 7-ft. gage, but later a third rail was laid for standard-gage trains from connecting lines and eventually the broad gage was abandoned. Part of the work was in tunnel, with brick arch roof, and part was in "cut and cover" with brick walls and cast-iron roof girders supporting brick jack arches on their lower flanges. The steam locomotives had an arrangement for turning part of the exhaust into the tanks and the cars were lighted by coal gas stored in collapsible rubber bags on the roofs. Electrification began to be considered in 1895 and the first electrified section was opened in 1907. Steam locomotives are still used, especially on the open air sections of the line. In 1863, the 3¾ mile line carried 9,455,175 passengers and its receipts were $508,535. In 1922, the Metropolitan Ry. had 93 miles of line (including suburban extensions on the surface), carried 180,500,000 passengers and had receipts of $9,800,000.

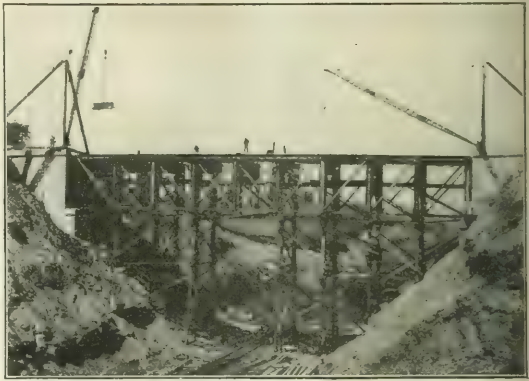


CHICAGO, ROCK ISLAND & PACIFIC RAILWAY
Placing concrete deck slabs on Chicago track elevation.
C. A. Morse, chief engineer.

ATCHISON, TOPEKA & SANTA FE RAILWAY
Construction trestle and fill at Crocker Creek on Eldorado extension.
C. F. W. Felt, chief engineer.

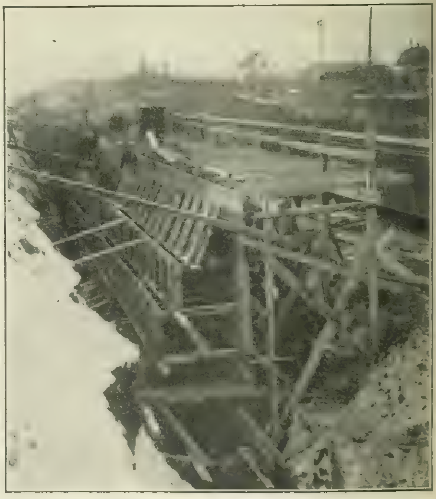
With the Railroads in 1922

Ten Pictures From Here and There, Typical of the Railway-Construction Projects That Have Been Under Way on as Many Different Roads During the Year Just Past.



PENNSYLVANIA RAILROAD
Overcrossing on Summitville—Kensington grade improvement; Pittsburgh—Cleveland division.
A. C. Shand, chief engineer.

NEW YORK CENTRAL LINES
Construction trestle over Baker's Kill, Hudson River Connecting Railroad near Albany.
George W. Kittredge, chief engineer.



CHICAGO & NORTHWESTERN RAILWAY
Building concrete retaining wall for Milwaukee track depression.
W. J. Towne, chief engineer.

CHICAGO UNION STATION
Installing foundations for headhouse.
J. D'Esposito, chief engineer.

PHILADELPHIA & READING RAILWAY
Double-track 46-span concrete arch bridge over Susquehanna at Harrisburg. Arches each 66 ft. in clear; total length 3,500 ft.
Samuel T. Wagner, chief engineer.

SOUTHERN RAILWAY
Track elevation in connection with Ohio River bridge improvement at Cincinnati.
T. H. Gatlin, chief engineer of construction.

TIMISKAMING & NORTHERN ONTARIO RAILWAY
Cofferdam and piers for bridge on new extension.
S. B. Clement, chief engineer

PERE MARQUETTE
North end of Flint River bridge on the Flint belt line.
H. A. [illegible] chief engineer

Developments in Railway Maintenance-of-Way Methods

Engineers' Opinions on Organization and Work of Track Forces—Uses of Machinery—Permanent Section Gangs—Cost Records—Training Engineers—Needs of Present Track

By E. E. R. Tratman
Associate Editor *Engineering News-Record*

RAILWAY track and its maintenance have been the subject of considerable discussion and criticism during the past few years, both as to the track structure itself and as to its relation to the traffic which it carries. Perhaps suggestion for improvement might be a better term than criticism, since the trend of discussion has been constructive or progressive. This situation suggested an extensive inquiry concerning the views of railway engineers and track officers as to possible lines of development in the work and organization of the maintenance-of-way department. The results of this inquiry are reviewed below and cover the following subjects: (1) Training engineers for track maintenance; (2) the organization of permanent section forces; (3) the relative advantages of work by section gangs and extra gangs; (4) machinery for track work; (5) housing and living accommodations; (6) piece-work and cost record systems; (7) methods of improving track and the efficiency of track work.

Before proceeding to this review it will be of interest to note briefly some of the suggestions which have been made for improvement in track and maintenance. They include the following: (1) More engineering supervision; (2) better economics of expenditures or assignment of funds; (3) more consistent programs of work; (4) better and more permanent working forces; (5) wider use of machinery and mechanical appliances, and (6) general improvement of track structure to put it in more economic relation to the traffic and loads which it carries. Along some of these lines the engineer is practically powerless to introduce any material changes or improvements, since they are governed largely by the financial conditions of the railways and the ideas of management and administrations. However, the engineer may find opportunity to inform and convince the higher and non-technical officers as to the economic aspects of track and maintenance work.

Where roadmasters and supervisors are mentioned in this article, it must be remembered that the qualifications and titles vary greatly on different roads. In some cases the supervisor is practically a super-foreman and in others he is identical with a roadmaster, or he may even be an engineer. The roadmaster also may be either a "practical man" or an engineer.

Training Engineers in Track Work

That railway engineers and especially those in charge of maintenance-of-way should have practical experience in track work is generally admitted. But few railroads appear to take any steps to encourage engineers to obtain experience in the maintenance department or to place them in such positions as roadmasters or supervisors with a view to later promotion in the maintenance branch of the engineering service. In fact, several roads state definitely that nothing is done along this line of development, although some consider that such practice would be beneficial. While it is not necessary that an engineer in charge of track should be an expert trackman, his efficiency will be increased materially if he has had some actual experience of the work and actual contact with the men who carry it on.

Appointing young engineers as roadmasters or superintendents of bridges and buildings is regular practice on a few roads and is preliminary to appointment as assistant engineers and then division engineers, or engineers of maintenance-of-way. Only a certain proportion of the roadmasters are selected in this way, however, as it is desirable to offer opportunities for section foremen who show the necessary ambition and ability. A modification of this practice is to have the young engineer begin as a roadmaster's clerk and work up as general foreman or assistant roadmaster, but always with the engineering staff of the maintenance-of-way department as his objective. A practice followed by some roads is to try out engineering students in the section forces during the summer and those who prove satisfactory may be given permanent employment after graduation, working up from roadmaster to assistant engineer. One road is planning to extend this method, since it is concluded that the practical experience in work and especially in the handling of men is beneficial for those holding the position of division engineer. This is particularly the case where the organization is such that the division engineers have charge of maintenance-of-way and structures.

An alternative to this system of developing engineers through the position of roadmaster is the establishment of a special apprentice system for training engineers in track work and then advancing them to the lower positions in the engineering force. Under this system, however, they do not always receive the experience and responsibility of handling men, which is one of the most important features.

Even where the opportunity is given for experience in track work the result is not always satisfactory. From a road which has developed some of its engineers in this way comes the report that many young men are unwilling to submit to what appears to them the drudgery of track work, the restrictions upon their time and the liability of being called out for extra or emergency work. Yet it is this discipline and experience which may make them valuable later. On the side of the young man, however, it may be said that if he accepts the position and its hard work for the sake of training and experience, it is only fair that he should have assurance of promotion and due allowance for the experience thus gained.

In the year past, railways have had the reputation of taking the attitude that the young engineer must work hard for very little pay and without assurance of advancement. This attitude undoubtedly has had a strong influence in rendering railway work unattractive. In fact, an engineer of a large railroad states that lack of success in training engineers through the position of roadmaster is due to the low pay and uncertain promotion.

The usual practice appears to be to train roadmasters as section foremen and to train engineers as axemen and rodmen. Reports from a few roads state definitely that the roadmasters should not be engineers, all work of an engineering character being done by the engineering staff. Similarly, the engineers, should not be trained in actual track work but should rely on the roadmasters for expert advice. This view of the case, however, is evidently that of a small minority.

Conclusion—As a general conclusion, it may be said: (1) Modern maintenance-of-way work requires a high degree of technical knowledge; (2) there is a wide appreciation of the value of track training for the railway engineer; (3) there is no general policy or system of providing or offering such training; (4) little encouragement is given to the young engineer to identify himself with the track or maintenance department; (5) where a definite system of training continued with promotion has been carried out the results have been highly satisfactory; (6) it would be well for the railroads and their engineering departments to give more serious and practical consideration to a policy of making the maintenance-of-way department attractive to the young engineer.

PERMANENT SECTION FORCES

Until very recent years track work has been regarded as necessarily seasonal, with the result of the universal practice of recruiting the force every spring and reducing it in the fall, just when the men have become trained and efficient in their work. This policy has been bolstered up by the general but erroneous assumption that track work is unskilled labor, requiring mainly muscular ability. Against the money saved by discharging men must be set the loss in work done inefficiently and materials wasted or damaged by inexperienced labor.

There is now a growing recognition of the fact that a man experienced in track work is a valuable asset and that some means should be taken to retain his services. The obvious method is to spread the track work over the entire year and thus provide permanent employment, instead of crowding the work into six to eight months. Careful study of the work has shown that many kinds of work can be done successfully throughout the winter, except during periods of severe storm or temperature.

To some extent the work is necessarily seasonal, especially in certain sections of the country where the working season is definitely limited by prolonged periods of severe cold or heat. Of thirty-four railroads, fourteen are using the permanent force system with success, ten believe in this system but are not using it and ten prefer the present system. It is instructive to note that one road in a cold northern mountainous district considers that even on such a road it would be practicable to find work for the section forces through the winter. On the other hand, the system is not universal even in the warm southern states.

Geographically arranged, railroads which use the system include eleven lines in the south, southeast and southwest and one each in the east, central and northwest districts. Each of these last three, however, uses it by maintaining minimum permanent gangs. Of two roads which approve the system, one would provide for the heavier summer work by enlarging the section gangs, while the other would have it done by extra or floating gangs.

Although twenty-four railways approve of the system and fourteen of these are using it, there are two lines of opinion as to the organization. On the one hand it is suggested that the permanent force should be a strong one, requiring only a few extra men for summer work. On the other hand it is claimed that the permanent force should be a minimum, or practically equivalent to the present reduced winter force. It is evident that the first is the better and more reasonable plan. Under the second plan, the very advantage sought by maintaining a permanent force would be lost, since this plan would perpetuate the present objectionable system of employing a large number of green men for a few months. One engineer points out that under conditions which now require eight men in summer work and four in winter, it would be better practice to have six men permanently employed.

Since it might still be necessary to engage extra men in summer, the permanent-force plan might seem at first to differ very little from the ordinary practice of alternately increasing and reducing the section forces, but the difference really is of the utmost importance. In the one case, the section foreman has a permanent force of skilled and experienced men who know what track work is and how to do it, and who have an interest in their work and in their employer. For the busy season he may have to employ a few extra laborers. In the other case, the experienced men probably would not stay with the small winter force. Even if they did stay the foreman would have to engage a number of green men in the summer, spend his time in instructing and watching them, only to discharge them just when he has got a trained gang, at the end of the season.

Conclusion—A conclusion based on the various individual reports is that there is a large opportunity for effecting improvement in the track department by expanding the general economics of the "permanent-force" system and investigating the advantages or possibilities of its application in individual cases.

SECTION GANGS VERSUS EXTRA GANGS

Whether the work of section gangs should be or should not be supplemented by that of floating or extra gangs appears to be an open question, but with a strong majority opposed to such assistance.

It is true that practically all railroads operate extra gangs, but they are employed mainly on heavy and extensive work which is not properly within the field of the section forces. Thus on tie or rail renewals, ballasting and widening cuts, or even in general surfacing, it may be more convenient and economical to put one track out of service for a time in order to do a large amount of work with a special gang on a long stretch of line, rather than to do it piecemeal by the maintenance gang or individual sections. With the latter procedure the work would have to be done under traffic, with consequent mutual interference of work and train service.

Several section gangs are sometimes combined for such extensive work. But the men are not trained to work together, so that they will be less efficient than a large extra gang accustomed to working as a unit. Furthermore it is generally considered inadvisable to make a practice of taking the section men away from their own sections, as this tends to loss of morale and of interest in their regular work.

As to maintenance work proper there are two lines of opinion. On the one hand it is held that the section gang should be only of such size as to attend to the putting in of occasional ties, lining and surfacing track, policing or inspection and the cleaning of ditches and right of way. All other maintenance, including such a specialty as turnout work, would then be done by floating gangs. This plan was advocated very strongly at one time, but has not come into extensive use. One argument given in its support is that the section forces change annually and thus have little experience with other than "pick and shovel" work, while the extra gangs are more permanent and therefore more proficient. This argument loses much of its force if considered in relation to the question of permanent section forces, as discussed previously.

That as much work as possible in each section should be done by the section gang is the more general opinion of engineers, roadmasters, and other railway officers. In support of this opinion, it is urged that work will be done more efficiently by men who are directly responsible for it and are not shifting from place to place. Similarly, both the foreman and his men will feel less interest or responsibility if they know they are to be helped (or interfered with) by an extra gang.

Where all maintenance work is left to the section forces the men will acquire a knowledge of the various kinds of special work. Furthermore, it appears to be generally considered that a floating gang is not likely to do the routine or minor maintenance work as well as a local section gang, upon which responsibility can be placed directly for negligence or defects. It is considered also that such work involves much loss of time and money in getting the extra gang to its work at various scattered points, since it would rarely be practicable to work from section to section. Another objection is that the foreman of the extra gang would be apt to slight the finishing of one job in order to move on to the next. However, it should not be difficult to train the foreman to realize that he is held responsible for finishing up his work completely and properly.

Of reports from thirty-three railroads, only four are definitely in favor of employing minimum section gangs and leaving to extra gangs all the heavier and more special items of track maintenance, as well as all kinds of renewals and improvements. The others either favor limiting the extra gangs to special duties, heavy work and emergencies, or suggest some slight assistance to the section forces. As to this latter point, however, some consider that it is better to enlarge the section forces than to do part of their work by extra gangs.

Conclusion—A definite conclusion appears to be that practically all track maintenance work should be done by the section gangs. While extra gangs are a necessary part of the railway organization their work should be on improvements and heavy replacement rather than on maintenance.

MACHINES FOR TRACK WORK

One of the most obvious and important steps for effecting a high degree of efficiency and economy of track work is the introduction of labor-saving machines and devices, thus securing a greater output at lower cost and with a smaller force. Many present and prospective economic applications of machinery have been noted in *Engineering News-Record*, May 18, 1922, p. 824. For example; ditching is done by machine at 2 to 6c. per cubic yard as against 75c. to $2 for hand labor; weed killing averages $19.50 per mile instead of $175; and rail renewals average $500 instead of $1,400 per mile. These few examples illustrate the great economic advantages of machine work. Furthermore, much of the work done by machinery is of the rough and heavy character which is repellent rather than attractive to the laborers. Space does not permit any detail description of the various machines or their work as mentioned in the replies from numerous railways, but the following lists outline their diverse kinds and applications:

A.—Machinery and Appliances for Light Work:

1. Electric ballast tampers and rail drills.
2. Pneumatic appliances for tamping ballast, driving spikes, drilling rails, turning nuts on track bolts, oiling track, sandblasting steel, riveting and chipping on bridge work, boring ties and timbers.
3. Spike setters, pullers and straighteners.
4. Tie borers, tie pullers and tie-spacing clamps.
5. Sod line cutter and ballast toe liner.
6. Weed cutters for track and shoulders.
7. Portable rail saws.
8. Track oilers, to prevent corrosion.
9. Oxyacetylene outfits for cutting, drilling and welding rails and frogs. But some track men doubt the advisability of cutting or drilling rails in this way.
10. Motor section cars to carry men and material to and from work.
11. Narrow-gage dump cars for use in widening cuts and cleaning ditches.
12. Track dollies and rolls for moving ties and timbers.
13. Light pile driver for fence posts.
14. Wood working outfits for use on bridge falsework and concrete forms.

B.—Machinery and Appliances for Heavy Work:

1. Ballast cleaning and screening devices.
2. Ditching machines for cleaning track ditches and widening cuts.
3. Spreader cars for leveling dumped material.
4. Small rotating steam shovels for ditching and light earthwork.
5. Dump cars for use with ditchers and steam shovels.
6. Ballast cars and plows.
7. Weed killers: using chemicals, steam or oil flame.
8. Rail sawing and drilling outfits for reclaiming damaged rails.
9. Small rail-laying cranes or derricks for use in laying single rails.
10. Rail and tie handling devices for loading and unloading cars.
11. Locomotive cranes for handling and laying rails, frogs and crossings; handling earthwork and ballast with grab buckets; handling scrap with bucket or magnet.
12. Derrick cars and wrecking cranes for handling heavy material, laying rails and driving piles.
13. Portable concrete mixing outfits for small jobs.
14. Thawing outfits for clearing snow and ice from switches.

Few suggestions were made in answer to a query as to new applications for machinery, but several engineers consider that there should be a much wider use of machines now available, since so large a proportion of maintenance work can be done by machine. It is pointed out that they are likely to prove highly economical where there is sufficient work to keep them busy.

Two suggestions are for simpler devices for cleaning ballast, although two or three such devices are now in use. Others are for a gasoline rail-drill and a vacuum-cleaner on a large scale for use at terminals and yards. Still another is for a tie-spotting machine to dress the rail seats of ties in the track, but with treated ties all boring and trimming should be done before treatment. It is suggested also that some electric tools are of lighter weight than pneumatic tools, so that there is opportunity for further development of the former as well as improvement of the latter. Home made devices have been rigged up in a number of cases and for a variety of purposes, but their use is limited.

More than one engineer points out that as a rule the detail work takes up so much of supervising officers' time that they have little opportunity to study or devise improved methods and machines. In fact, from two roads comes the suggestion that some of these officers or a special officer might be assigned to investigate the possibilities in this direction and to make recommendations accordingly.

Conclusion—All of the above information points to the conclusion that a much wider use of machinery may be expected within the next few years, even though no new uses or new machines are introduced.

HOUSING AND LIVING ACCOMMODATIONS

In view of the importance of the labor item and the acknowledged difficulty in getting and keeping men on railway maintenance and improvement work, it is strange that there has not been much greater progress in providing improved accommodations for section, extra and bridge gangs. There are several individual cases of radical change from old practice, but in general the facilities include old buildings and camp cars with more or less unsanitary conditions and unpleasant surroundings. The various replies indicate very plainly that there is a large field for improvement in the accommodations provided for the working forces, and that work in this field promises tangible results. It is not to be assumed that the labor problem will be solved by means of comfortable camps and good food. The human element is too diverse for such a result. Men will still leave for slight reason; because of a dislike for the work, the gang, the foreman or the food; because a friend is going or an enemy is not going, or simply because of the urge to move on. If a man knows his employment is only temporary, he feels he may as well go now as later. But there comes in the question of permanent forces, already discussed. If a man knows that he has a permanent or even long-time job he will put up with many real and fancied grievances, any one of which otherwise would be ample reason for quitting. If these grievances are reduced to a minimum by his employer, so will his tendency to quit be reduced. The ultimate result of careful attention to this living and housing problem is expressed tersely by an engineer of long experience in the two words: "It pays."

PIECE-WORK AND COST-RECORD SYSTEMS

A serious difficulty which faces attempts to increase the efficiency and economy of railway track work and general improvements is the lack of means for determining the output per man or per gang or the unit cost of the items of work performed. In the first place, the men usually receive a regular and uniform wage. In the second place, the only basis for cost data is in the inadequate and arbitrary entries of the section foreman or gang foreman in his time book. To quote from a paper by Mr. Ford, assistant chief engineer of the Chicago, Rock Island & Pacific Ry.: "In general the productivity of railway maintenance labor has not been commensurate with results secured in other lines of industry where measures have been used for gaging output" (see *Engineering News-Record*, May 18, 1922, p. 824). One engineer says present systems of maintenance-of-way accounting are of little value to the men in charge of the work.

Various cost-record systems have been tried by thirteen out of thirty-six railways, but in only one case has the system been introduced to any extent. In most cases the innovation is regarded as experimental and inconclusive; in general also the system is limited to obtaining unit prices for certain typical and specific items of work, such as tie renewals, ballasting and rail renewals. In fact one engineer considers this decidedly preferable to attempting to apply the system to the entire work, since it allows of definite comparisons being made and avoids the considerable expense of an accounting system which covers all details of the work. He considers that the three items mentioned would be typical and comparable throughout the railroad.

On the other hand, several engineers approve of a general cost-record system and consider that a simple, fair and efficient system could be worked out to determine unit cost and the relative efficiency of men and gangs. Reasons given for not carrying out a study along this line are mainly in regard to insufficient force and funds. An objection noted is in the varying local conditions of track and traffic, making general comparative data of questionable value. But this objection is avoided in some cases by making the comparisons between sections or districts requiring about the same character of maintenance and having about the same traffic.

A cost-record system for track maintenance work on the St. Louis-San Francisco Ry. is found to effect a saving of money and to result in good work being done (see *Engineering News-Record*, Nov. 11, 1920, p. 949). An improvement on the ordinary time-book plan as introduced by one road is to have the foreman send a daily report to the roadmaster and the division engineer, giving all information necessary for the complete accounting of the work done by the gang. This is found preferable to monthly reports; it gives the division officials a better check on their expenditures, and it is approved by the foreman since it frees him from all the bookkeeping which formerly was necessary. Another road has experimented with measuring the cost in man-hours of performing certain items of work with a view to rivalry among the section foremen and a resultant economy. It appears to be quite generally considered that real improvement, but with intangible and indefinite economy, results from the practice of periodical inspection with award of prizes. This practice is not now so general as it was some few years ago and several engineers favor a return to it.

As to the piece-work system, only four of the thirty-six railroads report having tried this. Two of these roads had to abandon it during the period of control by the U. S. Railroad Administration and have not yet resumed it. A third has a large proportion of its work done by contracting directly with the laborers and paying them by the unit of work performed. An objection cited in one case is the dissatisfaction likely to result from different pay to different members of the gang, with probable suspicion of favoritism on the part of the foreman. But this difficulty does not appear to have been encountered in the methods actually put into use.

Conclusion—Here again the conclusion may be presented that there is a fine opportunity for thorough investigation. Its objects would be as follows: (1) To determine the advisability and feasibility of a cost-record system and a piece-work system in railway maintenance work, and (2) to devise such systems in sufficient detail for their introduction both for the field or working force and the office or accounting force.

Improving Efficiency in Track Work

We come now to the suggestion of means or methods for improving the efficiency and economy of railway maintenance work and its organization. Several suggestions were made in the returns from individual railways, but few of these were discussed in any detail. In general they may be condensed and listed as follows, the figures in parenthesis indicating the number of persons making each suggestion:

A. Prepare a financial program, inform the maintenance officer how much may be spent per mile and then let him do his work without interference. Under the present system it is not so much a question of how much should be spent on a certain piece of road and in relation to its traffic, but rather how little can be spent, irrespective of requirement. This system is discouraging since the maintenance organization is not fully informed as to what it will be allowed to do. But it is admitted that this is difficult or impracticable under present financial conditions. (Four.)

B. Prepare a work program by which the items interfering with traffic (such as rail renewals and ballasting) will be done during the period of minimum traffic; that is, usually in the spring. (Five.)

C. Introduce a cost-data system and better accounting for close and accurate comparison of unit costs and gang performance. (Seven.)

D. Organize better clerical forces on maintenance and construction work. (One.)

E. Bring more men of technical education and railway engineering experience into the maintenance-of-way-department, and put this department on a plane equivalent to that of the maintenance-of-equipment department. (Three.)

F. More extensive use of labor-saving machinery and devices. (Seven.)

G. More thorough supervision of track work by supervisors, roadmasters and engineers. (Eight.) One of these suggestions includes shortening the roadmasters' divisions to provide for increased supervision.

H. Standardization of track work. (One.)

I. Heavier track construction in proportion to the loads and traffic carried. (Three.)

J. Permanent track forces. (Five.)

K. Definite training of men as section foremen, with pay sufficient to attract good men. (Three.)

L. Better pay for laborers. (Four.) Two of these suggest piece-work or payment by performance.

M. Better housing of laborers, foremen and extra gangs. (Five.)

N. Contract system of maintenance-of-way. (Three.) One suggests contracting work with laborers. (An extended article on the contract system was given in *Engineering News-Record*, Oct. 26, 1922, pp. 683, 702.)

O. Return to the former system of regular track inspection by superior officers, with award of prizes in money or in signs displayed on the winning sections. (Four.)

Supplementing the previous subject, inquiry was made as to the class of work most needed at the present time to put main tracks in condition for economic operation and maintenance. Naturally the replies varied with personal opinions and local conditions, but they may be classified generally as below. It is of interest to note the relatively small demand for new or heavier rails as compared with that for ballast, drainage and ties. An explanation of this is given by one engineer who remarks that new rails will not compensate for inadequate ties, ballast or poorly drained subgrade.

A. Drainage and ditching, including tile drains. (Twelve.)

B. Ballast of better quality and greater quantity. (Fifteen.)

C. Ties of better quality and in greater number. (Eleven.) Only three replies refer specifically to treated ties, and three advise the wider use of tie-plates.

D. Rails of heavier weight or new rails to replace those worn and battered in service. (Eight.)

E. Rail anchors as an aid to track maintenance. (Two.)

F. Better rail-joints as an improvement in themselves and as influencing the service and life of rails and track. (Two.)

G. More attention to general maintenance of gage, line and surface. (Eight.)

H. Intelligent and competent trackmen and foremen, and trained foremen and supervisors. (Two.)

I. Replacing old bridges with more permanent structures. (One.)

J. Regulation of train speed in relation to conditions of grade, curvature and track. (One.) Improvement in this direction is hardly to be expected. Schedules rarely take such factors into account, except when they are so severe as to be governing factors. In general, the maintenance department has to maintain the track under practically any and all operating conditions.

Conclusions

A study of the several subjects covered in this article suggests the following conclusions:

1. There is need of more engineers specially skilled in track work and need also of more skilled track foremen. But in general the railways are doing little to invite or encourage engineers to specialize in this department. Nor is there any general or definite policy of training foremen, who are the important non-commissioned officers in charge of the working forces.

2. The employment of permanent instead of temporary or shifting forces promises economic and practical results of high value. As a corollary to this, a permanent skilled section force should do all regular maintenance work. Extra gangs would still be needed, but would handle only improvement and emergency work and heavy replacements. Greater attention to the living conditions and social needs of the men is desirable.

3. Machinery for track work is increasing in extent and in variety, but the present demand is for wider use of the machines available rather than the development of others for additional purposes. It is particularly important to note that much of this machinery is to relieve the men of work that is severe or unpleasant.

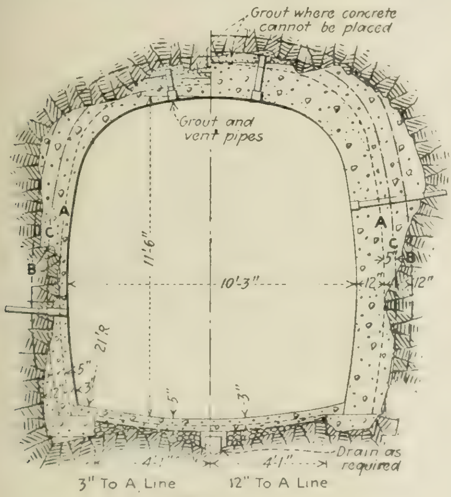
4. Cost-record systems are needed in order to permit of determining output performance and unit costs. Few railroads have systems giving results comparable with those employed in other lines of engineering work.

5. Extensive improvements are needed to bring the track into economic relation with the traffic. These improvements are needed more particularly in the substructure (roadbed and ballast), rather than in the rails which form the superstructure, although it is often assumed that heavy rails are needed first and will compensate for defects in the substructure.

World's Longest Continuous Tunnel Holed Through

On 18.1-Mile Shandaken Bore for New York's Catskill Water Supply Rock Excavation Totaled 573,000 Cu.Yd.

When a thin wall of rock separating the headings between shafts 1 and 3 of the Shandaken tunnel of the Catskill water-supply system for New York City was blasted down at 3 a.m., Feb. 13, the last barrier in the world's longest continuous tunnel, 95,740 ft., or about 18.1 mile, was removed. In length, this tunnel exceeds by 51 ft. the 95,689-ft. city aqueduct tunnel, also part of the Catskill system, for the delivery of the supply within the city limits. The total payment quantity of rock excavation on the Shandaken tunnel is approximately 573,000 cu.yd., while the amount per linear foot varies from 6.64 to 7.73 cu.yd. For concrete lining the yardage per foot of tunnel ranges from 1.87 to 2.64.



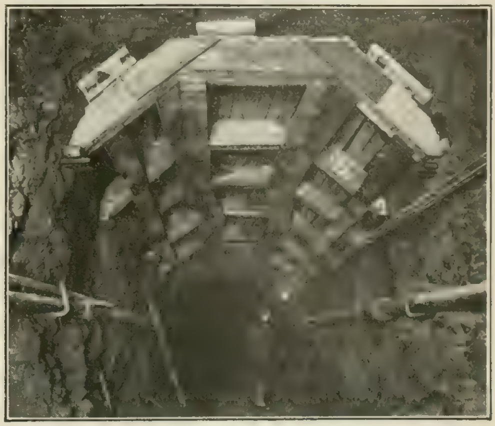
TUNNEL SECTION SHOWING CONCRETE LINING

The "A" line is the line beyond which no rock shall project.
The "B" line is the line of payment for excavation and concrete.
The "C" line is the line of average thickness of lining in any 4-ft. length of tunnel.

The water tributary to the Catskill water supply system rises in the Esopus and Schoharie watersheds in the Catskill mountains. Each of these watersheds will furnish a supply of about 300,000,000 gal. a day. The Esopus development was practically completed in 1917 and work on the Schoharie is now in progress. The Shandaken tunnel will conduct water from the Schoharie reservoir into Esopus creek, which flows directly into the Ashokan Reservoir.

This tunnel is horseshoe in section and concrete lined, with finished dimensions of 11 ft. 6 in. in height by 10 ft. 3 in. in width. Its carrying capacity will be about 600,000,000 gal. a day. It has a uniform slope of 4.4 ft. per mile except for the northerly 3¼ miles, which is depressed, making that portion a pressure tunnel. Seven intermediate shafts were provided, the aggregate depth of shaft being 3,238 lin.ft.; the maximum depth of a single shaft is 630 ft. The minimum distance between shafts is 1.3 miles and the maximum 2.7 miles; however, as actually excavated the maximum distance between shafts was 4½ miles.

The estimated cost of the tunnel is $12,138,738, and the original contract was awarded in December, 1917. War conditions interfered with the progress of the work during the early stages and on Nov. 10, 1920, the work was assigned to the Shandaken Tunnel Corp., New York City, at which time all shafts had been sunk and lined, tunnel headings turned, an electric power line installed over the entire tunnel location and 11,300 ft. of tunnel excavated.



PERMANENT TIMBERING IN SHANDAKEN TUNNEL
About 48.3 per cent of the tunnel required support.

Record of Progress—The first headings were holed through April 1, 1922, between Shafts 4 and 5, and concreting operations were started in this portion shortly thereafter. In the 2 years and 3 months following Nov. 10, 1920, 16 miles of tunnel were excavated and 7.9 miles lined with concrete. The maximum progress made on the excavation of the tunnel was as follows:

Progress of Tunnel Excavation	Feet
Max. monthly excav. in 12 headings	5,979
Max. weekly excav. in 12 headings	1,130
Max. monthly excav. in 1 heading	611
Max. weekly excav. of completed tunnel in 1 heading	164
Ave. weekly excav. in all headings	62
Ave. weekly progress, all headings, after Nov. 10, 1920	78

The rock through which the tunnel was excavated consisted of shale or sandstone varying widely in hardness. The beds were of varying thickness and the general dip of the formation was from 1½ to 2 deg. toward the south. The shales, mostly red with small amounts of blue and green, drilled easily and broke well to line but had a marked tendency to disintegrate rapidly when exposed to atmospheric conditions. The red sandstones were of slightly coarser texture, and roof support was usually required, as in all of the shale ground. The gray and blue sandstones were the hardest and coarsest grained, and consequently were more difficult to drill and shoot, required little scaling and when not too thinly bedded generally stood well without support. The inflow of water was never so great as to impede the work or to require other than ordinary methods for its control.

The top-heading method and hand mucking were used practically for the entire period in Shafts 1, 3, 4, 5 and 7 (south) and the full-faced method with machine mucking at Shaft 6 (south) and Shaft 7 (north). At the

EXCAVATION PROGRESS—SHANDAKEN TUNNEL

Shaft	Tunnel Heading	Length (Ft.)	Supported Lengths (Ft.)	Elapsed Time (Weeks)	Aver. Weekly (Ft.)	Max. Weekly Completed Tunnel (Ft.)	Material Excavated
Intake	S	16	0	4	4	12	Rock
1	N.	11,886	1,508	152	78	150	Rock
1	S.	13,357	0	166	80	155	Rock
2	N.	33	0	3	11	22	Rock
2	S.	709	[illegible]	13	60	119	Rock
3	N.	9,721	1,557	115	85	148	Rock
3	S.	6,664	2,677	100	67	151	Rock
4	N.	6,253	1,158	69	91	164	Rock
4	S.	4,791	1,904	53	90	150	Rock
5	N.	6,407	4,745	**123	52	138	Rock
5	S.	6,483	3,606	**123	53	130	Rock
6	N.	6,849	6,711	128	54	99	Rock
6	S.	8,333	8,330	150	55	114	Rock
7	N.	5,952	5,806	**160	37	84	Rock
7	S.	7,928	1,366	**162	49	155	7,614 ft. rock 314 ft. earth
Portal	N.	220	272	17	13	28	
Totals		95,602	*39,640	1,538	62		
After Nov. 10, 1920		84,302	37,109	1,078	78		

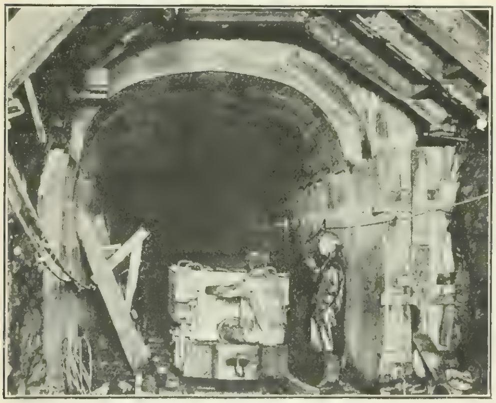
Note: The above lengths of tunnel between shafts do not include the portions of the tunnel which were excavated as shaft.

* In addition there was 6,564 feet of temporary support.

** No work for 16 weeks at 5 North
No work for 23 weeks at 5 South
No work for 21 weeks at 7 North and South

outlet portal there was 600 ft. of difficult soft ground work. Shifts were in general so organized as to permit of two shots per day in the top heading tunnels and alternate advances of two shots and one shot per day in the full faced tunnels. Trimming was carried on closely behind the main excavation. Water Leyner drills, mounted on vertical columns, were used in the headings and jackhamers on the bench.

No tunnel excavation was done from the intake shaft nor from Shaft 2, and only a few hundred feet of the soft ground was taken out from the outlet portal. The distance between Shaft 1 and Shaft 3, the maximum between shafts as excavated, was 23,819 ft. or 4½ miles. From May 4, 1921, to Feb. 13, 1923, when this stretch was holed through, a period of 94 weeks, the average weekly progress was 208 lin.ft. in these two headings.



CONCRETE LINING IN PLACE
Showing electric storage battery locomotive used to pull seven cars.

Transportation of tunnel muck to the shafts was accomplished by means of electric storage-battery locomotives, pulling six or seven end-dump cars, each averaging about 1 cu.yd. of solid rock.

Roof support by either permanent or temporary timbering, of practically the same design, was necessary in 48.3 per cent of the tunnel length. In the temporary type the timber was placed within the concrete limits and will be removed before the lining is placed.

Tunnel lining has been carried on since April 5, 1922, when the first concrete was placed. This work has been done from plants located at Shafts 1, 4, 5 and 7 and to date 42,069 lin.ft. of tunnel have been concreted, equivalent to 44 per cent of the total. The maximum rate of concreting per week for the entire contract has been to date 1,454 ft., and from one shaft 1,082 ft.

This construction is being done by the Board of Water Supply of the City of New York, of which Thaddeus Merriman is chief engineer. George G. Honness is department engineer in charge of the field work, and William B. Hunter and Roy W. Gausmann are the division engineers.

The representative of the Shandaken Tunnel Corp. on the work of construction is the Ulen Contracting Corp., of which Henry C. Ulen is president and Thomas S. Shepperd is general manager in charge of all construction operations. M. R. Keefe is general superintendent for the Ulen corporation, G. E. Hines is chief engineer and R. H. Keays is assistant general superintendent.

Gum Wood for Ties on Santa Fe Ry.

Although gum wood is generally regarded as undesirable for ties, owing to its tendency to extensive checking which promotes decay, it has been found very satisfactory on roads which have given it special attention, according to a paper read at the recent convention of the National Association of Railroad Tie Producers, at New Orleans, by J. R. Keig, manager of the Kirby Lumber Co., Silsbee, Texas. Mr. Keig referred especially to practice and experience on the Atchison, Topeka & Santa Fe Ry., stating that on this road it was realized that gum ties could be used with success if moved from the woods immediately to the track or loading point, properly stacked for inspection or loaded promptly for the treating plant, given the necessary care during seasoning, and then treated according to the most improved methods. The principal species are red or sweet gum, black gum, cotton gum or tupelo, and are found in the low-lands, usually along the rivers.

When ties are hauled to the right of way, they are not accepted unless indications show that they have been brought out almost immediately. They are stacked on the right of way (two by seven) with plenty of air space to facilitate inspection and seasoning, and every precaution is taken to load them before there is chance for infection. When ties are seasoned and ready for treatment they are sent to a boring and adzing machine which also cuts a slice from each end so as to permit an inspection of the wood. If a tie proves to be unsound, it is culled out. After thorough treatment, usually with creosote, the ties are stored in the yard or shipped to one of the many storage yards.

Gum ties (which are considered as hardwood) are used only on curves of two degrees or over, on heavy traffic main lines or switching leads, and on certain mountain division. They are inserted with care, which means the use of tie tongs and freedom from undue abrasion. Tie-plates are used, but it is said that there is little plate cutting of the tie and that the spike holding qualities are excellent. The Santa Fe Ry. is reported to have one instance where gum ties have given thirteen years service with only one per cent renewals.

Further Track Test Data: Rail Stresses and Track Distortion on Curves

Third Report of Track Stress Committee—Action of Locomotives on Curves, and Vertical and Lateral Rail Bending Developed—Load Distribution Changed—Track Distorted by Wheel Pressures

IN THE third report of the Committee on Stresses in Railroad Track, just published, new facts are brought to light fully as important as those contained in the two preceding reports. They define the principal phenomena of curve effects, both as to locomotive action and as to track resistance. For better comparison the report also analyzes the vertical and lateral effects on straight track more fully than was possible in the earlier reports.

Convenient summaries of the first and second reports were presented in *Engineering News-Record* of March 14, 1918, p. 517, and Feb. 26, 1920, p. 406. As there summarized, the two reports demonstrate:

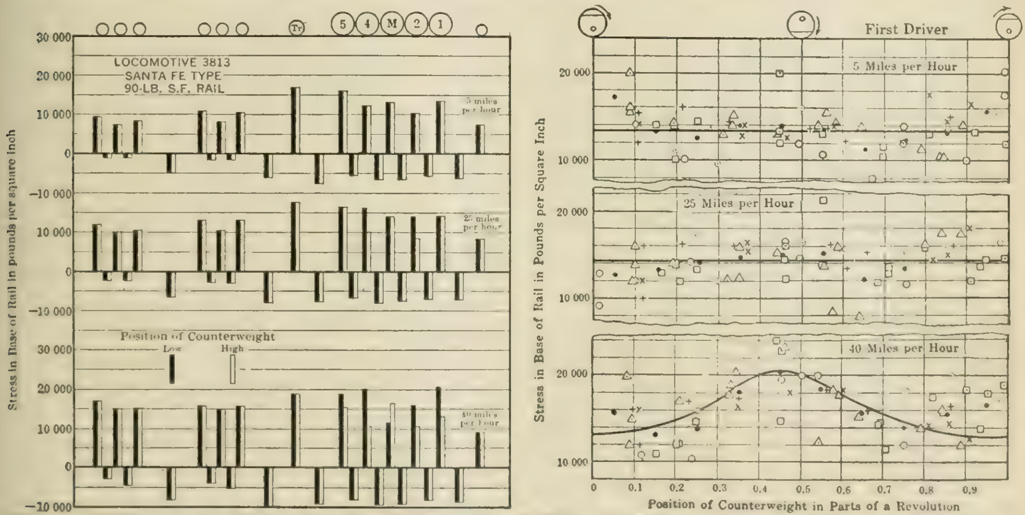


FIG. 1—VERTICAL RAIL STRESS ON STRAIGHT TRACK—SPEED AND COUNTERWEIGHT EFFECTS UNDER HEAVY SANTA FE TYPE LOCOMOTIVE

Left—Stresses under wheels at high and low positions of counterweight. Right—Stress variation under first driver during revolution.

First Report—Rail stresses are determined not by beam action between adjacent ties, but by the general track depression under the group of loads concerned; track depression and rail stress are proportional to the load; the rail stresses are greater for larger wheel spacings, lower on good roadbed than on bad, lower in heavy rail than in light, and greater for high speeds than for low by amounts ranging from 0.3 to 1.2 per cent for every mile per hour increase of speed beyond 5 miles per hour. Generally speaking, the stress in the outer flange of the rail exceeds that in the inner flange, but the rail is bent laterally into a sinuous form.

Railway roadbed is elastic, but with an initial inelastic deformation, which may be considered looseness or play. Measurement of the elastic constants of the track is simple and accurate, and calculations made with the use of these constants and the principles of the ordinary flexure theory give calculated stresses which check the measured stresses in the rail very closely. The distribution of the locomotive load between the several wheels has an important bearing on rail stress; for example, a defective equalizer lever produced abnormal stresses under one wheel.

Second Report—Rail stresses under drivers increase and decrease cyclically with the revolution of the counterweight; imperfect counterbalance increases the rail stresses greatly; aside from counterbalance effect, there is an increase of stress due to increase of speed, which in many instances amounts to half the static rail stress; such a speed effect is observed under the tender wheels as well as the engine wheels; the effect of the counterbalance may exceed the speed effect; the disturbance caused by counterbalance extends in some cases even to the leading and trailing wheels; the counterbalance effects are so important, and counterbalancing is so imperfect and uncertain, that the subject requires much more careful attention in locomotive design; in one locomotive the stresses under the left side were 20 per cent greater than those under the right; the lateral bending of the rail under the driving wheels is not related to counterweight position or to speed, and lateral bending moments ranging up to 8 per cent of the vertical bending moments were often found; the distribution of the locomotive loads to the ties and roadbed is the same as would be found on the assumption of uniform rail bearing; the bending of the ties shows that ordinary track is centerbound, while for a short time after tamping it is endbound; the greatest tie moment in a tie of first-class track is about 2.5W inch-pounds; the tie pressures distribute through the ballast in accordance with theory, and the ballast pressure is nearly uniform at a depth equal to the tie spacing.

Third Report—The third report, which is based on a greater number of measurements than the first and second combined, includes a new and more careful study of the vertical and lateral bending in straight track, especially with respect to speed and counterbalance effect, and a study of the corresponding actions in curved track of various degrees of curvature, under different locomotives, at speeds up to 60 m.p.h. In addition, a few measurements were made to determine the position assumed by a locomotive on a curve, and other measurements of the spreading of the track and the bending of the rails under a locomotive. Some of the major points brought out by this third report may be noted as follows:

1. No abnormal stresses are produced in the rail of straight track by locomotives with wheel loads of about 30,000 lb., except in case of a locomotive of decidedly rough-riding character.

2. Speed increases the stresses on straight track by 18 per cent at 40 m.p.h. and 27 per cent at 60 m.p.h. (in typical cases).

3. Counterbalance increases the rail stress about as much as speed does, provided the counterbalance is reasonably good.

4. Combined speed and counterbalance effect increases the rail stress by 30 to 53 per cent, but at one driver of a satisfactory locomotive the increase was 80 per cent and at one driver of a rough-riding locomotive the combined increase was 190 per cent.

5. The stresses under the two sides of the locomotive show only slight and variable differences.

6. The lateral bending stress in the rail on straight track is frequently 33 per cent and in a few cases 50 per cent of the vertical bending stress but ordinarily the ratio did not exceed 10 per cent, with individual measurements varying 4,000 to 5,000 lb. per square inch from the average. The ratio of lateral to vertical bending appears to be independent of speed or counterbalance.

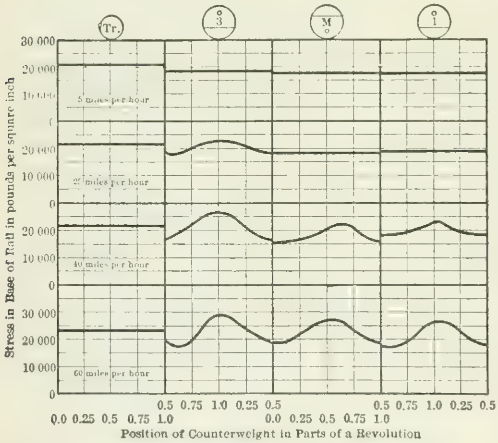


FIG. 2—SPEED AND COUNTERWEIGHT EFFECTS ON STRAIGHT TRACK

Curves of average rail stresses under wheels during one revolution, for drivers and trailer of Pacific type locomotive. The counterweight effect is represented by the variation in the ordinates of the curves. The difference between the mean values of the lower curves and the upper represents the speed effect.

7. On curved track, friction on the rail head plays a part in developing lateral pressure on the rail.

TABLE I—SPEED AND COUNTERBALANCE EFFECTS FOR VARIOUS LOCOMOTIVES ON STRAIGHT TRACK

Principal values of per cent increase in vertical bending stress at the given speeds over the stress at 5 m.p.h. Lateral bending is not included.

Type of locomotive.	Drivers.				Trailer.	Tender Wheels.	
	Speed Alone.		Combined Speed and Counterbalance.				
	General value.	Maximum under one driver.	General value	Maximum under one driver.		General value.	Maximum under one wheel
Atchison, Topeka and Santa Fe Railway:							
Pacific, 60 miles per hour	27	30	53	53	15	75	98
Balanced Compound Prairie type, 50 miles per hour	15	26	30	43	29	50	87
Mountain, 60 miles per hour	20, 20	30	35	50, 55	10	40, 60	110
Light Santa Fe, 45 miles per hour	40	77	105	190	10	23	35
Heavy Santa Fe, 40 miles per hour	18, 18, 18	28	50	80	15	75, 70, 50	110
Delaware, Lackawanna and Western Railroad:							
Pacific, 60 miles per hour	20	24	49	59	14	45	57

8. The distribution of load between the different drivers is greatly modified when the locomotive traverses a curve. The speed effect is about the same as on straight track, but the counterbalance effect is variable.

9. Large lateral bending stresses occur on curved track, these stresses being in many cases extremely high.

10. Very high combined stresses are likely to occur on curves, particularly because the high lateral bending is apt to occur under wheels giving abnormally high vertical bending. One reading of 75,000 lb. per square inch was recorded.

11. An intense and severe lateral bending action is exerted on the track as a whole while the locomotive passes around a curve, tending to distort and loosen the track.

12. On curves the gage of the track is spread by amounts which sometimes exceed ½ in.

Test Conditions—The tests were conducted at eleven different locations on four railroads, on straight track and on curves ranging in sharpness up to 10-deg., on profiles ranging from level to 1.40 per cent downgrade and 2 per cent upgrade. A large range of different kinds of track construction was represented. The rail ranged from 85 to 105 lb. in weight, the tie spacing from 18 to 22 in. Track with and without tie plates, and with plain and screw spikes, was represented. The ballast ranged from cinder to broken stone. Locomotives of seven different types were used—light and heavy Prairie type (2-6-2), Pacific (4-6-2), Mikado (2-8-2), Mountain (4-8-2), light and heavy Santa Fe types (2-10-2), and a Santa Fe with four-wheel trailer truck (2-10-4). The driver loads ranged from 25,000 to 33,000 lb. per wheel.

The main tests, in which rail stresses were measured, were carried out with the use of the stremmatograph, described in connection with the first report. This is an extensometer of 4-in. gage length, in which the lengthening or shortening is recorded without magnification by a fine metal point bearing on a smoked glass disk rotated by a hand-driven gear. Generally eight instruments were used, four on each rail, with the result that the measurements were very much more comprehensive than in the earlier tests, in which four were used. Each instrument carried two disks, recording separately the stresses at inner and outer edge of the rail base.

Most of the tests were made with the engine coasting, but in a few tests loads were hauled; no particular effect of the drawbar pull upon the rail stress could be found.

All measurements of stress from the records were corrected for the distance of the stremmatograph bar below the rail base, and for the variation of stress within the gage length, so that the figures finally reported represent the stress in the middle of the rail base at the point directly under the wheel. A total of 470,000 microscope readings of records was required in reducing the results, and the work extended over three years; a skilled observer could make 1,000 to 1,200 readings per day.

Straight Track—Vertical bending effects in rail as found from the measurements on straight track are typically represented in Figs. 1 and 2 herewith. The stresses are averages, usually some 50 to 125 observations being averaged to give a single figure. Variations of 5,000 lb. per square inch above and below these averages occur. At slow speed the measured values agree very well with those calculated by the theory previously developed (see first report), using 1,600 lb. per lin.in., of rail as the value of the modulus of elasticity of rail support (determined for these particular tests by special measurements).

TABLE II—RATIO OF STRESS AT OUTER EDGE TO MEAN STRESS IN BASE OF RAIL

General values of average ratio, for wheels of several locomotives.

Locomotive.	Speed, in miles per hour.	Average of tender wheels.	Trailer.	Driver Number.					Front truck wheels.
				5	4	3	2	1	
Atchison, Topeka and Santa Fe Railway:									
Pacific	5	1.06	1.05	....	...	1.17	1.14	1.12	1.08 1.01
	25	1.06	1.04	....	...	1.14	1.12	1.12	0.96 1.05
	40	1.03	1.07	....	....	1.08	1.10	1.12	1.06 1.08
	60	0.99	1.07	....	....	1.06	1.13	1.17	1.08 1.01
Light Santa Fe	5	1.00	0.96	1.10	1.10	1.01	1.26	1.33	1.05
	25	1.01	0.97	0.99	1.08	1.05	1.29	1.31	1.04
	35	1.00	0.99	0.96	1.09	1.05	1.21	1.31	1.00
	45	1.04	0.94	1.00	1.02	1.07	1.27	1.20	1.04
Heavy Santa Fe	5	1.13	1.08	1.08	1.18	0.97	1.16	1.12	1.01
	25	1.07	1.01	1.06	1.15	0.93	1.10	1.06	0.97
	40	1.00	1.05	1.03	1.18	0.89	1.10	1.06	0.97
Double Trailer, Heavy Santa Fe	5	1.08	1.02 0.98	0.96	0.98	0.97	1.00	1.06	0.97
	25	1.05	1.04 1.01	0.97	0.98	0.94	1.01	1.01	0.96
	40	1.05	1.06 1.06	1.08	1.05	0.99	1.05	1.07	1.04
Delaware, Lackawanna and Western Railroad:									
Mikado	5	1.06	1.00	...	1.06	1.14	1.21	1.17	1.20
	15	1.05	0.96	....	1.04	1.18	1.31	1.15	1.14
	25	1.04	1.01	....	1.07	1.16	1.23	1.13	1.13

Counterbalance effects are not perceptible at the speed of 5 m.p.h., but at greater speeds the plotted points when averaged in narrow groups form a distinct wave-like curve (see right-hand diagram in Fig. 1), so that the rail stress under different wheels may be plotted on fractions of the driver revolution as abscissas, as in Fig. 2. The average for the full revolution, taken as the mean stress under the wheel for that particular speed, is greater than the stress at a speed of 5 m.p.h., this excess representing the speed effect. The difference between the high or the low point of the wave-like curve and its mean is the counterbalance effect. The counterbalance effect differs considerably in the different locomotives, and, just as in measurements previously reported, some of the locomotives appear to be very badly counterbalanced. However, the counterbalance stresses are reported as being "not unreasonably high" except in one locomotive (Light Santa Fe type).

Speed effect (see Table I) was found to average from 15 to 27 per cent, except for a considerably higher value in the Light Santa Fe. Except for two engines, the maximum speed effect under any one driver is reported as generally less than 35 per cent.

Combined speed and counterbalance effect ranged from 30 to 53 per cent, and the maximum under any driver from 43 to 80 per cent. The maximum stress in the rail ranged from 20,000 to 29,000 lb. per square inch; this figure disregards the variation of individual observations from the averages, and also does not include the effect of lateral bending, or the excess of stress in the outer or inner edge of rail base from the mean.

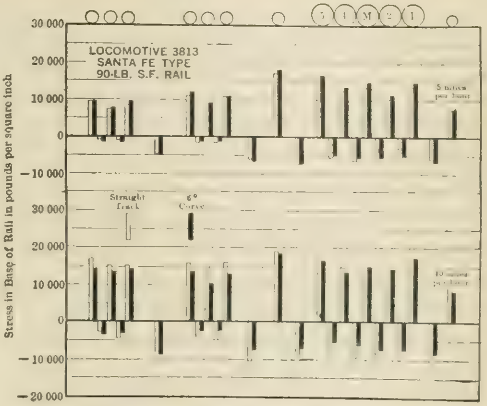


FIG. 3—TOTAL VERTICAL EFFECT ON CURVE SAME AS ON STRAIGHT TRACK

Black bars, average of stress in inner and outer rail on 6° curve. White bars, rail stress on straight track.

Both are for a locomotive of Heavy Santa Fe type, on 90-lb. rail, at speeds of 5 and 40 m.p.h. The stresses are those in the middle of the rail base.

In the Light Santa Fe type locomotive the combined speed and counterbalance effect under the several drivers was 87, 74, 190, 97, and 73 per cent respectively. As found later, the lateral bending produced by this locomotive is also high.

The trailer showed no counterbalance effect (such an effect was noted in the second report), but its speed effect was about the same as that of the drivers. The speed effect of the tender was generally larger than that of the drivers, ranging from 40 to 75 per cent.

Summarizing, the report says that, except for the Light Santa Fe type, no abnormal vertical stresses were found at any speed. The wheel loads being closely alike, the stresses found under the drivers do not differ greatly (allowing for differences in rail weight), except in one or two cases where the division of load apparently differs from the nominal division. The speed effects, 18 per cent at 40 m.p.h. and 27 per cent at 60 m.p.h., are regarded as moderate. The counterbalance effect is reported as about the same as the speed effect; however, it is generally much greater under some one driver, and more careful study of the counterbalancing problem seems desirable. In all the locomotives tested, the conditions of counterbalance in the main driver differed considerably from that assumed in the design.

As the average stresses under all the wheels checked closely with the average of the stresses calculated from the previously developed theory, the theory is considered to be further confirmed.

A special comparison of the stresses under the left and the right sides of the locomotive showed no particular difference.

Lateral Bending on Straight Track.—From the ratio of the stress at one edge of the rail base to the mean stress in the rail base it was found that the lateral bending stress is frequently 33 per cent or more of the vertical bending, in a few cases reaching 50 per cent. The lateral bending stresses plot in a belt having a width of 4,000 to 5,000 lb. per square inch either side of the mean curve. The average lateral stress percentages for different locomotives under different wheels usually remained below 10 per cent, but under the first two drivers of the Light Santa Fe the average percentages ranged from 20 to 33. The report says:

"For a ratio of stress at the outside edge to mean stress with a value of 1.33, it is seen that the lateral bending moment in rail is about 7 per cent of the vertical bending moment required to develop the mean stress in the base of rail. A value of the lateral bending moment found quite frequently is 4 per cent of the vertical bending moment, although in a few cases it reached 14 per cent, if the effect of the added 5,000 lb. per square inch of the belt of stresses is taken into consideration. From a study of the observed values, it would seem that in designing a rail section for straight track a lateral bending moment at least equal to 14 per cent of the vertical bending moment should be provided for."

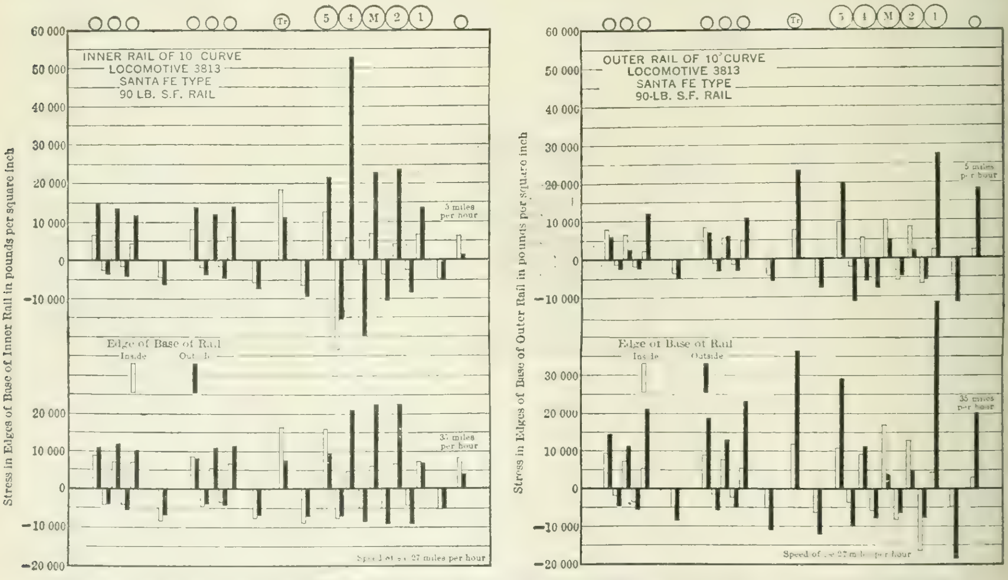


FIG. 4—LATERAL BENDING STRESSES IN RAILS UNDER A STIFF LOCOMOTIVE ON A SHARP CURVE

Comparison of stresses at inner and outer edges of rail base on 10° curve under a locomotive of Heavy Santa Fe type, running on 90-lb. rail, at low speed and at high speed.

The ratio of lateral to vertical bending stress seems to be independent of speed and of position of counterweight.

Curved Track—While the tests on curved track gave in many respects more variable results that those on straight track, their accuracy is well shown by a comparison of the total vertical effect (average of stress in the base of inner and outer rail) with the rail stress on straight track. Fig. 3 shows that the results are substantially identical. It is to be remembered that lateral bending effects are eliminated in this diagram, as the plotted values represent the stress in the middle of the rail base.

The large lateral bending effects on curves, and their essential difference for the inner and outer rail, are represented typically by the two diagrams in Fig. 4, taken under a locomotive of Santa Fe type on 10-deg. curve, at slow speed and at fairly high speed. The change in distribution of lateral pressure with speed is obvious. The high pressure of the fourth driver against the inner rail at low speed and the high pressure of the first driver against the outer rail at high speed are particularly noticeable.

It is reported that in the observations the body of the observed values lay in a belt that was frequently within 6,000 lb. per square inch of stress of the line of average stress, although in some cases the range was much wider; generally it may be assumed that the average stresses are representative of the actual phenomena, but that a range of stress above and below the average line amounting to 4,000 to 12,000 lb. per square inch occurs.

The change of lateral bending with speed is represented by direct plotting in Fig. 5, which represents stresses under a Mikado locomotive on 6-deg. curve. The principal change evidently is concentrated at certain of the wheels.

Specific figures for lateral bending stress (averages for many observations) are given in the lower diagram in Fig. 6, which represents the stresses produced by a locomotive of Mountain type on 6-deg. curve. Other lateral effects on the same curve with the same locomotive are shown in the upper and middle diagrams of the same figure, showing for a standing locomotive the position of the wheel flanges with respect to the rail and the distortion of the track, or the amount by which the rails have been forced away from their unloaded position. The amounts of displacement are given in inches, and they have been drawn to a highly exaggerated scale, but it may be seen that the track is very seriously distorted. No such measurements were made under a running locomotive, but from the change of lateral bending stresses with speed it may be presumed that the distortions would be different at speed.

Some of the points brought out in the report with respect to the lateral bending stresses are: In locomotives with two-wheel front trucks, the lateral bending of the outer rail at the outer front driver is positive at all speeds, but in the case of four-wheel leading trucks this pressure is usually negative (directed toward the center of the curve) at low speed and tends to become positive at higher speeds. The outer rear driver produces outward thrust at all speeds, except in one locomotive. The other drivers generally give negative bending (tending to straighten the rail) at low speeds, with a tendency toward positive bending at increased speeds. The trailer has an outward thrust against the outer rail in all cases at the higher speeds, but its action against the inner rail varies.

These lateral bending stresses "are of considerable magnitude, in many cases extremely high." Under the fourth driver of a Santa Fe locomotive on the inner rail of a 10-deg. curve lateral bending of 23,500 lb. per square inch was found at low speed, in another similar test 25,800, and in a third 20,300. An outer front driver of another locomotive at high speed produced lateral bending on the outer rail of 22,600 lb. per square inch. The third driver of another locomotive produced lateral bending of the inner rail of 19,800 lb. per square inch on 10-deg. curve at 5 miles per hour. Other values scale downward from these figures.

"When the stress due to lateral bending is combined with that due to vertical bending, it will be seen that the resulting stress may be very great. This is the more marked because the high lateral bending stresses generally occur under wheels giving very high vertical bending stresses, much greater than those developed on straight track. Thus, for example, at the outside edge of the base of the inner rail of the 10-deg. curve under the fourth driver of the Santa Fe type locomotive at 5 m.p.h., the stress is the sum of 23,500 and 29,200, resulting in a stress of 52,700 lb. per square inch. This value is the average of a large number of runs; not infrequently stresses several thousand pounds greater than this were found, indeed one of 75,000 lb. per square inch was recorded. It may be added that the value of the lateral bending stresses under many of the wheels ranged from 40 to 100 per cent of the vertical bending stress under the same wheel."

The lateral bending moments for the two rails, and also for the two rails combined, that is, for the track as a whole, were also studied, producing such diagrams as reproduced in Fig. 7. The lower diagram, showing the combined bending moment (on the track as a whole) is particularly important. It shows "the intense and severe lateral bending action which comes on the track as a whole as the locomotive passes around the curve, tending to push the ties and ballast first to one side and then to another and to throw the curve out of line."

The ratio of the lateral bending moment to the vertical bending moment at the same point of the rail reached an average value of 0.16, as compared with an average value of 0.04 on straight track.

Vertical Effects on Curves—The division of load between the two rails was found to be very closely that computed from the lateral inclination of the track and the centrifugal force, when the average of all the wheels on one side was compared with that on the other. However, the distribution of load between the several wheels on one side is quite different from that found on straight track or to be expected from the functioning of the equalizer system. "At 5 m.p.h. the vertical bending stresses in the inner rail of the 6-deg. curve under the third and fourth drivers of a heavy Santa Fe locomotive are far higher than are to be expected from considerations of transverse inclination of track and centrifugal force. The loads transmitted from these inner drivers, estimated from the observed vertical bending stresses, are 47,000 and 46,000 lb., 50 per cent greater than the nominal load. On the 10-deg. curve at Ribera, at 5 m.p.h., the load transmitted to the inner rail by the fourth driver is estimated to be 64,000 lb., more than twice the normal load. In the Mountain type locomotive, the vertical bending stresses in the inner rail of the 6-deg. curve under the second and third drivers at a speed of 5 m.p.h. are 2¼ and 2½ times those in the outer rail. This means loads of 44,000 and 42,000 lb., 40 per cent more than the normal load on straight track—far more than will be produced by transverse inclination of track alone. On the 10-deg. curve, the corresponding vertical bending stress in the inner rail under the second driver is nearly three times as great as that in the outer rail, and under the third driver five times as great. This means loads of 45,000 and 53,000 lb., 50 per cent more than on straight track for

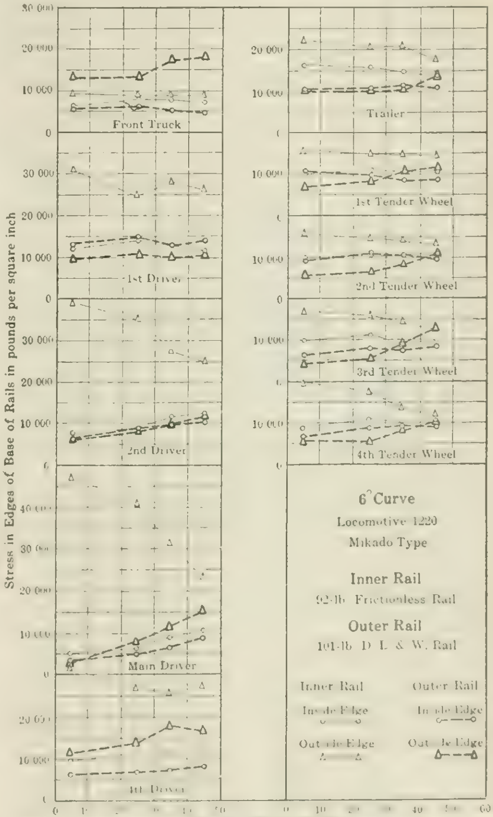


FIG. 5—EFFECT OF SPEED ON RAIL STRESS ON CURVE

the second driver and 75 per cent for the third driver, the latter driver thus giving a very high bearing pressure on the rail."

Again, "These excessive loads produce high stresses in the rail, but more important still they give very high bearing pressures on the rail. It is a well known fact, of course, that the inner rail of curves suffers greatly from the high pressure on it. The bearing pressures on the rail on straight track constitute a serious problem, and the conditions on the curves seem to be far worse that they have been thought to be. As the bearing pressures found are considerably higher under some of the wheels than those which ordinary analysis of the effect of transverse inclination of track and centrifugal force would predict, it would seem well to have a study made of the action of the equalizing levers and the springs on curved track to try to find the cause of the concentration of load, and to attempt to modify the design so as to obviate such gross inequalities."

The effect of counterbalance on the rail stresses proved to be much more variable on curved than on straight track. "In estimating the stress that will include the effect of counterbalance, the best that can be done is to take the average stress throughout the revolution of the driver and then allow for a very much greater variation in the stress above and below this line than would be done for straight track."

Effect of Locomotive Type—When straight track alone is considered, "variations in the design of locomotive, such as the length of wheel base, the number of drivers, the use of two-wheel or four-wheel trucks, may be made without bringing unduly high stresses into the rail." On curves, there are marked differences between the actions of two-wheel and four-wheel leading trucks, and the unexpected effect of greatly increased load on the inner rail under one or more of the drivers, as well as the strong lateral spreading action on the inner rail, bear directly on locomotive design.

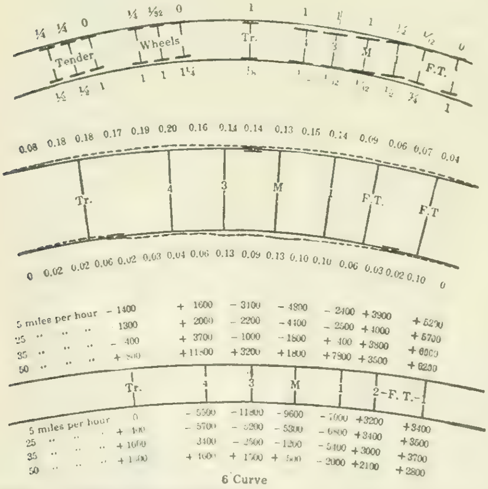


FIG. 6—LOCOMOTIVE POSITION, TRACK DISTORTION AND LATERAL RAIL STRESS ON CURVE

Mountain type locomotive on 6° curve with 4.7 in. superelevation.
Upper diagram shows position of wheels (not to scale), with figures giving distances of flanges from rails, in inches, under the standing locomotive.
Middle diagram shows in exaggerated plotting the distortion of the track under the standing locomotive, the figures giving the displacement of the rail from unloaded position, in inches.
Lower diagram gives the lateral bending stresses in the rail base at speeds of 5 to 50 m.p.h.; positive values represent a tendency to increase the curvature.

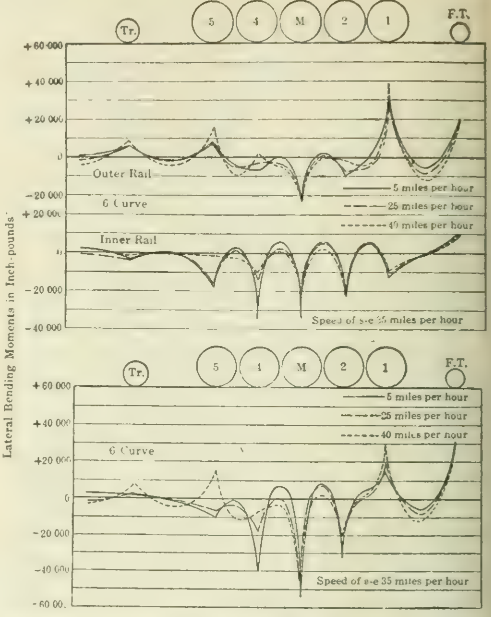


FIG. 7—LATERAL RAIL BENDING AND TRACK BENDING

Upper diagrams show lateral bending moments in outer and inner rail of 6° curve under locomotive of Heavy Santa Fe type.
Lower diagram shows combined lateral bending moments (algebraic sum of the above) on the same curve.

The four-wheel leading truck of the Pacific and Mountain types was found to have distinct advantages over the two-wheel truck of the Santa Fe and Mikado types, the former giving moderate vertical bending as well as moderate lateral bending, and relieving the first outer driving wheel of guiding action, while with the two-wheel truck the lateral bending stress under the first outer driver was often great or even excessive. As to four-wheel vs. two-wheel trailing truck, the one locomotive with four-wheel trailer had a changed distribution of load on the other wheels, so that the value of the arrangement could not be judged fairly.

Wet rail modifies the stress distribution somewhat.

Bending of Rail Sections—By means of a special instrument, which could be fastened to the rail base and measured the lateral deflection of the head of the rail with respect to the base, the transverse bending of the rail section was determined in several tests. The deflection ranged up to 0.016 in., being greater on 10-deg. than on 6-deg. curve.

The Special Committee to Report on Stresses in Railroad Track is headed by Prof. Arthur N. Talbot, of the University of Illinois, Urbana. It is a joint committee of the American Society of Civil Engineers, the American Railway Engineering Association, and the American Railway Association, and has been at work since 1914. The third report, summarized in the preceding, was presented before the American Society of Civil Engineers at its annual meeting in January, and is to be presented to the American Railway Engineering Association at its meeting on March 14.

How the Johnstown Water Company Met the Recent Drought

Industrial Supply of Steel Company Drawn On and Chlorinated Under Unusual Conditions—Public Advised to Boil Water

As A result of the severe drought in Pennsylvania in the latter part of 1922 the City of Johnstown was compelled to resort to an emergency water supply. Besides requiring chlorination and other precautionary methods this gave rise to a hydraulic problem, all as described below through the co-operation of Charles W. Kunkle, superintendent of the Johnstown Water Company.

Johnstown is an industrial city of some 75,000 population. Its water supply is furnished by the Johnstown Water Co., from impounding reservoirs having a combined capacity of 1.14 billion gallons. The extensive works of the Cambria Steel Co., in and near Johnstown, have an independent water supply for industrial purposes only, which was pressed into service for the domestic supply of Johnstown during the flood. Like the city supply, that of the steel company is drawn from impounding reservoirs, one on Hinckston Run and one on a tributary of Stony Creek. The latter is known as Quemahoning reservoir, has a capacity of about 11 billion gallons and is the largest artificial body of water in the State of Pennsylvania.

Auxiliary Supplies Attained—In September, 1922, because of the rapid depletion of the supplies normally used the Johnstown Water Co. found it necessary to obtain an auxiliary supply and this was secured from the Hinckston Run system of the Manufacturers' Water Co., which company is controlled by the Cambria Steel Co. Application for the use of this supply was made to the Pennsylvania Department of Health on Sept. 25, and approval of the project being granted, the supply from Hinckston Run reservoir was turned into a portion of the system in the western part of the city on Sept. 28. The water was chlorinated.

At the same time an appeal was made to consumers to conserve the use of water in every way, this merely emphasizing a notice to that effect made previously.

Some relief was experienced by the use of the Hinckston Run supply but the drought continuing it was discovered that an additional auxiliary supply would be necessary and accordingly on Nov. 27 the Johnstown Water Co. requested permission to avail itself of the supply from the Quemahoning reservoir, already mentioned as an industrial supply—which under normal conditions is not chlorinated. There are several interesting features in connection with the use of the Quemahoning supply.

The supply main from this reservoir is 66 in. in diameter and at the point where the connection was made the pressure is about 110 lb. It was proposed to connect from the Quemahoning line to a 10-in. main of the Johnstown Water Co., ordinarily used as a distributing main on a pumping system. Consequently the problem presented was to effect the introduction of the Quemahoning water into the distributing system and to so control the pressure in the distributing system as to satisfactorily serve the water to consumers and at the same time enable the water company to introduce chlorine gas into the supply.

Hydraulic and Chlorination Control—About 200 ft. of 12-in. connecting pipe line was laid from a 6-in. air valve on the Quemahoning pipe line. The necessary valves were installed for the control of the water and the 10-in. distributing main, which became a supply main, was tapped at such an elevation as to bring some 20 to 25 lb. back pressure on the chlorine machine, which was installed in a small temporary building at a street intersection. In the same building a pitometer was connected with the 10-in. main in order to measure the amount of water supplied from the Quemahoning line into the distributing system and also to enable the operator of the chlorine machine to so manipulate his valves as to keep the pressures in the right relation in order that the chlorine gas machine would properly function.

The flow of water after chlorination was directed in a round-about way in order that the longest practicable period of contact between the germicide and the water might be obtained before it reached the consumers.

Coincident with the introduction of the Quemahoning supply the Johnstown Water Co. spread broadcast throughout the entire city notices advising the public of the necessity of boiling all water used for domestic purposes, calling attention to the fact that the supplies were depleted and the water levels in the reservoirs had been drawn down to a point near the bottom and that consequently the beneficial effect of sedimentation in the reservoirs was practically nullified.

The arrangement for handling the Quemahoning supply proved to be entirely satisfactory and capable of quite delicate control. This supply was cut off from the system on Dec. 18, 1922. In addition, to making the daily analyses of the water furnished its patrons in the city tests for residual chlorine with orthotolidin were made at frequent intervals to determine the efficiency with which the chlorine apparatus was working.

The notice advising the public to boil water was issued by the water company on its own volition but with the knowledge of the local health officials and of the State Department of Health. After the emergency supplies were discontinued the water company flushed the system and when the results of the bacteriological analyses of the supply indicated the water to be free from sewage organisms the State Department of Health advised the water company and the local officials that the "boil water" notices could be withdrawn.

During the entire period the closest co-operation was had between the water company and the local health officials as well as with the State Department of Health. It is significant also that the public assisted in the efforts of the water company to handle a serious situation. This demonstrates the advisability of frankness on the part of a public utility with the public in meeting emergencies of this sort.

Cape-To-Congo Railway Service

Through trains between Cape Town, South Africa, and Bukama, at the head of navigation on the Congo, are being run twice a week. The distance of 2,700 miles is covered in about seven days, of which two days are spent at Bulawayo and Elizabethville (capital of Katanga) for the convenience of tourists. The route includes the South African Government Railways to Bulawayo, the Rhodesian Railways to Sakania, and the Katanga Railway (through Belgian Congo) to Bukama.

New Floor Design Reduces Load in Tall Steel Building

Increased Weight Due to Additional Stories Is Compensated by Adopting Floor Design of Lighter Weight

A CHANGE to a lighter type of floor construction for a large partly-finished steel-frame building at Kansas City, Mo., has been made necessary by the decision to build additional stories and thus add to the weight to be carried by the structural work already erected. The steel frame for the 19-story Kansas City Athletic Club building was erected about three years ago, but work was then stopped on account of financial difficulties. When the project was revived and financed recently, it was decided to complete the building substantially according to the original plans, but to increase the height to twenty-one stories and a roof garden.

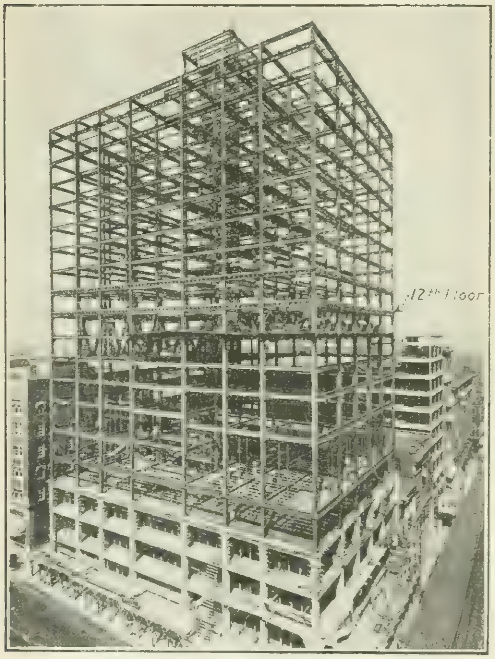


FIG. 1—KANSAS CITY ATHLETIC CLUB BUILDING
Two stories added to 19-story structure. Light floor construction used in upper floors. Steel trusses carry upper stories over open space

To explain the redesign of the floors some description of the steel design is necessary. Steel trusses having their upper and lower chords in the eleventh and twelfth floors carry the east 56 ft. of the building (three panels) above the eleventh floor across the gymnasium. Similar but deeper trusses, having their chords in the tenth and twelfth floors, carry the west 56 ft. of the building over the swimming pool. These latter trusses are located in the partitions between the handball courts. In the original design all the floors were to be of ribbed concrete slabs, and this construction is used up to and including the level of the bottom chords of the trusses in both ends of the building.

In checking the design to provide for two additional stories it was found that the columns would sustain the load due to floors of the original ribbed slab design in the new stories, but that the trusses would require reinforcement. In order to avoid such reinforcement, it was decided to use a lighter floor construction, consisting of a 2½-in. reinforced slab carried on pressed-steel joists fitted between the original floor beams. Beginning this new floor design in the twelfth floor, the resultant reduction in dead load of the eight floors proved to be sufficient to compensate for the additional load of the twentieth and twenty-first floors. In this way the total load on the trusses was increased so slightly that no alterations in the steelwork were required. The original ribbed slab design is being adhered to for the main roof, the roof garden and the pent-house construction, as well as for the first eleven floors.

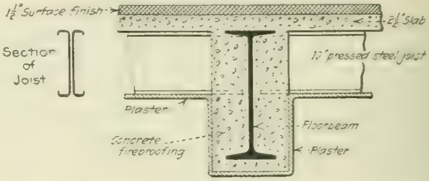


FIG. 2—LIGHT-WEIGHT FLOOR CONSTRUCTION

Typical panels are 19½ x 20¼ ft. and 19½ x 18 ft., with the new joists in the 19½-ft. spans and spaced 20 to 24 in. c. to c. according to the width of the panel. These are standard 10 in. pressed-steel joists, made of pairs of light pressed-steel channels set back to back and spot-welded together so as to form an I-section (see *Engineering News-Record*, Aug. 17, 1922, p. 269). Over the floor-beams and the joists is **a 2½-in. concrete** slab with a 1½-in. surface finish.

Special construction was required for the support of the new joists, since the original construction had no provision for such members. To attach brackets or shelf angles in the field, necessitating the drilling of rivet holes in all floor beams, would have been impracticable and would have resulted in additional weight. The plan adopted was to build the lower part of the concrete casing or fireproofing of the floor beams so as to form a shelf for the 10-in. joists, the ends of the joists being embedded in this casing, which is reinforced with wire-mesh fabric. This floor construction is shown in Fig. 2. Wood forms for the combined shelf and beam casing were suspended from the floor beams, as shown in Fig. 3. While this concrete was being placed the joists were supported by falsework, which was kept in place for at least one day after the concrete was poured.

The relative fire resistance of the new type of floor, as compared with the heavier reinforced-concrete construction, in the event of a great conflagration, was taken into consideration in view of the fire in the Burlington Building at Chicago in March, 1922. But the owners of the Athletic Club Building considered the additional two stories to be of sufficient importance to justify the change in construction. For fireproofing the truss members a solid reinforced-concrete casing is to be applied.

Live-loads in general are 50 lb. per square foot, but there are a few exceptions in special locations; a load of 40 lb. was assumed for the roof, 75 lb. for the roof garden, 90 lb. for the main dining room, kitchen and gymnasium, and 300 lb. for the sidewalks. In addition to these live loads on floors an allowance of 20 lb. per square foot was made to provide for partitions.

For the original design as well as the present altered design of the building the architects were Hoit, Prince & Barnes, of Kansas City. The Swenson Construction Co., also of Kansas City, is the general contractor. The original structural framing and its present additions were designed and erected by the Kansas City Structural Steel Co., but the pressed-steel joists were furnished by the Central Steel Co., Massillon, Ohio. The combined club and office building is now owned by the Continental Building Co.

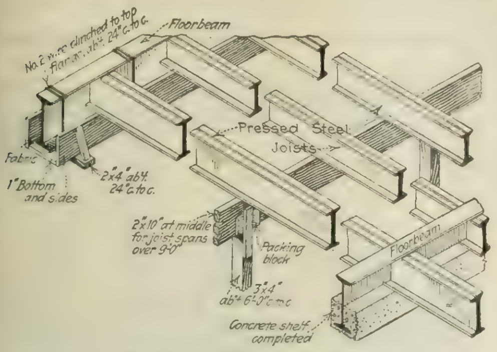


FIG. 3—CONCRETE SHELVES SUPPORT NEW JOISTS

Railway Terminal Station Plans for Chicago

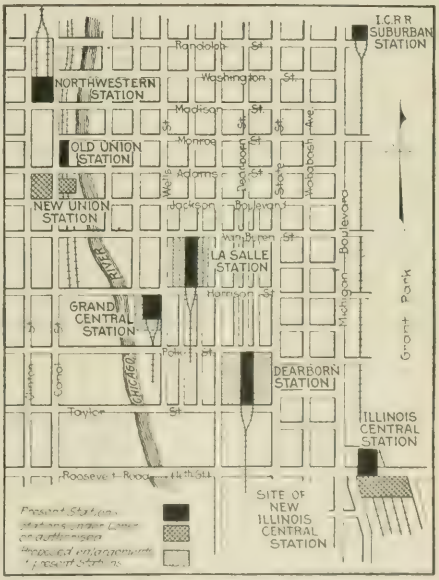
A SOMEWHAT confused situation in the Chicago railway terminal problem has been brought about by the preparation of varied and conflicting projects for new passenger stations, so that there is now a combination of existing, authorised and proposed stations of modern type and large capacity. The situation will be explained by reference to the accompanying plan. There are now six terminal stations and independent projects are on foot for the reconstruction of three of these stations. Confusion arises from the fact that some of these projects propose the elimination of other stations by providing accommodation for the tenant roads of the latter. Whether any combination of the various groups can or will be effected remains to be seen.

Of the present six stations, the Northwestern Station of the Chicago & Northwestern Ry., opened in 1911, was the first of the modern stations. It is the only one of the terminals used by a single railway and is notable as being new both as to location and construction. All other projects provide for reconstruction on existing sites, suitably enlarged, to accommodate present or prospective groups of railways. The ancient Union Station is now being replaced by a large modern structure with greatly increased trackage and other facilities for a group of railways. Plans have been authorised for the reconstruction of the Illinois Central Station on a large scale, and it has been suggested that this new station might be utilized by some of the railways now entering other stations.

This leaves the Dearborn Station, La Salle Station and Grand Central Station to be considered. All of these serve groups of railways. The second is comparatively modern and has an office building over the headhouse, but the others are old and the last named is the smallest of the Chicago terminal stations.

Now comes the question of reducing the number of stations. It has been suggested that many or all of the roads now using these three stations might be accommodated in the enlarged Union Station and Illinois Central Station, thus releasing valuable property sites and concentrating the terminal facilities. But plans have already been prepared for a new and enlarged Dearborn Station, and this project includes the suggestion that the roads now using the La Salle Station might be accommodated with mutual advantage. This project is offset, however, by independent projects reported for the reconstruction of the La Salle Station and the Grand Central Station.

Possibilities of earlier projects for a single great passenger station to accommodate all the numerous railways have long ago disappeared, owing to the establishment of some modern individual stations and to the impossibility of uniting all the various interests upon the acceptance of one site and one plan. Probably this is well for Chicago and the traveling public, since the practicability of efficient operation of a station serving about twenty-four railroads has been questioned. All these roads have approximately the same concentration of heavy inbound main-line traffic in the early morning and heavy outbound traffic in the evening, so that the station facilities would have to provide for these two peaks of service. In addition, some of these roads have very heavy suburban service. However that may be, or might have been, projects of this class are no longer a practical factor in the problem, but the developments in the present terminal situation may be watched with interest on account of the civic and economic aspects as well as the railway and engineering aspects.



PRESENT AND PROPOSED CHICAGO TERMINALS

Northwestern Station is modern. Union Station is being rebuilt. Illinois Central Station reconstruction is authorized. Independent projects propose reconstruction of Dearborn La Salle and Grand Central stations.

From Job and Office

Hints That Cut Cost and Time *For the Contractor and the Engineer*

Submarine Cutting Torch Used in Bridgework

By C. P. Howes
Bridge Engineer, Texas & Pacific Ry., Dallas, Texas

After various means had been discussed for the removal of obstructive sheet piles in the channel of the Atchafalaya River, Melville, La., use of a submarine cutting torch was decided upon. The same system of cutting was applied as was used last year in the repair of a 36-in. pipe line which carries the New York City water supply from Brooklyn to Staten Island. (See *Engineering News-Record*, March 2, 1922, p. 346). Thirty steel sheet piles at depths under water ranging from 15 to 25 ft. were cut off with the electric torch. Necessity for removing the piles was due to their having been bent when, during the unprecedented flood of last spring, a huge timber fender pier containing about 120,000 ft.b.m. of timber was torn loose from a bridge forty miles upstream and in passing the Atchafalaya Bridge struck the end of a sheet-pile cofferdam, which had been installed as pier reinforcement, shattering the concrete filling and tearing a portion of the cofferdam loose. Though the integrity of the pier as a support for the bridge was not affected, the immediate removal of the bent sheet piles was important as they encroached on the west navigable channel opening of the bridge and obstructed free navigation in low stages of the river.

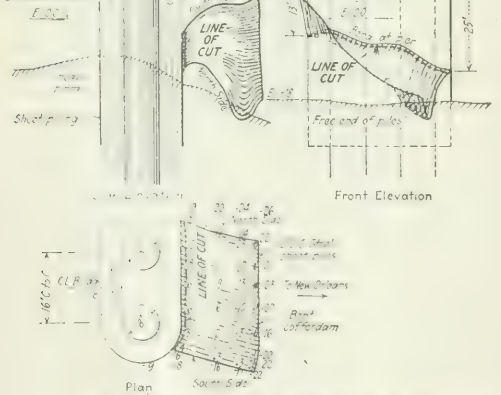


FIG. 1—PIER ELEVATIONS SHOWING BENT COFFERDAM

Removal of the bent cofferdam was necessary as obstruction to river transport was offered at low-water level. Position of the sheet piles before and after the pier was damaged is easily indicated.

FIG. 2—DIVER DESCENDING FOR CUTTING WORK

Each of the piers under the fixed spans of the bridge, (which was built in the early eighties) consists of two metal cylinders 8 ft. in diameter, filled with concrete, and extending about 80 ft. below the river bed. The supporting strength of these piers had never been questioned, but with the increase in rolling stock weights, timber piles were driven around the cylinders and a cofferdam constructed of 12-in. steel sheet piles, 45 ft. long, inclosing the timber piles to act as forms for concrete. Such reinforcement was deemed advisable, in order to reduce the flexibility of the piers. The sheet piles had a penetration of about 20 ft.

When it was found necessary to remove the sheet piles it was deemed impractical to pull them, either singly or collectively, because of their distorted condition. Other methods, not involving what appeared prohibitive expense, were discarded because of uncertainty as to effective results. The use of the underwater cutting torch was then suggested and decided upon by E. F. Mitchell, chief engineer of the railway. Arrangements were therefore made with the Merritt & Chapman Derrick & Wrecking Co., New York, who hold patents on the tool, to do the work.

A foreman, diver and equipment, including a 50-kw. turbine-driven generator set, switchboard, diving gear and all special appliances, were sent by boat from New York to New Orleans, where the generator was installed on a river tow-boat, and connected to its boilers. The necessary oxygen supply was taken on board, and the men and supplies transported to the bridge site, about 200 miles, by water. Cutting work was started Nov. 17. 1922, and completed in seventeen working days. Considerable time was consumed in washing fragments of the concrete from the bent sheet piles to make cutting more effective. Because of the character of bends, it was found necessary to make a second cut on five of the piles at the north end of the dam after the whole bent section had been severed and removed. A total of 67 hr. was consumed in actual cutting work and 47 hr. in jetting operations. It is estimated that in all about

450 sq.in. of steel were cut under water. Cutting off five piles was the largest day's work.

The cost of the work, including rental on the equipment and the towboat, transportation charges, subsistence for men, fuel, etc., was about $5,500, as against a minimum estimated cost of $35,000 by any other method. In addition, considerable time was saved.

The facility and celerity with which the work was accomplished were in large measure due to the energy and skill of the diver, John Tooker.

Upon the completion of the cutting, the bent cofferdam was lifted by tackle from the span above, fastened to the tow-boat and floated away. Plans for the restoration of the pier reinforcement are now under way.

Handling Precast Bridge Slabs on Track Elevation: C., M. & St. P. Ry.

By T. H. Strate

Engineer of Track Elevation, C., M. & St. P. Ry.

In completing the track elevation between Irving Park Boulevard and Howard St., on the Chicago and Evanston Division of the Chicago, Milwaukee & St. Paul Ry. in 1922, a total of 236 bridge slabs was required. Of these, 115 were built in place and 121 were pre-cast at the slab yard, loaded onto flat cars, hauled to the job and set in place with a 50-ton derrick car. The latter plan was adopted principally on account of traffic conditions, as it was not desirable to give up certain sections of track for the length of time necessary to build the slab in place and allow it to season sufficiently for carrying load. These slabs varied in weight from 21 tons to 44 tons, the majority being in the neighborhood of 41 tons. Most of them were about 11x20 ft. and 36 in. thick. The accompanying view shows the placing of a deck slab on a trestle approach.

The precast slabs were made at a yard on the line extending from Galewood to Dunning and were loaded onto cars with a 100-ton wrecking crane, one flat car being required for each slab. Before the setting of the slabs could be commenced, the trolley wire and poles had to be removed on account of interference with the boom of the 50-ton derrick. Crossovers were installed so that slabs could be delivered to the derrick within the six-minute interval between trains. In some cases it was necessary to carry the slab for a distance of 1,000 ft. after it had been removed from the flat car. This was first attempted by placing the slab on small rail carriages, but the weight was too great. A four-wheel truck was then removed from a flat car and the slab placed on it and hauled to the opening. All of the weight, however, was not placed on the truck as the derrick still kept hold of the slab and carried probably half the load. On the openings north of Lawrence Ave., where it was not necessary to restore traffic each night, the maximum daily setting was eight slabs in eight hours, while the average was six slabs.

On the trestle between Wilson Ave. and Montrose Ave., which is single track (see *Engineering News-Record*, Dec. 23, 1920, page 1226), it was necessary to remove the trolley wire each morning and to replace it in the afternoon. It was also necessary to remove the trestle and close up the track again on account of the night freight service. This is the work shown in the illustration. The interchange of slabs was made at the siding just north of Wilson Ave., the loaded flat car being set on the main line, the slab picked off by the derrick and the car then pushed in the clear on the side-track. In this case the haul of the slabs after the derrick had taken them off of the car varied from 400 to 1,600 ft. The placing of six slabs was the maximum day's work, but the average for the job was only three per day.

DERRICK CAR PLACING CONCRETE SLAB

All of this work was done without any delays to the elevated passenger service, which, together with the Chicago, North Shore & Milwaukee R.R. service, amounted to approximately 200 trains during the eight-hour working period. Passenger traffic on this division is operated by the electric elevated railway and the North Shore line. Fortunately the rush-hour service interfered for only about one hour in the morning.

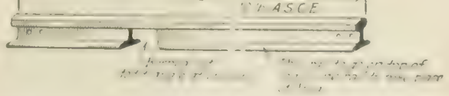
This track elevation improvement, with the exception of the station buildings, is being carried out by the railway company's forces under the direction of the writer as engineer of track elevation.

Temporary Frog Made by Fitting Burned Out Section Over Main Line Rail

By Frank B. Lee

Superintendent of Construction, Philadelphia, Pa.

In dismantling the high-tension tower line which fed Hog Island during the war, an obstacle was encountered in getting from the Pennsylvania R.R. main-line tracks to the old shuttle track, which is along the right-of-way of the transmission line. The frogs and switches connecting these tracks had been removed, and the Pennsylvania R.R. would not allow them to be replaced for us to cross over.



BURNED OUT RAIL SECTION MAKES TEMPORARY FROG

A temporary crossover was made in the following manner: The crossing rail at the frog location was made by burning out a section of rail at the right angle and placing the section on top of the main line rail and blocking this rail for support on the ties. This rail could be taken up and laid down in about ten minutes.

At the lead-off switch points were used with a 1½-in. plate to jump the main line outside rail.

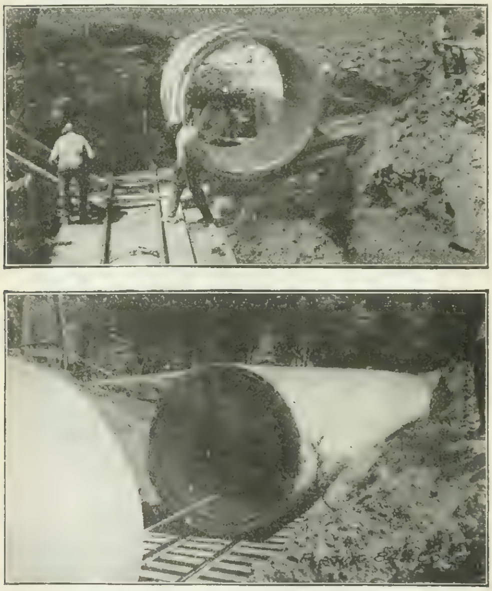
From Job and Office

Hints that Cut Cost and Time

Laying 7-ft. Concrete Pipe Culvert on New York Central Lines

THE methods of placing 84-in. reinforced-concrete pipe for a culvert on new railway construction are shown in the accompanying illustration. This work is on the new low-grade 5.4-mile cut-off between Hobson and Meigs, Ohio, built by the New York Central R.R. (Ohio Central Lines) for northbound tonnage trains. The line, which was opened for service on Sept. 19, 1922, has a grade of 0.2 per cent compensated for curvature and eliminates a long hill on the old line with a grade averaging 1.2 per cent.

At Station 140 it was decided to put in a culvert of 84-in. concrete pipe to carry a small stream through a 30-ft. fill. This culvert consisted of nineteen lengths of pipe, each 6 ft. long. The pipe was unloaded by a locomotive crane at a short distance from the site and was rolled down to the channel by hand. In the bottom of the creek a foundation was built of old ties and upon this was laid a track of 29-in. gage on a grade of 1.5 per cent, using 56-lb. scrap rail. The rails were thoroughly greased. By means of an incline at the upper end of the culvert each length of pipe was rolled down onto this track, being controlled by a cable wrapped around it, as shown. When in place on the rails a cable was passed through the pipe and attached to a tie laid across the rear end, so that a team could pull the pipe along the rails to bring it in contact with the pipe previously laid.



HANDLING 7-FT. CONCRETE CULVERT PIPE
Above—Rolling pipe into trench.
Below—Hauling pipe along greased rails.

When all the pipes had been laid and jointed the rails were loosened and pulled out sideways by the team, leaving the pipes resting on the old ties. The fill was then placed. A camber of 8 in. was given to the culvert in construction and later it settled so that it is practically on the true grade. The soil was yellow clay and the stream was nearly dry at the time the work was done. Lowering and placing the pipe in its final position required about ten hours' time with a foreman, fourteen men and one team. The work was in charge of C. McVay, division engineer, and E. R. Neff, resident engineer.

Concrete Handled in Dump Buckets on Illinois Central R.R. Job

DISTRIBUTING concrete in dump buckets conveyed on an industrial railway operated by a gasoline locomotive is the method employed by the contractor in building several subways on the track elevation work of the Illinois Central R.R. at Matteson, Ill., just south of Chicago. The structures include two railway crossings and three highway crossings, all consisting of concrete bents and abutments with slab decks. A total of 13,000 cu.yd. of concrete will be required.

As all the structures are included in a distance of 5,000 ft. a stationary concreting plant was installed on the east side of the tracks, a spur track for supply cars being laid from the main line and a stretch of about 2,500 ft. of 24-in. gage industrial track laid for the concreting cars. The mixer is of 1-yd. capacity, with gravity supply from overhead wooden bins containing 50 tons of stone and 30 tons of sand. A steam locomotive crane with 1-yd. grab bucket unloads stone and sand from cars, and a stiff-leg derrick with 65-ft. boom and 1-yd. bucket handles these materials from the stock piles to the bins. Cement in bags is stored in an adjacent shed and carried by buckets on the industrial cars, these buckets being lifted by the stiff-leg derrick to the mixer hopper. Water is piped to an overhead measuring tank. Charges of stone and sand are measured by means of a batch hopper.

The mixer is set on blocking at a sufficient height to discharge into 1-yd. steel buckets which are carried by four-wheeled flat cars on the industrial railway. Two loaded cars are hauled by a 6-ton gasoline locomotive, as shown in the accompanying view. The haul is from 200 to 2,500 ft., on level track. For work near the plant, the buckets are handled and concrete dumped into the forms by the locomotive crane. At each more distant structure a stiff-leg derrick is installed to handle the buckets, either dumping the concrete directly into the forms or

INDUSTRIAL RY. CARRIES CONCRETE BUCKETS

From Job and Office

For Contractor and Engineer

into an elevated hopper with inclined delivery chute. This hopper is set on a temporary tower which carries a cable to support the chute. The concreting force averages ten men at the concreting plant, fifteen men at the structure being concreted, and one on the locomotive.

This work is being done under the direction of F. L. Thompson, chief engineer of the Illinois Central R.R., and T. H. Armistead, assistant engineer. The contractor is the Bates and Rogers Construction Co., Chicago, with A. S. Armstrong as its superintendent in charge.

Renewing a Long Slip-Switch by Wrecking Cranes: Pennsylvania R.R.

RENEWING a 114-ft. length of a double slip-switch 160 ft. long in a four-track main line by lifting it out bodily, with ties attached, by means of two wrecking cranes which then placed a new slip already built up the side of the track, was accomplished in 1 hr. 18 min. on the Pennsylvania R.R. near Johnstown, Pa. The weight was about 22 tons for the old slip with 100-lb rails, and 27 tons for the new slip with 130-lb. rails. These slips, with No. 15 frogs, were 160 ft. 7 in. long over heels of frogs, and the portion lifted out was 113 ft. 10 in. long. The greatest length of switch timbers or ties was 13 ft. In preparation for the lift, the ballast was cribbed or shoveled out from between the ties to the level of bottom of the ties, and a supply of fresh ballast was placed alongside the track ready for use. Fig. 1 shows the old slip slung between two 125-ton wrecking cranes.

The new slip-switch was built up complete directly opposite the site and alongside a yard track adjacent to the main tracks on which the work was to be done. Its construction included the stock rails which extended a few feet beyond the end switch points. No reinforcement of planks or other support was placed under the ties to stiffen the slip while being handled. It was necessary, however, to put blocks and wedges across the ends of the switch points to prevent them from lifting out of the switch-plate seats, as shown in Fig. 2. It will be seen from Fig. 2 also that for lifting the slip the chains did not pass under the switch timbers but those on the forward hold were applied round the rails at the heel blocks and those at the end next to the point were simply wrapped around the rails and switch point. With this arrangement no distortion of the slip resulted.

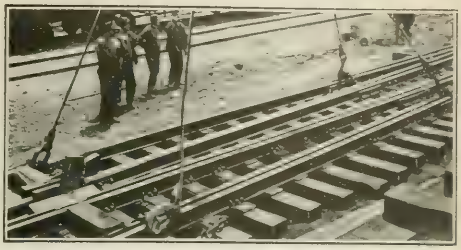


FIG. 2—CHAIN ATTACHMENTS, SWITCH POINT BLOCKS

After the wrecking cranes had been spotted in position they were not moved until the entire operation was completed. Between them, but not filling the space between them, were placed two flat cars to hold the old slip temporarily while the new slip was lifted over it into position. With the derricks close enough to handle the load, the ends of the old slip lapped over their decks, as shown in Fig. 1. As this position would have interfered with swinging the new slip across the cars arrangements had been made to have oxy-acetylene operators at hand to burn off these lapping ends, thus allowing the slip to rest flat on the decks of the cars. When the new slip was in place the old one was landed clear of the track and there dismantled. The load and the difficulties of landing the slip longitudinally were increased materially by the fact that the cranes or derricks were not making a direct vertical lift but were pulling diagonally against each other, so that heavy anchorage of the cranes was required.

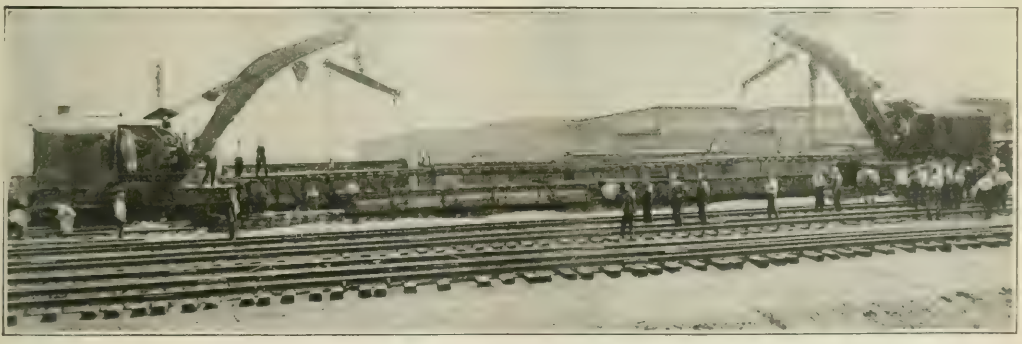


FIG. 1—WRECKING CRANES RENEWING SLIP-SWITCH; PENNSYLVANIA RAILROAD

As soon as the old slip had been removed the roadbed was trimmed and ballast dressed to an even bed for the new slip. The end frogs were renewed while the slip was being handled. After the insulated joints had been connected up, some bar lining and surfacing was done and new stone ballast placed by hand before the track was put in service. For this work there were fifty-two track men in addition to the wrecking-crane crews. The renewal of this large piece of track was planned and carried out under the direction of E. O. Wood, assistant division engineer of the Pennsylvania at Johnstown.

From Job and Office

Hints that Cut Cost and Time

Section House Moved Twenty Miles on Flat Car

By Dennison Fairchild
Supervisor, Bridges and Buildings, Northern Pacific Ry. Co., Duluth, Minn.

When a branch line of the Northern Pacific Ry. was recently abandoned, structures, track and other materials were salvaged. The photograph reproduced herewith shows the method in which a section house 23x29x26 ft. was moved on a flat car a distance of twenty miles.

The house was loaded rather high on the car so as to clear the narrow cuts, and was stayed by snubbing it to a car of rails in front and a locomotive crane in the rear. The crane was used to tilt the load slightly in passing obstacles, to steady it over particularly rough places, and keep it in better equilibrium when passing through curves of high super-elevation.

RAILWAY SECTION HOUSE MOVED ON FLAT CAR

A heavy timber frame, shaped like the bottom of the building, was securely fastened to the car immediately in front of the house. This frame bunted away stumps and other obstructions met in transit and indicated whether the house would pass other obstructions.

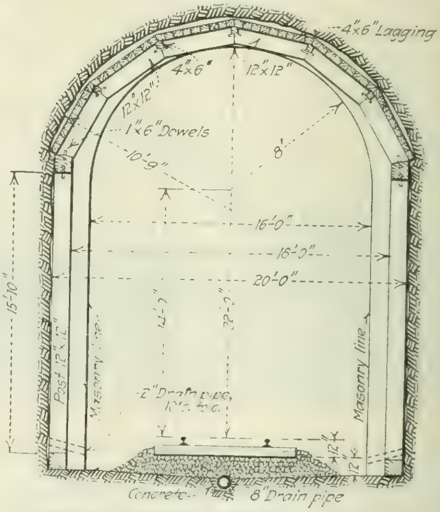
Concrete Tunnel Lining Poured Through Well Holes: C., B. & Q. R.R.

Pouring concrete through vertical boreholes drilled from the surface of the ground was the method adopted for lining an old 700-ft. tunnel of the Chicago, Burlington & Quincy R. R. near Belmont, Neb. This method, which has been applied to sewer work for some years past, was employed in order to reduce the labor and time as compared with any method of handling concrete inside the tunnel, since it avoided all interference with traffic. From the surface to the crown of the tunnel the depth is 50 to 65 ft., mainly in magnesia rock known as Brule clay. After the old timbering had been pulled out by means of a hoisting engine and cable, the tunnel was enlarged to the required dimensions by men with drills and picks working on platforms which traveled along the track. These platforms were run out onto a sidetrack to clear trains. A typical tunnel section is shown herewith.

Two portable well-drilling outfits drilled 12-in. holes 16 ft. apart above the center line of the tunnel, the holes being lined with 8-in. or 10-in. iron casing as their net size permitted. The last hole at the south end was within 20 ft. of the portal, but at the other end a 93-ft. section of concrete lining had been placed a few years ago. A 1-yd. mixer was located on the surface nearly over the middle of the tunnel. Material was hauled up from the railway by teams and the sand and gravel were moved from the stock piles to the mixer by 1-yd. wooden dump cars on a 36-in. track.

Each batch of concrete was discharged into two wooden ½-yd. end-dump cars attached to a cable and running down grade on a 36-in. track laid directly over the line of bore holes. The mixer being at the highest point there was a descent for gravity loaded movements in both directions, the empty cars being hauled back by the cable. The two cars were dumped into two adjacent holes in order to secure a good flow over the forms, with an average distance of 8 ft. from each hole. A portable funnel or chute was fitted to the hole while concrete was being poured. Concreting was commenced at three points and the work progressed down grade along the tunnel to the north end. A 1:2:4 concrete mix was used, made with pit-run sand and gravel.

Timber forms in 33-ft. lengths were used, each form being left in place for 72 hours after pouring. Three of these lengths sufficed for the entire work. Concrete was poured over two forms for a length of 66 ft. (including side walls and crown) while the rear form was being collapsed, shifted ahead and set up in its new position. Pouring one 33-ft. length was a day's work. In all about 2,400 cu.yd. of concrete were placed in this way, forming the side walls and arch with a minimum thickness of 18 in. The walls were seated on concrete footings built in 1901, when the feet of the 12x12-in. posts of the timber lining had decayed so as to require repair. Concrete for the portals was delivered to the forms by the same ½-yd. cars used at the boreholes. These holes were filled with concrete to the surface, except that at four holes the casing was driven through the concrete to form ventilating shafts.



LINING OF BELMONT TUNNEL: C., B. & Q. R.R.
Old timber lining was pulled out in advance of new concrete lining.

From Job and Office

For Contractor and Engineer

Two portable well-drilling outfits were used by the railway in making the holes and a contract for the concreting was let to the Foundation Co., Chicago. This work was done under the direction of A. W. Newton, chief engineer, Chicago, Burlington & Quincy R. R., and F. T. Darrow, assistant chief engineer.

Tractor Used on Swampy Railroad Location

DURING 1922 the Florida East Coast Ry. made a survey locating a proposed extension from Okeechobee to Miami, Fla., a distance of approximately 122 miles, the route being through the Everglades except for about ten miles at the southern end. The purpose of the line is to develop the agricultural resources of a territory of about 1,670,000 acres, and to secure the traffic therefrom, but with the branch of which it is an extension it will also provide the railway with a second main track, 264 miles in length, between New Smyrna and Miami. As now located, the line follows rather closely along the east shore of Lake Okeechobee for a distance of about 45 miles, so that for this part of the work it was practicable to quarter the survey partly in houseboats, which were towed by a motor boat.

South of the lake, and between the North New River Canal and Miami Canal, the line was projected through country known as "muck" land, which was entirely submerged to a depth of one to three feet and covered with a rank growth of "saw grass," a rough bladed grass which will tear clothing to shreds. This muck land is an enormous peat bog, varying in depth from 3 ft. to 10 ft. Consequently it affords very poor footing, especially during wet seasons, and men walking over it will sink to a depth above the ankles.

If it was attempted to make a survey through this territory by ordinary methods the daily progress of the party would be limited by the amount of stakes and supplies that the men could carry, and the amount of line that could be cleared by use of axes or other hand tools. To do the work in this way it would have been necessary for the party to cover long distances on foot over this soft material, a severe task under the existing conditions. It was decided, therefore, that on account of the flooded condition of the Everglades, and the heavy growth of saw grass, it would be practically impossible to complete the survey of the 15-mile portion between the Fort Lauderdale and Miami canals by employing the methods in general practice on railroad surveys.

In an investigation to determine what methods should be employed, it was developed that a caterpillar tractor had been used on a canal location survey, in 1911, and subsequently on extensive township and section subdivision work in the Everglades. The general design of this machine had been worked out by F. C. Elliot, now chief engineer of the Everglades Drainage District, and the details and assembly by "Dad" Hilt of the Buckeye Traction Ditcher Co. This tractor had not been used for some years and was found lying along the bank of the Palm Beach Canal, without engine, minus most of its gears and in bad condition generally on account of exposure. It was purchased and put in first-class condition, and the survey difficulty was thus solved. As shown in Fig. 1, the tractor carries a light steel frame which was covered with canvas, forming a house for the party, with accommodations for meals and sleeping quarters.

Four distinct advantages resulted from the use of this tractor: (1) The line was cleared without the necessity of using axemen and hand tools; (2) the soft muck was consolidated by the weight of the tractor, so that a substantially improved footing was provided for the party; (3) stakes and supplies were carried on a sled attached to rear of tractor, thus eliminating necessity of transportation by stakemen; (4) by keeping the tractor just in advance of the party, travel between work and camp was entirely eliminated and all meals were served in camp without delay to the work. A view of the survey party is given in Fig. 2.

In this way the line was run through the 15-mile stretch between the North New River and Miami canals in five days, while without the employment of the tractor, it is considered unlikely that any party of men would have undertaken the task. After the Miami Canal was reached the tractor was used in running line for twenty-five miles parallel to and alongside of the canal, but during this portion of the survey the party lived in the houseboats in the canal, as the quarters were larger and more convenient than those provided on the tractor.

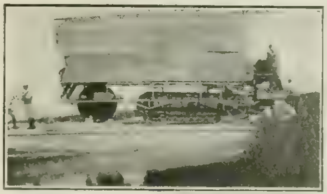


FIG. 1—TRACTOR FOR RAILWAY SURVEY IN THE EVERGLADES

Machine mounted on a lighter for transfer across Miami Canal.

FIG. 2 — SURVEY PARTY IN THE EVERGLADES

For 40 miles south of the North New River Canal the line was through country inhabited only by wild cats, alligators, snakes and other wild animals and reptiles, and every station was staked out in water from one to three feet deep. This abnormal flood condition was due to continued heavy rains which began after the survey was started and caused the highest water in the Everglades for many years. To carry out this survey, therefore, required a party of men with plenty of stamina. Realizing that hardships would have to be endured, the company provided good quarters, food and equipment and a camp physician. As a result the survey was completed successfully, economically and without serious illness in the party.

H. N. Rodenbaugh, then chief engineer (now general manager), was in charge of the work, which was carried out under his direction by Calvin Oberdorf, then principal assistant engineer (now engineer of construction); A. A. Jackson was assistant engineer of construction and J. E. Lucas was chief-of-party.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Morrison Street Bridge Reinforcement

Sir—In your issue of Nov. 30, 1922, p. 947, a letter entitled "Doubtful Bridge Reinforcement" was published over the signature of George Rae. The sketch accompanying the letter, together with the description, identifies the structure referred to as the Morrison St. bridge in Portland. The statements made in the letter are totally in error.

The facts of the matter are that the alleged great deflection of the span when it was repaved in 1921 did not occur; that the deflection which occurred at the time of repaving was 2.46 in., the measurement almost precisely checking the previously calculated amount and being, of course, duly taken care of; that the bottom chords of the bridge did not on any occasion buckle as charged, nor did any contractor make or announce such a "discovery" so far as the writer knows; and that, while Mr. Rae's description of the emergency repairs is in a rough way correct, his speculations as to the stress conditions and the weakening of the chord are wholly without foundation; that the timbers were attached to the lower chord not to take compression, but to stiffen the chord where it had been slightly kinked at the fourth panel point from the end by an accident which sheared the end latches.

It may be of value to the bridge engineering reader to know that the emergency reinforcement is not designed with a view to having the wood and steel act in unison, but with a view to having the timbers stiffen the chord. The two timbers are, however, capable of carrying the entire chord stress without reliance on the steel, at usual allowable unit stresses. I need hardly add that the bolt holes by which the abutment castings are attached to the chord do not weaken the chord, both because the limiting net section in the panel is at the pin or splice plates near the joint, and because this particular chord panel contains considerable excess metal and even with several additional bolt holes out it would never get as high a stress as adjacent panels of the chord.

Mr. Rae's insinuations against the competence of the two county officials under whose direction the construction work was carried out are, of course, wholly reprehensible. As already stated, the reinforcement work was designed by the writer. It was carried out by the two officials in question, in most excellent manner. The work was done on a cost-plus basis, at a total expenditure of about $3,000, with a saving of four weeks in time and possibly 25 per cent in cost.

Quite apart from the unwarranted criticisms just referred to, the Morrison St. bridge is highly interesting because of an agitation several years ago to have it replaced by a new bridge. At that time a careful investigation was made by the writer's department and an exhaustive report prepared, at a cost of about $6,000. It was found that more than $1,000,000 could be saved by adopting a system of repair work rather than renewing the structure. There was a popular belief that the bridge was unsafe, which was never the case, and had it not been for the careful investigation made at that time the public would unthinkingly have been plunged into a needless investment running into millions. Of the $208,000 repair program recommended, all has been completed with the exception of one contract involving about $40,000. When this work is completed, the entire cost for repairs will be below that originally estimated, and the structure will be safe for unrestricted traffic for a service period of ten to fifteen years.

C. B. McCullough,
Bridge Engineer, Oregon State Highway Commission.
Salem, Feb. 13.

Faults in the Tacoma Arch

Sir—The failure of a skew arch described in your issue of Feb. 22, p. 355, should have more notice than a mere passing slap at laitance and excess water in concrete.

In at least two respects the design of this arch is subject to serious question.

The curve of the arch is semi-elliptical. The semi-ellipse is not the equilibrium polygon for vertical loads. It is only by assuming large horizontal forces at the haunches that a curve approaching a semi-ellipse will result in the equilibrium polygon. In my book "Concrete" I point out, on p. 15, that the semi-ellipse or basket handle is not the proper shape for an arch in any other position but a subaqueous tunnel: this is because of the absence of an active horizontal pressure of the earth over the haunches and the abutment earth *may* exect a large horizontal pressure, and again it may exert practically no horizontal pressure whatever. It may even dry out and shrink away from a retaining wall.

Arches should be designed on the assumption that no horizontal pressure is exerted on the haunches and against the abutments. The stability of the arch depends on designing on this assumption.

This arch broke exactly where it would be expected to break without the aid of active horizontal pressure on the haunches, namely, at the sharpening of the curve in the haunch. The absence of horizontal pressure results in an excessive bending moment at the point where the break occurred. When the ring of the arch was broken by this bending moment, the horizontal thrust would immediately come into play, causing the shearing break.

The other seriously questionable feature in this design is the large skew. The thrust of skew arches tends to act normal to the axis of the barrel of the arch and not parallel with the face; hence the greater the skew, that is, the farther the abutments are thrown from positions opposite one another in lines normal to the axis of the barrel of the arch, the greater the disadvantage at which arch action comes into play. If the three "ribs" of this arch had each been made a square-ended arch, and thus steps made in the skew, there would be reason for separating the ribs; but to separate these ribs as the designer has done simply accentuates the skew and loses the help that one rib might have offered the other. Edward Godfrey.

Pittsburgh, Pa., Feb. 27, 1923.

Tests on Effect of Paint Between Riveted Plates

Sir—Referring to A. Sabin's article, "Paint to Prevent Rusting Between Plates," in *Engineering News-Record* of Feb. 8, p. 271, I believe some additional light would be thrown on this subject by the attached correspondence, in reference to certain paint tests made in connection with the erection of the Metropolis Bridge.

Pittsburgh, Feb. 14. Richard Khuen, Jr.,
General Manager of Erection, American Bridge Co.

Mr. C. R. Fickes, Chief Engineer,
Paducah & Illinois R.R. Co.,
Metropolis, Ill.

Dear Sir:—

To demonstrate the effect of paint upon contact surfaces in riveted work, we have in accordance with my understanding of your wishes provided six 12 x ½-in. plates 3 ft. 2 in. long, each plate punched for ⅞-in. rivets spaced transversely 3 in. centers with edge distances of 1½ in., and longitudinally 3½ in. centers with edge distances of 1⅜ in., this spacing corresponding with spacing in chord splices, etc., of the Metropolis Bridge. With these plates, we have made the following tests:—

Test No. 1.—We painted each surface of each plate with three coats of Dutch Boy red lead paint, composed of 67 lb. of red lead to 1 gal. of boiled linseed oil, and 1 gal. of raw linseed oil and 0.33 gal. dryer, allowing proper drying time between each coat of paint. We then put the six plates together, bolted them up tightly as a regular joint would be fitted, and drove the 44 rivets, driving the middle rows first, and after the rivets and plates had cooled off, cut the rivets out and separated the plates.

Test No. 2.—This test is a duplicate of No. 1, except that two coats of paint were applied to each surface of each plate instead of three.

Test No. 3.—This test is a duplicate of test No. 1, except that one coat of paint was applied instead of three.

Between each test, the plates were thoroughly cleansed of all paint left from the prior test.

Our foreman reports the following results:—

In Test No. 1, during the riveting of the plates together, the paint boiled out over the edges to a very considerable extent. After the plates were riveted together, the rivets were tested and 25 per cent of them found loose. After the plates were cut apart, the paint on the contact surfaces was found to have been reduced to a powder, which could be easily removed by blowing or dusting off, on a large proportion of the surface.

In Test No. 2, the same boiling, of a less degree of the paint in the joints was observed and as to the rivets 10 per cent of them were found loose. After cutting apart, the painted surfaces showed a little more live paint but still largely reduced to a powder.

Test No. 3 showed considerable boiling during the riveting operation and upon testing the rivets showed 5 per cent loose, and upon cutting the plates apart showed the surfaces with considerable paint.

I understand that these tests were watched carefully by your inspectors and I would very much appreciate advice from you, first, checking or correcting the above statement of facts as we understand them, and second, your conclusion as to painting of contact surfaces in riveted joints for the balance of the work.

Yours truly,
H. A. Greene,
Division Erecting Manager,
Pittsburgh, Nov. 29, 1916. American Bridge Company.

Mr. H. A. Greene, Erecting Manager,
American Bridge Co.,
Pittsburgh, Pa.

Dear Sir:—

Your tests were carefully watched by me and also by my inspectors and in general what you say regarding the tests are the facts. My conclusion in regard to this matter, after seeing the tests made, is that one thin coat of red lead in oil carefully brushed in on each of the surfaces in contact is the proper method of treating the plates in riveted joints. During the balance of the work we will not insist on repainting the entire surface of surfaces which are in contact and riveted in the field, but will insist that spots where the paint has been scraped off and which have begun to rust be cleaned and given one thin coat of paint.

C. R. Fickes,
Chief Engineer, Paducah & Illinois R.R. Co.
Metropolis, Ill., Dec. 8, 1916.

An Engineering Substitute for the Cellar Door

Sir—The "spillway for kids" shown in picture and section for this article, having a total height of 5 ft., ice-surfaced, is safe for kids who can walk and entertaining for the boy or girl up to 15 years of age.

No sleds are necessary. They float down, slide down, roll down, singly, in twos or in spirals. But when my 33 months' boy started to *leap* down from the foot-rest shown, while others older stood on and leaped from the apex, then came the real test of the remarkable properties of this particular curve.

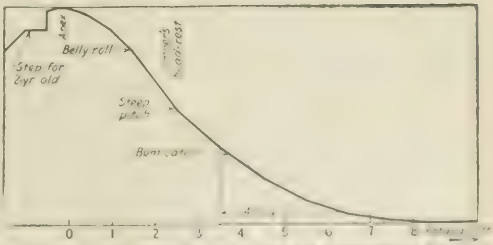
Whether it closely resembles the standard water spillway I have not yet verified; but I cross-sectioned it, and intend to keep on building them next winter, at $5 a piece, if the engineering trade is dull. Those who can afford it will be taxed $10.

A good deal of water is necessary. Settled snow is thrown in blocks into a heap and the water applied at irregular intervals for packing. It is necessary to keep the idea of steepness in mind to start with; but otherwise the face is given very little attention till near the end of the job. Then it is smoothed somewhat with a shovel, and the water first sprinkled, then "sloshed" on it, picking a real cold day. After that, maintenance consists in sprinkling both it and the retarding apron at intervals of a week or so.

A good firm top, with square shoulders is desirable. The base will need to be 10 or 12 ft. either way; steps lead up to the rear. Water should be thrown over the sides also when the weather permits, in order to provide a good coat against the spring sun.

Heads cannot be broken on this slide. G. P. Morse,
Assistant Engineer,
Winnepeg, Man., Feb. 10. Public Works of Canada.

[This recalls an incident about twenty years ago when a new toboggan slide was to be put up at an eastern university. An enthusiastic engineering student remembering a page in his calculus saw to it that the slide was built to the mathematical "curve of least descent," on the theory that such a curve would get the toboggan to the bottom quickest and therefore with the most excitement. If recollection serves, the first toboggan, carrying the designer, clung to this nicely calculated curve along its slowly descending upper slope but at the point of curve where the descent began to steepen the toboggan shot out into the air in a perfect tangent and, after achieving a middle ordinate of about 20 ft., landed pretty well smashed on the flattened slope at the bottom of the slide. The reconstructed slide, on conventional lines, was another triumph of practice over theory.—Editor.]



A HOME-MADE TOBOGGAN SLIDE OF SCIENTIFIC DESIGN

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

At a recent meeting of the Colorado Engineering Council it was agreed that Colorado Senate Bill 265, calling for an appropriation of $25,000 for state mapping work, be made to read $50,000 so as to take full advantage of money available from the U. S. Geological Survey for mapping purposes.

Hard-surfaced roads, contained in a 173-mile system, are to be built with money provided by a $2,500,000 bond issue that Champaign County, Illinois, passed Feb. 27, by a two-to-one vote. Most of the highways will probably be of concrete, 9 ft. wide to be widened to 18 ft. as traffic demands.

Plans are under way for the annual meeting of the Building Officials Conference to be held in Toledo, Ohio, April 24-27. Aside from various technical discussions there will be committee reports, among the latter being a report upon the building code recently published by the U. S. Department of Commerce. A complete program will be announced sometime this month.

Endorsement of the plan for establishing a national hydraulic laboratory was contained in a resolution passed by the Boston Society of Civil Engineers at a recent meeting. The society had previously endorsed the resolution by letter ballot. Congressmen from Massachusetts are to be sent notice of the society's action.

The twelfth annual conference of Lockwood, Greene & Co., engineers and managers, of Boston, was held Feb. 28, March 1 and 2, in Boston. A feature of the program was a clinic for managers identified with dental and medical work of the mills over which the Lockwood-Greene company has administration.

Preliminary work on changing the channel of the Arkansas River through Pueblo, Colorado, and increasing the carrying capacity to avoid repetition of the destructive flood of 1921, is under way. The Dayton-Morgan Engineering Co. has investigators at work and when a complete report is available, probably within three or four months, bonds will be issued and contracts to do the work let.

The Colorado State Supreme Court has found that the Colorado conservancy law, passed by the general assembly in 1921, is valid. Opponents to the law sought to have it declared unconstitutional. The purpose of the bill is to enable the people of Pueblo to protect themselves against a repetition of the disastrous flood of 1921, when millions of dollars worth of property was destroyed and many lives lost.

New York Governor Urges State Water Power

In a message to the Legislature on Mar. 5 Governor Smith, of New York, strongly reiterates his previous demands for a state owned water-power system. The message first points out the huge water power resources in the state, especially in the Niagara and St. Lawrence Rivers and then says that the state "should develop these power resources and transmit energy created thereby to every municipality over transmission lines owned and controlled by the state." He therefore recommends: one, legislation to carry out this policy; two, that the state engineer be clothed with power to begin such development at once; three, that pending this development existing transmission lines should be declared common carriers; four, that no further private licenses be issued; and five, that $75,000 be immediately appropriated to defray the expenses of the suit of the State against the legality of the Federal Water Power Act.

Bill to Reclassify Government Employees Passed by Congress

Washington Correspondence

Material increases in the federal government salary scale are provided in the reclassification bill, which was passed just before Congress adjourned. The act, signed by the President March 4, is known as the Sterling-Lehlbach bill.

The new schedules will not go into effect until July 1, 1924. A special board headed by the Director of the Budget is charged with the actual reclassification, which must be effected to determine the employees who are entitled to the increased salaries.

Inasmuch as the legislation was pushed through during the last hours of the session, printed copies of bill are not yet available.

Engineering Council's Executive Board to Meet March 23-24

Government reorganization and reforestation will be among the chief questions to be discussed at a meeting of the Executive Board of the American Engineering Council, the executive body of the Federated American Engineering Societies, to be held March 23-24, in Cincinnati. As a part of the reforestation program, the co-operation of the government and of the Federation in a nation-wide campaign to conserve the country's forests is announced by Dean Mortimer E. Cooley, president of the Federation. The campaign is the result of a conference with Col. W. B. Greeley, chief of the U. S. Forest Service. It is planned to enlist the aid of engineers in all parts of the country in the reforestation movement, working in co-operation with state forestry services, organizations of farmers, universities, railroads and other bodies.

Direct Oxidation Company Accuses Engineer

Charges Clyde Potts With Holding Up Plans for Trenton Sewerage-Works Before State Board of Health

The Direct Oxidation Disposal Corporation of Philadelphia has filed charges with the governor of New Jersey against Clyde Potts, consulting engineer, New York City, and one of the two engineer-members of the State Board of Health, for holding up for improper personal reasons the plans for new sewage-works of the direct-oxidation or lime-electrolytic type for Trenton, N. J., drawn by Col. George A. Johnson, consulting engineer, New York City. All the charges except those relating to motive bear the approval of Colonel Johnson. By request of *Engineering News-Record*, Mr. Potts has supplied a copy of the charges for publication here, as follows:

DIRECT OXIDATION DISPOSAL
CORPORATION
LAND TITLE BUILDING
PHILADELPHIA

Hon. George S. Silzer,
Executive Offices,
Trenton, N. J.

Feb. 19, 1923.

Sir:

The Court of Chancery has issued a mandatory decree to the City of Trenton to build a sewage disposal plant. The City of Trenton has complied with the Court decree by having its Engineering Department, aided by a competent and internationally recognized consulting engineer, investigate and report upon the various types of sewage disposal plants and processes, and to prepare plans and specifications therefore. (Initialed G. A. J.)

The plans, specifications and reports of the Engineering Bureau of the City of Trenton have been submitted formally to the Engineering Bureau of the State Department of Health. Date of submission, Dec. 15, 1922. (Initialed G. A. J.)

It is necessary to point out that the State Department of Health, in the face of endorsement by its own Engineering Bureau of the plans and specifications of the City of Trenton so submitted, and despite the request of the City of Trenton for immediate action in order that the city might properly comply with the Chancery Court decree, and also that the city might take advantage of the lower prices it could obtain by letting a contract during the past winter, has failed, since Dec. 19, 1922, to give its approval of the project so submitted. (Initialed G. A. J.)

This failure, inexplicable in view of the face germane, on the part of the State Department of Health to accept the engineering verdict of its own bureau which has to do with such matters primarily, is attributable unequivocally to one member of the State Department of Health, Mr. Clyde Potts, a consulting engineer of New York, and also mayor of Morristown, N. J. (Initialed G. A. J.)

Mr. Potts has set himself against all other engineering opinion, and is opposing the program proposed by the City of Trenton, recommended by its consulting engineer and its own engineering staff, and for which funds have been provided to defray the cost of construction. Unanimous opinion of the Board of City Commissioners in favor of this project, approving the recommendation of the city's consulting engineer without internal dissension, involve an expenditure of $1,063,000 as against a cost of nearly $2,000,000 for a discredited type of sewage disposal system, favored by Mr. Potts. (Initialed G. A. J.)

Mr. Potts has never given any public reason, technical or otherwise, for opposing this newer and cheaper system proposed for Trenton, which is now in successful operation on a smaller scale in the cities of Allentown, Pa., and Phillipsburg, N. J. There appears to be no reason why he should oppose the approval of this project for the City of Trenton, as a member of the State Department of Health of New Jersey, except that he sought and was denied the donation of a large stock interest in the patented process involved in the system recommended to and unanimously adopted by the city commissioners of Trenton.

The efforts of Mr. Potts to secure an interest in this process were made by him after a study of the then available facts pertinent to it. Inasmuch as he has since made no further investigation of it, his attitude, in advising the State Department of Health to withhold its approval of the project submitted by the City of Trenton, cannot be ascribed to engineering reasons.

This evidence is submitted with the thought that when the State Department of Health, possessing as it does broad powers—indeed it would seem in the existing circumstances powers improperly plenary, in view of the matter in which they are now being exercised—is operating in a fashion inimical to the best interest of the citizens of New Jersey, and the public at large. On this account the foregoing is respectfully submitted for the immediate and serious consideration of the chief executive of the state. (Initialed G. A. J.)

Very truly yours,
H. JEROME HIRST.

Approved as initialed
G. A. JOHNSON,
Consulting Engineer.

It is reported that the delay in acting on the Trenton plans had been due to a feeling of uncertainty on the part of members of the board as to the suitability of the direct-oxidation process for Trenton, which had finally led the board to authorize Dr. Henry Spence, president of the board, Mr. Potts and R. J. Harder (city engineer of Paterson) the other engineer-member, and H. P. Croft, chief engineer of the board, to obtain outside expert advice before deciding on what action to take.

Governor Silzer has referred the charges to the State Board of Health.

Rock Foundation Failure Causes Collapse of New Building

An apartment house under construction on Crotona Park North, New York City, collapsed just after working hours on March 2, under unusual circumstances. The outside walls did not fail and were only locally damaged, but the five floors fell, pointing toward the longitudinal center line of the building, and the upper part of the front wall was also carried down. The building was framed with transverse wooden joists carried on the stone and brick side walls and on a short wall and girders running front to back through the building. The short wall fell, while the posts and piers carrying the girders remained standing. The wall that failed was built of local stone, in cement mortar that had set hard and bonded the wall well. It rested directly on rock at cellar level. Failure of this rock foundation caused the collapse of the wall.

The rock here is Manhattan schist. A trench about 2 x 2 ft. for the house sewer had been cut in the rock directly along the base of the wall, and a few hours before the collapse a couple of laborers had been sent to trim the sides of the trench to give more working room. This trimming apparently loosened the rock under the wall enough to bring about the failure.

Construction was going on with no supervision except that of the owner, a real estate man who was acting as his own general contractor.

32 Proposed Bills Would Merge N. Y. State Agencies

The exhaustive reconstruction program introduced in the New York Legislature by democratic leaders March 5 embodied in 32 bills the consolidation of over fifty agencies of government. A feature of the program is the proposed consolidation of all machinery which has to do with engineering, architecture and building.

This important measure establishes the new Department of Public Works, which would comprehend in its jurisdiction the functions now scattered throughout the highway department, the inter-state bridge commission, the department of public works, the department of public buildings, the trustees of public buildings, the office of state architect, the boundary waters commission and river regulating districts. The department would be organized with four main bureaus to which would be given the work of the several offices taken over:

The Bureau of Highways;

The Bureau of Canals and Water Control;

The Bureau of Architecture;

The Bureau of Public Buildings.

At the head of the Bureau of Highways is the highway commissioner; at the head of the Bureau of Canals and water control is a deputy superintendent of public works; at the head of the Bureau of Architecture is the state architect; at the head of the department of Public Buildings is the superintendent of public buildings. As the executive head of the entire organization, the superintendent of public works would stand with concentrated responsibility and complete control of all of the public works of the state.

Minnesota Engineers Meet with Federation

Joint Sessions Produce Interesting Program of Civic, Welfare and Technical Discussions

Engineering News-Record Staff Report

In a joint meeting of the Minnesota Federation of Architectural and Engineering Societies, representing ten organizations, and the Minnesota Surveyors and Engineers Society Feb. 21, 22 and 23 the former furnished the general technical program and bulk of the welfare and civic topics while the state society provided excellently devised technical programs for its three sections (highway, municipal and drainage) and a minimum of discussion on organizations, welfare or civic activities.

The engineer in Minnesota apparently is buckling down to his duties as a citizen. This was apparent not only in the exhortation to greater civic service in the address of W. H. Woodbury, president, but also in the highly satisfactory report of the six major activities of the public affairs committee, in the activity of the legislative committee in pushing bills in which engineers have interest, and in getting the accomplishments of the engineer to the public by proper publicity methods.

FEDERATION'S PROGRAM

The technical program of the federation was designed to be of main interest to men outside of the particular specialty. In consequence, the subjects were handled in a semi-technical manner and with the exception of detailed treatment of economic highway location by O. L. Kipp, engineer with the state highway department, covered such subjects as wood waste, water treatment, city planning, use of power on the farms of Minnesota and a general survey of scientific development.

Work of the federation for the past year has centered on its public affairs and legislative committees. Peat utilization is still being studied; and the Great Lakes-St. Lawrence Waterway interests furthered. A state lighting code has been written and the legislative committee authorized to push it through the legislature but to withdraw it if it should be emasculated by amendment. Endorsement was given to successive road bond issues of $10,000,000 each for 1923 and 1924. Backing for appropriations for the sanitary engineering program of the state board of health and for topographic and hydrographic mapping. The "toothless" engineers registration law is to be amended to extend the penalties to out-of-state engineers, to exempt only "elective" but not "selective" municipal or county engineers and to reduce the $5 renewal fees. In addition to these activities resolutions called for the continued co-operation between the state highway department and the state university in research work, for the state board of health to furnish tourist camp inspection and for increased activities of planning and zoning.

By restricting to a minimum the technical matter in the *Bulletin* its cost has been reduced so that now it is nearly self-supporting and the dues to the federation are to be reduced from $4 to $3. The first six months of 1922

(Continued on p. 465)

A.A.E. Board Acts on Registration Laws

Authority Given to Combat Repeal Attempt in Pennsylvania— Other Business

In addition to a resolution calling for the immediate trial of those against whom indictments or suits have been instituted charging fraud in cantonment construction (see *Engineering News-Record*, March 1, p. 412), the board of directors of the American Association of Engineers at the recent quarterly meeting authorized action to combat a movement to repeal the Pennsylvania engineers' registration law; recommended the elimination from the proposed registration bill in Tennessee of a provision granting licenses on the basis of society membership; and authorized a study of the unification of engineering organizations. Co-operation with other societies and formulation of principles bearing on the subject will be undertaken by a committee consisting of H. C. Ferry, director of California; B. W. Matteson, director of Utah; G. M. Butler, director of Arizona, and D. L. Turner of New York. The committee is to report at the annual meeting in Norfolk, May 7-9. A committee on Americanization, headed by Elon H. Hooker, New York, was appointed.

The judiciary committee membership has finally been made up as follows: L. E. Ayres, 1 year; Paul Augustinus, 2 years; R. P. Luck, 3 years; L. K. Sherman, 4 years; H. C. Clausen, 5 years. This committee is the final court of the association and will pass on all questions submitted to it by the board, by the practice committee or by twenty members.

CANDIDATES FOR OFFICES

Nomination by petition of candidates for offices to be voted on at the 1923 election are as follows: President, W. L. Benham, Kansas City, Frank T. Payne, New Orleans, R. I. Randolph, Chicago, George E. Taylor, Charleston, W. Va.; first vice-president, L. E. Ayres, Will P. Blair, G. M. Butler and A. M. Knowles; second vice-president, Morris Bien and W. H. Strong; directors, W. H. Marsh, district 1; H. C. Ferry, district 2; J. C. Nagle, district 4; J. E. Kaulfuss and Clark E. Mickey, district 5; Dan W. Patton, district 6; W. R. Harris and Henry Riedl, district 7; M. Z. Balf, district 10 and P. Sellers, district 12.

Application was approved for the Oklahoma Engineering Society to amalgamate with the chapters of the state to form the Oklahoma Division.

Mississippi River Problem to Be Am. Soc. C. E. Topic

The river and harbor problems of the lower Mississippi will be the basis of the technical discussions at the spring meeting of the American Society of Civil Engineers to be held at New Orleans April 18, 19 and 20. Social features will supplement the technical sessions, and there will be excursions through the French quarter of New Orleans and an all-day boat trip around the harbor. Various nearby engineering projects will as well be inspected.

Congress Grants Coal Commission $400,000 Appropriation

Washington Correspondence

While the continuance of the President's Coal Commission was imperiled by the delay in voting its appropriation, Congress, in an eleventh hour effort gave the Commission all of the legislation which it had asked. This included the appropriation of $400,000; the authorization to require sworn answers to questionnaires; the extension of the life of the commission until Dec. 31 and the authorization for Judge Alschuler to serve as a member of the commission.

The appropriation was added to the third deficiency bill in the Senate. It was approved with practically no objection. A separate vote on the amendment was demanded in the House, but the item was approved without a roll call. Prior to that action, however, the House had passed the bill which authorizes the Commission to require sworn answers to its questionnaires. The amendments to the original act included the desired increase in the appropriation.

Pennsylvania Plans Highway Traffic Survey

A highway transport survey is planned by the Pennsylvania State Highway Department. In an announcement by Paul D. Wright, commissioner, and William H. Connell, deputy commissioner, it is stated that in this survey "our engineers will consider the importance of feeder territory as to its agriculture, its industries, the population of the towns and cities. They will consider the trans-Pennsylvania traffic which will pass through their districts and the logical route for this traffic to follow. They will endeavor to determine through reasonable deduction the probable development of feeder territory. The material gathered in various section of the state will be studied as a whole; and the result will be a composite picture of Pennsylvania's highway requirements for years to come. We shall determine from the normal road use of the present and the result of our studies of the future what highway types will be necessary. The survey will aid in the conservation of the state's financial resources, because it will give Pennsylvania the best possible road system at the least possible expenditure of public funds."

Smith Proposes Port Authority and Tunnel Commission Merge

Governor Smith has written a letter to Governor Silzer of New Jersey, asking him to join in considering a plan to bring about a consolidation of the Port of New York Authority and the Vehicular Tunnel Commission. Governor Smith asserts in the letter that when the vehicular tunnel is completed it will logically be a part of the general plan to improve the Port of New York. There would be many advantages, he believes, if the vehicular tunnel project were transferred to the jurisdiction of the Port Authority. Under such a merger the Port Authority could issue its own bonds for financing the tunnel project from now on, relieving the taxpayers in both states from further burdens.

Garrett Blocks U. S. Participation in International Road Congress

Washington Correspondence

Unexpected objection raised during the closing hour of Congress by Representative Garrett, the Democratic leader, resulted in the defeat of the resolution providing for American representation in the Permanent Association of International Road Congresses.

Representative Anderson, of Minnesota, explained that the cost of membership is negligible and that the United States should participate in the exchange of views in the matter of road construction. He pointed out that the proposal not only has the endorsement of the President, the Secretary of State and the Secretary of Agriculture, but in addition was recommended by Secretary Meredith, who was in charge of the Department of Agriculture during the preceding administration. Despite these facts and others presented on behalf of the resolution, Mr. Garrett insisted on his objection just at the time the friends of the resolution were rejoicing in the fact that they had been able to get the resolution before the House. It had been taken for granted that no one would object.

Congress Gets Another Bid for Muscle Shoals Property

Washington Correspondence

Another bidder for the Government's project at Muscle Shoals appeared in the closing days of the 67th Congress when a bill was introduced by Representative M. J. Hogan, of the Seventh New York District, to authorize the Secretary of War to dispose of the Government's property to John Kissel and unnamed associates.

Mr. Kissel represented the Third New York Congressional District in the House of Representatives. He has been a newspaper publisher and is prominent in Kings County, New York, politics. Both Representative Kissel and Representative Hogan retired from the House Mar. 4.

The terms of the bill as introduced by Representative Hogan are identical with those of the revised Ford offer for Muscle Shoals, which are contained in the bill introduced by Representative Wright, of Georgia, to accept the Ford offer. The exact terms are followed in the Hogan Bill excepting that instead of paying $5,000,000 to the Government, the Kissel bid would pay $6,000,000 and extend the time of payment from five to six years.

Shipping Board to Recondition Two Former German Liners

The United States Shipping Board has announced that it has authorized the reconditioning of the steamships "Agamemnon" and "Mount Vernon." Both vessels are ex-German liners, the "Agamemnon" having been formerly known as the "Kaiser Wilhelm II." and the "Mount Vernon" as the "Kronprinzessin Cecilie." It is expected they will be ready for service in the 1924 season, when they will be operated by the United States Lines in the North Atlantic in conjunction with the "Leviathan" and the "George Washington." Both will be converted into oil burners. The vessels are approximately 700 ft. long, with a gross tonnage of about 20,000 tons and a speed of 23 knots.

Minnesota Engineers Meet

(Concluded from p. 463)

it cost 20c. per member and the last six months 33c. per member per month. The membership now numbers 1,163. One society, the St. Paul section of the American Society of Mechanical Engineers, has withdrawn.

Nine technical papers presented to the highway section of the Surveyors and Engineers Society, which was attended by 225 state and county engineers and officials, covered the use of marl, subgrade analysis, gravel location, Bates and Pittsburg road tests, snow removal, marking, county aid work, contractors point of view on materials and bridge maintenance.

Highway Section—Charles H. Dow, in reporting on three roads made of marl and sand like a sand-clay road indicated that the greater tendency to become dusty may be overcome with calcium chloride, that unlike sand-clay, marl-sand resists the penetration of water, that although more compressible, marl-sand ruts less easily as it retains its molded shape under pressure while sand-clay flows under pressure. The university experiment station has just issued a bulletin covering Mr. Dow's work which was carried out co-operatively by the university and state highway department.

C. L. Mott, of the state highway department, explained how to use the available geological information in hunting gravel deposits.

E. O. Hathaway, of the U. S. Bureau of Public Roads, outlined briefly the Bates and Pittsburg road tests giving his conclusions on the capacity of surfaces and subgrade to support loads, the temperature effect, effect of traffic and its distribution on the surface.

Snow removal experiences on a 100-mile stretch of road north of Lake Superior from Two Harbors to Grand Marais beyond the end of the railroad were given by P. D. Mold, of the state highway department. Drifts 12 ft. deep following a gale of 70 miles per hour were opened in three days after the blizzard the middle of February. Including snow plow equipment the average cost per mile will be under $150. Discussing the paper of J. A. Myron on marking Mr. Mold stated that he had plowed up most of the markers on this road, indicating the necessity of locating them beyond the shoulders.

E. J. Miller outlined the inspection procedure of the state highway department, the method of calculating whether it was cheaper to repair or renew old bridges.

Municipal Problems—The municipal section, after a discussion on fire prevention methods, brought in a resolution passed by the whole society calling for uniform hydrant threads. Later the proposal will go to the federation for final endorsement and possible legislative action. Garbage in small towns was discussed by F. D. Minium, city engineer, New Ulm. O. E. Brownell, assistant engineer of the state board of health, read a paper on "The Disinfection of Wells, Reservoirs and Distribution Systems to Remove Indications of Contamination."

Drainage Section—Thaddeus Surber, biologist of the state game and fish department, warned the drainage section of the dangers to the state's water resources of excessive drainage through lowered ground water, smaller rainfall and more rapid runoff.

A progress report was submitted on the problem of obtaining better tile by D. G. Miller, senior drainage engineer, U. S. Bureau of Public Roads. E. V. Willard, state commissioner of drainage and waters, outlined the state's procedure in the inspection of tile. The section asked the society to approve further co-operation in research on drainage and tile on the part of the university and Bureau of Public Roads.

A move to kill the publication of the *Proceedings* was balked and the whole matter referred to the publication committee with the consensus of opinion favorable to making some arrangement with the federation to publish in the *Bulletin* abstracts of the papers and proceedings, paying for the additional space required over that which would ordinarily be given to the state society.

The newly elected officers of the state society are: President, C. L. Mott; vice-president, T. H. Curtis; representative on the federation board, J. L. Pickles; secretary-treasurer, E. G. Briggs.

Engineering Societies

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 13-15.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Spring Meeting, New Orleans, La., April 18-20.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Detroit, Mich., May 21-25.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

The Boston Society of Civil Engineers on March 28 will hold its seventy-fifth annual meeing. In addition to reports of committees and election of officers there will be a smoker and vaudeville. The meeting is to be held at the Boston City Club.

The Society of Terminal Engineers, New York, will listen on Tuesday evening, March 13, to a talk on "Tentative Regulations of Marine Properties Against Damage by Fire," by Charles H. Fischer, chairman, committee on docks, piers and wharves of the National Fire Protection Association. The meeting will be held in the Engineering Societies Building, 29 W. 39th St. at 8 o'clock.

The Topeka Engineers' Club at its meeting recently elected as 1923 president F. W. Epps, bridge engineer of the Kansas highway commission, to succeed A. B. Griggs. R. H. Pennartz was elected first vice-president; W. S. Lammers, of the Santa Fe, second vice-president; H. E. Buchanan, of the public utilities commission, secretary and publicity director, and Clyde A. Funchess, of the Southwestern Bell Telephone Co., treasurer.

Personal Notes

COL. A. B. BARBER has been appointed manager of the department of transportation and communication of the Chamber of Commerce of the United States to succeed J. ROWLAND BIBBINS who has resigned to engage in private engineering practice. Colonel Barber is a graduate of West Point who served during the World War, first on the railway commission sent to France in the Spring of 1917 to study transportation conditions and later with the army in various capacities. After the war he was connected with the American Relief Administration in Central Europe and later became techical adviser to the Republic of Poland.

ALEX LARIVIERE, of Quebec, has been appointed by the provincial government of Quebec chief engineer of the Quebec Public Service Commission with offices at Montreal.

M. E. MILLIRON, of Butler, Pa., has been chosen city engineer of DuBois, a position recently made vacant by the resignation of WILSON MORROW. Mr. Milliron has been connected with the Carson Engineering & Construction Co. of Butler, Pa. He is a graduate of Ohio Northern University and has had eleven years' experience in railroad, highway and municipal engineering.

SULLIVAN W. JONES, of Yonkers, has been nominated by Governor Smith to be state archietct of New York, succeeding LEWIS S. PILCHER. Mr. Jones is a graduate of Massachusetts Institute of Technology and until recently had been technical director of the American Institute of Architects' committee on structural service.

GABRIEL HURTUBISE, consulting engineer and surveyor, has been authorized by the town council of Terrebonne, Quebec, to prepare a complete plan of the town, which was recently destroyed by fire.

F. W. SEIDENSTICKER, for more than 16 years engineer in charge of design in the Chicago office of Purdy & Henderson, and for the last five years chief engineer in the office of J. J. Heuser, engineer, Chicago, has opened a consulting office at 64 East Van Buren St., Chicago.

SOLOMON-ABBOTT CO., industrial engineers of New York, announce a change in the firm name to that of ABBOTT, MERKT & CO., INC. No change is made in the personnel of the firm except that Col. G. R. Solomon will be active only as a director and stockholder. Col. Solomon has become vice-president of the Earl & Wilson Co., collar and shirt manufacturers of Troy, N. Y.

E. H. MCGOVERN has been appointed office engineer of the Cleveland, Cincinnati, Chicago & St. Louis Ry. Co. with headquarters at Cincinnati, Ohio. He replaces F. H. PLASTER, who recently resigned.

WILLIAM E. WILBUR, formerly designing engineer with Harrington, Howard & Ash, consulting engineers of Kansas City, Mo., has recently joined B. H. Klyce, consulting engineer of Nashville, Tenn. Mr. Wilbur is an associate engineer in the firm, in charge of bridges and other structures of steel and reinforced concrete.

G. E. Farnsworth, until recently a resident engineer with the Oregon State Highway Commission, has been made assistant engineer of the road department of the County of Riverside, Calif. He is stationed at Santa Monica.

E. H. Weileman, former designer on hydro-electric developments with the Electric Bond & Share Co. of New York City, has become associated with Mees & Mees, consulting engineers of Charlotte, N. C., as designing engineer.

The United Engineers, Inc., 303 Wood Street, Pittsburgh, consulting engineers, has been recently incorporated by John M. Erhard, Lee L. Lamm, and others. The firm will specialize in structural and mechanical design and detail. John M. Erhard is president of the company.

McClellan & Junkersfeld, Inc., announce that Renshaw Borie is associated with them in their work of engineering, construction, and management, and is in charge of their Philadelphia office at 112 South 16th St.

Stevens and Wood, Inc., New York City, announce that the engineering and constructing business formerly conducted by the Wood Hulse Yates Co. has been taken over and the personnel increased by associates of wide experience. The firm members of the new organization are R. P. Stevens and B. F. Wood.

Don L. Jacobson has resigned as resident engineer of the Union Bridge Company of Kansas City at the Grand Town Power house terminal and has accepted a position as designing engineer for the Truscon Steel Company in their Kansas City office.

W. P. Near, who for the past ten years has been city engineer of Saint Catherines, Ontario, has resigned and has been appointed city engineer of London, Ontario.

H. Z. Osborne, Jr., has resigned from the position of chief engineer, Board of Public Utilities, Los Angeles, Calif., which he has held for the past three years, to carry out the wishes of his father and become a candidate for United States Congressman from the Tenth District of California to succeed his father, who was the late Congressman Henry Z. Osborne.

Richard Sachse has resigned as chief engineer of the California Railroad Commission, effective March 1, to engage in private consulting engineering work. Mr. Sachse entered the employment of the Railroad Commission in 1912 as assistant engineer and for the past seven years has been chief engineer.

Obituary

Ira C. Sunderland, U. S. junior engineer of Detroit, Mich., died at Silver City, N. M., Feb. 15, aged 43 years. Mr. Sunderland's professional career began after his graduation from the University of Wisconsin in 1902, when he entered the service of the U. S. Lake Survey with headquarters in Detroit. From 1909 to 1919 he was in charge of the survey steamer, Col. J. L. Lusk, during which time he made topographic and hydrographic surveys along the West shore of Lake Huron. One of the most important surveys of which he was in charge was that of the so-called Nine-Fathom Bank, a rock reef in Lake Huron approximately fifty miles from the Michigan shore. His work formed the basis for a number of new and revised charts of various sections of the Great Lakes issued for navigators, by the U. S. Lake Survey Office. He was a member of the Detroit Engineering Society.

Joseph Benjamin Rider, an engineer of South Norwalk, Conn. who maintained a consulting office in New York City, died at his home last week, aged 54 years. During recent years Mr. Rider had spent a great deal of time in consulting work for public and quasi-public works and utilities, paying particular attention to water supply and purification, sewerage and sewage and refuse disposal. He was a graduate of Rensselaer Polytechnic Institute, later receiving a doctor's degree from Lafayette. During his earlier professional career he had served as editor of *Fire and Water*, had contributed to the technical press, and was the author of "Rider's Little Engineer." He was a prominent member of the American Water Works Association and had been active in its proceedings. He was a member as well of the American Association of Engineers and the American Society of Mechanical Engineers.

William McNab, of Montreal, late chairman of the valuation committee and engineer of the Grand Trunk Ry., died in Montreal, Feb. 23, aged 69 years. Mr. McNab was born at Irvine, Scotland, and entered the services of the Grand Trunk in 1870 as draftsman. He was appointed chief draftsman in 1887 and assistant engineer in 1896. He became principal assistant engineer in 1916 and chairman of the valuation committee in 1918. He was elected a director of the American Railway Engineering Association in 1905, and after holding the office of second vice-president, first vice-president and chairman of many committees, he was elected president of the association in 1908, being re-elected the following year.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Paint as an Aid in Maintaining Industrial Property and Equipment

Special Qualities Needed to Protect Metal Surfaces—Preparation of Surface Important—Spray Painting Has Many Advantages

UPKEEP painting, done at regular intervals, is one of the best investments a plant owner can make. This statement is made as a preface to a book of 190 pages by Roy C. Sheeler, soon to be issued by the Paint and Varnish Division of the E. I. Du Pont de Nemours & Co., Inc., Philadelphia, and intended as a practical aid to plant superintendents and others responsible for the maintenance of industrial property and equipment. From advance proofs of the chapters on painting and preservation of metal surfaces the following notes have been prepared:

If a protective coating can be applied that will keep out water in every form and if means could be devised to make the metal resistant to the flow of surface electric currents, there would be no corrosion. Iron will not corrode in air unless moisture is present and it will not corrode in water unless air is present. Paint manufacturers have developed finishes for metal surfaces which, if properly selected and used, will retard rust and decay.

Essential Qualities

In general, a paint for the protection of iron and steel should be composed of suitable pigments combined with the proper vehicle, the resultant product being chemically permanent, chemically inert toward iron, resistant to physical damage, impervious to air and moisture, sufficiently elastic to expand and contract without damage, and rust inhibitive. The pigment must be exceedingly fine for satisfactory results and there must be an affinity between the pigment matter and the oil. If this attraction does not exist, the paint may brush out thin but be full of breaks and imperfections, giving poor protection to the metal underneath. Too rapid drying is an indication of unstable chemical condition. A paint that dries to a brittle, easily abraded surface is of little value on metal work.

Elasticity is one of the most important characteristics of a successful paint coating. If it does not expand and contract with the metal over which it is used it will quickly fail. Metal surfaces primed with a paint composed of a substantial amount of one or more basic or chromate pigments and finished with carbon or iron oxide paint, will be protected from corrosion under most conditions for a long time. Linseed oil, when used without the addition of pigment, is not a desirable material to use as a priming coat. Such a foundation coat is often a direct cause of peeling or blistering of the finishing coat. Paints containing tar or those with a tar base should not be used on steel structures exposed to the weather, as tar paint films rapidly check and crack.

Preparation of Surface

The metal surface must be properly prepared before the paint is applied. It must be free from dust and dirt and all grease and oil should be removed by benzene. Rust and mill scale should be removed by sand blasting or with hammers, steel scrapers, or wire brushes. Sand blasting is the best, but the most expensive method.

Galvanized iron surfaces, although able to withstand the action of the elements for a short time, should be painted promptly when new. In the process of galvanizing an oily surface remains, to which paint will not adhere. This oil must be removed by washing with a solution made by dissolving 8 oz. of copper acetate or copper sulphate in 1 gal. of warm water.

Application of Material

Faulty application is one of the greatest causes of paint defects. The use of the proper primer is of utmost importance. It should be brushed out well and not applied too heavily. Plenty of time between coats should be allowed for thorough drying. Paint will blister and peel if the surface on which it is applied is damp or if the coat applied is too heavy. The paint should be stirred thoroughly before using and the manufacturer's recommendations as to the material to use if thinning is required should be followed. If the contents of a paint container have skinned over, remove the skin—do not stir it into the paint under any circumstances.

In painting structural steel, the shop coat, which acts as a primer, is followed with a field coat. In each case the spreading capacity is about 750 sq.ft. per gallon, or about 2 tons of steel per gallon of paint, for one coat.

In painting steel tanks containing volatile liquids the color of the paint is vital. Dark colored paints absorb heat rays, causing loss by evaporation of the contents of the tank. Gloss finishes absorb less heat than flat paints.

Spray Painting

In spray painting just enough air pressure should be used to cause the paint to flow freely through the hose to the spraying machine. When working on the ground a pressure of from 5 to 10 lb. is sufficient to force the average material through the hose and from 35 to 45 lb. to atomize the paint at the nozzle. The nozzle should be held at a distance of from 6 to 8 in. from the surface to be coated. It is necessary to have a variety of sprays and nozzles for different kinds of work. The average spray requires 6 cu.ft. of air per minute. The spray job will generally prove more satisfactory for industrial upkeep purposes than brush work. Cleaning spray equipment after each day's work is of utmost importance. All paint should be blown out of the line and tank and half a gallon of kerosene run through. The spray should be disassembled from the hose and left in kerosene overnight.

In spray painting a large amount of scaffolding is eliminated and an operator can cover a surface 10 to 15 ft distant. The average width of spray stroke is 10 in., as against 3 to 4 in. with a brush.

Periodic inspection of plant and equipment, at least once a year, should be made to determine the condition of all surfaces.

Paint for the specific purpose of construction equipment maintenance will be discussed in a supplementary article by Roy C. Sheeler, to appear in an early issue. Editor

New Center Lock for Double Leaf Bascule Bridges

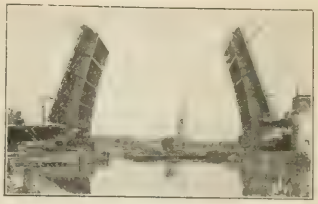
Jaw Castings and Links Act as Toggle in Closing Bridge—Wear Reduced by Improved Device

By P. L. Kaufman

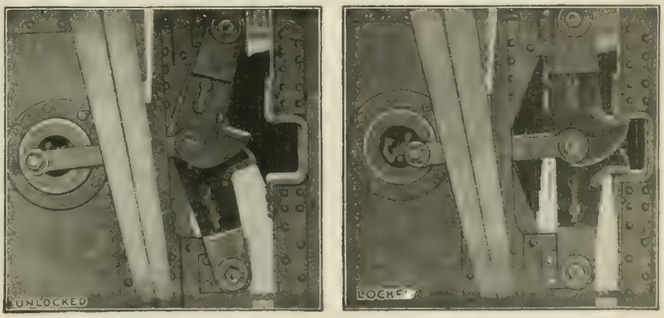
The Strauss Bascule Bridge Co., Chicago

Center locks on double-leaf bascule bridges serve the function of equalizing the shear between the leaves where each leaf acts as a cantilever under live load. When one leaf is loaded and the other not—a condition that occurs every time a heavy wheel load passes the floor joint—it is apparent that unless some means is employed to cause both leaves to deflect practically the same amount there will exist an offset in the roadway at the joint.

Heretofore, the best center lock employed in bascule bridges consisted of a motor-driven latch-bar, or plunger, moving in guides secured to the bottom chord of each bascule truss, which fitted into a socket-like casting in the bottom chord of the other leaf.



First Bridge with New Lock
The State Street Bridge, Racine, Wis.



Bascule Bridge Center Lock in Open and Closed Positions

While the latch-bar type answers the purpose reasonably well, it has certain deficiencies. There is, for instance, considerable wear both in the guide castings and in the socket casting which can only be properly adjusted by a cumbersome method of shimming. In bringing the two bascule leaves to exact closure independently of the operating motors in the final stages of closing the bridge, the horizontal latch bar overstrains the connections of the guide and socket castings, besides creating friction and wear between the bar and the socket casting.

The so-called jaw lock developed and patented by the Strauss Bascule Bridge Co. overcomes the deficiencies above explained. It was installed for the first time on the State St. Bridge, Racine, Wis., completed in July, 1922. It will be seen from the illustrations that the lock consists primarily of two jaw-like castings attached to the end of each main girder of the leaf fitting securely into the rectangular mouth or opening of a flanged casting attached to the end of each main girder of the other leaf. The jaw castings are pivoted at their extremities and are moved back and forth by a pair of forged steel links. The links are, in turn, actuated by a crank pin on the hub of a gear wheel mounted in a collar bearing bolted to the girder web. The gear wheel meshes with a pinion keyed to a cross shaft extending between the main girders and actuated at the center of the bridge by a 5-hp. electric motor.

The throw of the crank-pin is such as to cause the jaws to engage the opening in the flange casting. When the gear is revolved in the other direction the jaws are pulled back entirely clear of the casting. An adjustment is provided whereby the vertical distance between the horizontal faces of the jaw castings can be varied slightly until a proper fit is secured. The main castings are cast in half and bolted together in place which facilitated manufacture and erection.

The efficiency of the lock in drawing one leaf into place after the other is closed is apparent as the jaws and links act as a toggle and are a great assistance to the operator in finally closing the bridge. The advantage over the old style plunger lock in this respect is marked. The jaws, in disengaging, move away from the surfaces of the casting which they engage and thus avoid wear.

To Produce 3,000,000 Motor Vehicles This Year, Reeves Estimates

Based on figures for January and February, and depending somewhat on supplies of closed bodies, production of motor cars and trucks should approach the 3,000,000 mark in 1923, according to a statement made last week by Alfred Reeves, general manager, National Automobile Chamber of Commerce. The production for 1922 was 2,577,000 cars and trucks.

There are now 11,750,000 motor vehicles in use in this country, 10 per cent of which are trucks. Students of the industry, believe, Mr. Reeves said, that the United States can profitably use 12,000,000 cars and 3,000,000 trucks, which would require a renewal demand in excess of 2,400,000 vehicles.

To Develop Standards for Construction Equipment

The Associated General Contractors of America has requested the co-operation of the Materials Handling Division of the American Society of Mechanical Engineers in the development of specifications and standards for road-building and general construction machinery. The executive committee of the division, at its meeting Feb. 16, voted to co-operate with the contractors by undertaking, through its membership, the technical work involved. The contractors, it is understood, believe that there is an opportunity in the direction of simplification of repair parts and for improvement in the quality of materials entering into construction plant.

H. V. Coes, chairman of the Materials Handling Division of the A.S.M.E., presented a plan for organization within the society of a contractors' equipment code committee to produce the standard specifications discussed at the meeting. The plan involves co-operation of several of the professional divisions and the research and standardization committee of the American Society of Mechanical Engineers. It was pointed out that if the society, at the outset, communicated its plans to the American Engineering Standards Committee, the latter body would undoubtedly be glad to sponsor the work and would agree to have such specifications as were produced designated as American standards.

Business Notes

David Reeves, president, Phoenix Iron Co. and Phoenix Bridge Co., Philadelphia, died Feb. 5.

David Cochrane, inventor, designer and first builder of the open feed-water heater which bears his name, died Jan. 24. He was born in Scotland in 1850, came to the United States in 1879 and while employed by the Harrison Safety Boiler Works, Philadelphia, brought out his open heater in 1883. His contribution to steam engineering made possible the more efficient utilization of exhaust steam for heating buildings and for heating and purifying water for boilers and other industrial purposes.

L. R. Grannis, former Chicago manager of the Blaw-Knox Co. and later manager for Landes & Co. of Denver, Colo., has been appointed as agent for the sales of Blaw-Knox products in Colorado. This selling representation by Mr. Grannis will cover road-building equipment, clamshell buckets, Prudential buildings and other products.

Bruce C. Wilson, general manager of the Asphalt Block Pavement Co., Toledo, Ohio, will be connected with the Brooks Construction Co., Fort Wayne, Ind., as its secretary, after Feb. 1, 1923.

Louis W. Sipley has resigned from the position of Commercial Engineer in the Philadelphia office of the Safety Car Heating & Lighting Company, to become affiliated with the Alfred J. Forschner Co., Philadelphia, in the sale of construction equipment and contractors' supplies.

Pennsylvania Crusher Co., Philadelphia, has opened a district office in Chicago in charge of C. S. Darling. The equipment handled will include single-roll crushers for primary breaking and hammer crushers for secondary and finer crushing of rock, in addition to coal-breaking machinery. Mr. Darling is a graduate of Worcester Polytechnic Institute, served as captain with the 108th Engineers during the World War and was editor of *Rock Products* during the past year.

J. A. Fay & Egan Co., of Cincinnati, Ohio, manufacturers of wood working machinery, have leased the building at 260 Spear St., San Francisco and will occupy the structure as a salesroom and warehouse. The branch will be under the management of Guy D. Reynolds, Pacific Coast manager. Salesmen from this office will cover six western states.

P. H. Brigham, formerly engineer with the New York State Highway Department, has resigned as engineer in charge of sales of road equipment in the Middle West for the Lakewood Engineering Co., Chicago, and has entered the firm of List & Gifford Construction Co., of Kansas City, Mo., in charge of its road construction, with headquarters at St. Louis, Mo.

E. O'Keefe has discontinued his private engineering practice and will represent the Western Paving Brick Manufacturers Association in Iowa and Minnesota, with headquarters in Mason City, Iowa.

Wayne Wetherill, formerly chief engineer of the Link-Belt Co., Chicago, has opened an office in the Real Estate Trust Bldg., Philadelphia, as consulting engineer, specializing in conveying machinery and general construction.

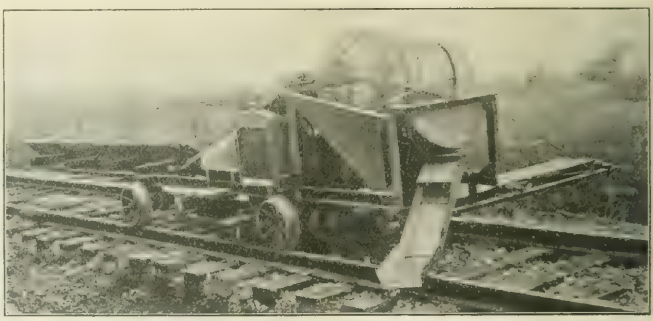
N. F. Ambursen has severed his connection with the Blaw-Know Co., Pittsburgh, where he held the position of chief engineer of the building department, and has entered into private consulting practice, specializing on hydraulic construction. Mr. Ambursen is the originator of the reinforced concrete type of dam which bears his name.

Penn Metal Co., Boston, has purchased the New England steel rod and bar business of the Midvale-Cambria Co., including all machinery, tools and merchandise. The Boston plant of the Midvale company will be operated by the Penn Metal Co. until such time as the Penn company's new bar and rod plant is completed. The list of steel shapes fabricated includes plain and deformed bars, plain rounds, rods, angles, cold-drawn steel, spirals for concrete columns. This gives the Penn company what is claimed to be the largest and most complete plant in New England for this kind of work.

Equipment and Materials

Ballast-Cleaning Machine on Santa Fe Ry.

For cleaning stone ballast in railway track a light power-operated and self-propelled machine introduced originally on the Atchison, Topeka & Santa Fe Ry. has been found more rapid and economical than the ordinary method of handling the material with ballast forks. The entire equipment is mounted on a low four-wheel truck and has an overall length of about 26 ft., with a weight of $1\frac{1}{2}$ tons. One of the latest of the machines is shown in the accompanying view.



Track Machine for Cleaning Railway Ballast

Projecting beyond the front wheels is a long shallow hopper or trough into which the men shovel the dirty ballast. At the bottom of the trough is a 10-in. belt conveyor, 13 ft. long, feeding a similar conveyor inclined 22 deg. above the horizontal and fitted with leather slats or lugs. From this second conveyor the material is discharged into a cylindrical wire screen 34 in. in diameter and 44 in. long, having a rectangular mesh $\frac{11}{16}$ x $1\frac{3}{8}$ in. It revolves at 21 r.p.m. and in operation it is covered by a sheet-iron hood. Dirt falling through the screen drops into a hopper feeding a 16-in. belt conveyor carried by a lateral frame and discharging about 1 ft. beyond the toe of the ballast. Clean stone passing off the screen drops into a hopper with inclined delivery chute at the rear of the machine. This hopper and chute swing on a vertical axis, so that the stone can be delivered between or outside of the rails.

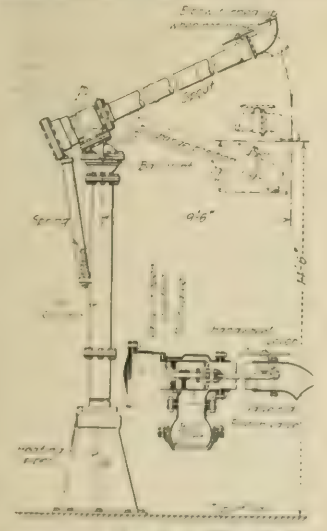
Power for the conveyors and screen and for propelling the car is furnished by a 15-hp. four-cylinder gasoline motor of the automobile type, the rear axle having a transmission gear with shaft driven from the motor shaft through a clutch. In going to and from work the machine can travel at about 13 m.p.h. By means of handles and a pair of flanged wheels set transversely to the rails, the machine can readily be lifted, turned round and moved clear of the track on a pair of temporary rails at right angles to the track rails.

In operation, the machine is accompanied by a gang of about 18 men; 12 men digging out the ballast and shoveling it into the hopper, 1 man handling the stone chute, 1 man helping with the stone and also clearing away the dirt from the discharge conveyor when necessary, 2 flagmen, 1 machine operator and 1 foreman. The shoveling of ballast into the hopper averages 1 cu.yd. per man per hour. With ballast taken out to the bottom of tie at center of track and sloping to 4 in. below end of tie and then to the toe of the ballast, the quantity handled averages 30 cu.yd. per 100 ft. of single track.

This machine was invented originally by W. F. Muff, roadmaster of the Atchison, Topeka & Santa Fe Ry., but has been developed and improved by the engineers of the Maintenance Equipment Co., Chicago, which is now manufacturing it.

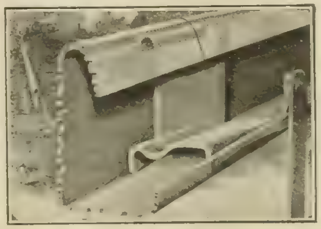
New Detail for Oil Columns in Railway Service

A reversible discharge elbow on the spout of an oil column for supplying oil fuel to locomotive tenders is a new device introduced by the T. W. Snow Construction Co., Chicago, to prevent the waste and nuisance of oil dripping on the track. For delivering oil, the pivoted spout is pulled down to the position indicated by the dotted line in the accompanying drawing. When the tank is full the fireman reverses the position of the elbow and releases the spout, which is returned to a position above the horizontal by means of a coiled spring. In this position oil in both the elbow and spout is drained back to the valve chamber at the rear of the spout. A full opening for the flow of oil is given by a piston valve having its stem within the spout and operated by a lever and hand wheel. The first movement of the valve rod opens a small pilot valve to equalize the pressure and further movement of the rod then opens the main valve



Road Form Has Line-Point Top and Rivetless Wedge Joints

Elimination of all rivets, bolt holes and stake boxes, a rounded or line point top surface on which stone or concrete cannot lodge and interfere with the smooth riding of finishing machine, subgrader, or hand templet, and a lock joint of two simple wedges, are distinctive features of the Carr form for concrete roads which has recently been introduced by the Lakewood Engineering Co., Cleveland, Ohio. The several points in which the design of this form differs from that of other road forms are indicated in the accompanying sketch.



The form is manufactured of $\frac{3}{16}$-in. metal in 12-ft. lengths, 20 per cent longer than has been customary for road forms, thus reducing the number of joints. The rounded top, the manufacturer claims, provides a self-cleaning feature inasmuch as it prevents concrete or pieces of stone resting on the top surface and causing bumps over which the wheels of the finishing machine must pass. With the line point top, therefore, an accurate thickness and smooth surface of concrete slab is secured. Even a slight tilting of the form, it is pointed out, does not change the elevation of the top surface or working edge.

An ingenious locking arrangement of two simple wedges insures accurate and rigid connection of form sections. The wedges are tightened or loosened by a few blows of a hammer or, if that tool is not handy, the metal stake itself may be used.

The base of the forms is 5 in. wide, sufficient to afford ample bearing for the support of mechanical finishing and subgrading machines. The usual stake boxes are done away with and a flat stake with a penetration of 18 in. may be driven at any point to engage the upturned outer edge of the form base. As a rule, three stakes are used for each 12-ft. section of form.

The forms are manufactured in heights of 6, 7, 8, and 9 in., weighing, without wedges and stakes, 9, 9.6, 10.2, and 11 lb. per foot, respectively. The simplicity of the design of this form minimizes handling costs on the job, in addition to producing a smooth slab of accurate thickness.

Samuel M. Vauclain, president, Baldwin Locomotive Works, has accepted an invitation from Dr. Thomas S. Baker, president of Carnegie Institute of Technology, to address the general assembly of students March 14. For many years Mr. Vauclain was superintendent of the Baldwin works, becoming vice-president in 1911, senior vice president in 1917, and president in May, 1919.

Publications from the Construction Industry

Industrial Railway Equipment — Koppel Industrial Car & Equipment Co., Koppel, Pa., illustrates and describes its line of narrow-gage cars, tracks, and batch boxes in a new bulletin. One of the newer developments is the multiple batch-box truck, designed for 24-in. gage track and with a capacity of 20,000 lb. or five loaded 31-cu.ft. batch boxes. The same type of truck for 36-in. gage has a capacity of 36,000 lb., or five loaded 54-cu.ft. batch boxes. Both steel and wood batch boxes are illustrated; they are of the tip-over and the drop-bottom types. With the latter a special cement compartment may be used.

Water-Works Pumps — De Laval Steam Turbine Co., Trenton, N. J., in a 100-p. illustrated manual, entitled "Ten Years' Progress in Water-Works Pumps," presents to water-works officials and engineers not merely an outline of the development of the steam turbine driven centrifugal pump, but a comprehensive technical treatise with photographs and diagrams on steam pumping units. In addition, there are detailed descriptions of actual installations in many of the principal cities of the country. The manual is replete with engineering data. There is a chapter on water measurement with Venturi meter, orifices and nozzles and Pitot tubes. A considerable amount of tabulated matter is presented as well as curves and charts for determining resistance of pipes to flow of water.

Lighting Data—Edison Lamp Works, of the General Electric Co., Harrison, N. J., has issued a series of illustrated bulletins dealing with the lighting of industrial plants of all kinds. Specific data are given for textile mills, woodworking plants, paper and pulp mills, garages, the food industries, and street lighting with Mazda lamps.

Water Testing Apparatus—Wallace & Tiernan Co., Inc., Newark, N. J., is issuing a series of technical publications describing its various bacteriological and chemical testing outfits for water supply and sewage treatment work.

Paving Mixers—Chain Belt Co., Milwaukee, has just issued a new 44-p. catalog, covering the 1923 models of Rex pavers. It is well illustrated and many of the operating features are shown with the internal mechanisms exposed to indicate their exact functions. The machines are shown with both full and half length chain treads. Particular attention has been given to the enclosed transmissions. The discharge of the Rex paver has been speeded up by the use of an enclosed automatically controlled mechanism which relieves the operator [illegible] the discharge chute is placed in motion. On the charging skip the throat opening has been designed so that [illegible] the throat [illegible] are restricted by the discharging angle of the skip. The distributing system has several automatic operating features.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Production and Materials Stocks In Nine Cities

Steel Operations at 90 Per Cent of Capacity—Lumber Output Recovering—Winter Brick Production at High Mark

Steel—With the pig-iron output more active than at any time during the last two years, the average yearly production rate for steel ingots, promises to run well above 45,000,000 tons for the current month. An average annual rate of 40,000,000 tons prevailed during the last quarter of 1922, with an increase of 10 per cent in the first month of the new year. The steel industry is now reported to be operating at 90 per cent of capacity as against 55 per cent, one year ago. Increasing operations, however, face decreases in the labor supply, as, beginning with the current month, out-door labor is expected to attract many men away from the steel mills.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Lumber, Minneapolis, 100,000,000 ft.); time required for delivery of carload lots to city job, example: (hollow tile, Atlanta 5 @ 7 days); and stocks on hand in general terms, example: (sewer pipe, Philadelphia, depleted.)

	San Francisco	Denver	Minneapolis	Detroit	New Orleans	Atlanta	Baltimore	New York	Philadelphia
Sewer pipe..	Plenty	Del. 24 hr., local plant	Sufficient	Plenty; demand increasing	Fairly well supplied	Del. take 5 @ 7 days	Enough	Mill del. slow	Depleted
Cement	Small reserve	Normal	Large Quantities	Sufficient for immediate demands	Plentiful	30 @ 40 cars	Shortage	No Shortage	Stocks low
Lime ..	Fair Supply	Plenty	Ample	Enough in warehouses; del, prompt	Enough	25 cars	Ample	Enough at present; demand increasing	Limited supply
Common brick. .	Large quantities on hand	3,000,000	Available at short notice	Moderate supply in local yards	Large supplies	Plenty	Shortage; demand heavy	50 @ 60 bargeloads	Yards working to capacity
Hollow tile	Fairly well supplied	Stocks normal	Sufficient	Small stocks; del. take several days	About enough	Del. take 4 @ 5 days	Sufficient	Nearby plants; del. by water	Enough no excess
Lumber..........	Heavy stocks	Normal level maintained	100,000,000 ft.	Normal; filling all demands	Mils filling all orders received	Plenty	Well stocked	Del. take 4 @ 6 weeks from mill	Shipments heavier than replenishments.
Asphalt..	Extensive native reserves	About 10 cars	Enough	Del. take one to two days	No market	Well supplied	Enough	Heavy reserves in N. J.	Supply center, none moving
Structural steel..	Plenty of structurals; low on rivets	Warehouse stocks sufficient	Meeting all demands	Enough in warehouses	Sufficient for present	About 5 cars	Plenty in warehouses	Mill shipments slow	Premiums on quick mill del.

Lumber—Total production for the entire country, as reported to the National Lumber Manufacturers' Association, reached 785,022,079 ft. b.m. for the month ending Feb. 24. In comparing this total with 766,498,788 ft. cut during the month ending Jan. 27, a strong recovery is shown during the last week in February from the temporary restrictions imposed by the severe weather of the middle of the month. February shipments reached 980,852,638 ft. as against 951,036,199 ft. during January. There was a slight let up in demand, however, as shown by February orders for 1,042,652,940 ft. as compared with 1,093,505,601 ft. during January.

Cement—Although the trend of mill shipments, which had been downward during October and November, took a sharp upward turn in December and continued in that direction during January, mill stocks have been steadily accumulating since October owing to the seasonal slackening of demand. The production curve in the meantime, pointed downward from October to January. With prospects of an unprecedented demand close at hand, production is expected to take a sharp upward turn followed closely by shipments, and with a gradual lessening of reserve stocks at factories from April to October of the current year.

Brick—Although nearly one-third of the brick plants of the country shut down, largely for seasonal reasons, the winter production is at the highest mark in recent years, according to the Common Brick Manufacturers' Association of America. Total burned brick on hand as of Feb. 1, amounted to 199,449,000, against 238,858,000 available Dec. 1, 1922.

REPORT ON COMMON BRICK FROM 90 YARDS AS OF FEBRUARY 1, 1923

Dist. No.	Including States Of	No. of firms reporting	Plants closed down	Burned Brick On Hand	Unburned Brick On Hand	Orders On Books	Price Per Thousand At Brickyard
1.	N. Y., New England.....	7	5	9,847,000	4,300,000	14,765,000	$15.00 to $20.00
2.	Pa., N.J., Md., D.C., Del.	11	5	21,151,000	4,873,000	43,142,000	14.00 to 20.00
3.	Va., N.C., S.C., Ga., Fla	7	1	4,619,000	1,284,000	1,645,000	12.00 to 16.00
4.	Mich., Ohio, W. Va	5	2	4,867,000	220,000	5,980,000	13.50 to 15.50
5.	Ill., Ind., Wis...........	25	3	138,609,000	5,213,000	156,786,000	10.00 to 16.00
6.	Ky., Tenn., Miss., Ala., Ark., La...............	12	5	4,740,000	3,815,000	10,560,000	10.00 to 20.00
7.	N. & S. Dak., Minn., Neb., Ia., Kan., Mo....	6	5	3,442,000	40,000	1,170,000	10.25 to 18.00
8.	Okla., Tex., N. M........	3	1	3,606,000	56,000	563,000	8.00 to 12.00
9.	Wash., Ore., Mont., Wyo., Ida., Utah, Colo.......	10	3	6,139,000	2,881,000	1,545,000	12.00 to 16.00
10.	Calif., Ariz., Nev........	4	2	2,429,000	2,644,000	2,330,000	14.50 to 15.50
		90	32	199,449,000	25,326,000	238,486,000	

San Francisco—Fairly well supplied with lump lime, expanded metal lath and hollow tile. Shortage of cement, structural rivets and wire nails. All other building materials plentiful.

Denver—Plenty of brick. Stocks of nearly all construction materials at normal levels.

Minneapolis—Shortage of face brick. Lumber supply unchanged during month, with plenty on hand. Dealers looking forward to early spring demand.

Detroit—Small stocks of hollow tile; delivery in large quantities requiring several days. Sufficient cement to supply immediate demands. Some mills so heavily booked ahead that even large orders are being declined. Asphalt available in one to two days. Plenty of all other materials.

New Orleans—No market for asphalt and crushed stone. Building materials plentiful with heavy demand. Lumber mills filling all orders received; railroads buying in large quantities.

Atlanta—Plenty of lumber, asphalt and common brick. About thirty to forty carloads of cement; twenty-five, of lime and five cars of structural steel, on sidings. Hollow tile deliveries take four to five days; sewer pipe, five to seven.

Baltimore—Shortage of cement; none in the market. Scarcity of common brick; demand heavy.

New York—Pine lumber shipments from mill, received in four to six weeks as against six to eight weeks, one month ago. Enough lime at present but unusually heavy demand anticipated before end of current month. Slow pipe deliveries from mills. Between fifty and sixty bargeloads of common brick

(*Concluded on p. 472*)

Trend of Production, Sales, Prices and Wages Upward

Business Conditions as Reviewed by the Federal Reserve Agent at New York Show General Improvement

Further increase in the volume of production in basic industries to a level higher than in 1919 or 1920, a continued advance in the prices of many basic commodities, additional borrowing from banks for commercial purposes, and somewhat higher money rates are the principal recent developments in the business situation, according to the *Monthly Review* of the Second Federal Reserve District.

Production in basic industries, as measured by the Federal Reserve Board's index, was 6 per cent higher in January than in December, and reached a volume exceeded only once in the past, in May, 1917. Production of steel ingots and of anthracite coal and mill consumption of cotton showed particularly large advances, and most other important industries increased their output. Building operations have been maintained on a large scale.

Employment and Wages Increased

Industrial employment continued to increase during January, and shortages of both skilled and unskilled labor were reported by textile mills, steel mills, and anthracite coal mines. More wage increases at industrial establishments were announced than in December. There is still some unemployment in States west of the Mississippi. In industrial and commercial centers there has recently been a larger demand for office workers, although throughout the country there is much unemployment in this group.

The index number of the Bureau of Labor Statistics, computed from the wholesale prices of about 400 commodities, including finished and semi-finished products as well as raw materials, showed the same average level of prices in January as in November and December. Between December and January the prices of clothing, fuel, metals, building materials, chemicals and house furnishings advanced, but these advances were accompanied by declines in farm products and food, so that the combined index remained unchanged. During recent weeks the prices of a number of basic commodities advanced rapidly and in many cases reached the highest points since 1920 or the early part of 1921.

An active distribution of goods for this season of the year is indicated by reports to the Reserve Banks, both of wholesale and retail dealers for the month of January. Sales of department stores in over 100 cities were 12 per cent larger than in January, 1922. Inventories show that there has been no large increase in stocks of goods held by department stores and the rate of turnover continues rapid.

Money rates showed a tendency to become firmer, especially in recent weeks. The open market rate for commercial paper, which was 4 per cent last summer, rose during February from a range of 4¼-4½ to a range of 4¾-5 per cent.

On Feb. 23 the discount rate on all classes of paper at the Boston and New York Reserve Banks was advanced from 4 to 4½ per cent.

The changes in principal aspects of industry and trade are summarized below. Comparisons are made between those months when low points were reached and the month of January.

Industry—Production, measured by the index of output in 22 basic industries, has increased since July, 1921, 54 per cent. Employment, measured by the number of workers employed in New York State factories, has increased since July, 1921, 23 per cent.

Trade—Wholesale trade in this district, measured by the sales reported by representative dealers in 10 lines (with allowance made for seasonal changes), has increased since July, 1921, 31 per cent. Retail sales in this district, measured by the reports from 60 department stores (with allowance for seasonal changes), has increased since September, 1921, 13 per cent.

Debits to Individual Accounts Higher

Bank Transactions in 140 centers outside New York City, measured by debits to individual accounts (with allowance for seasonal changes), have increased since July, 1921, 32 per cent.

Prices—This bank's index of wholesale prices of 20 basic commodities increased from June, 1921, to February, 24, 1923, 30 per cent. The Department of Labor Index of wholesale prices increased from January, 1922, to January, 1923, 13 per cent. The cost of living, measured by the index of the National Industrial Conference Board, increased from June, 1922, to January 15, 1923, 2 per cent.

Wages—The hiring rate of wages for unskilled labor in this district increased from April, 1922, to January 15, 1923, 16 per cent. Average weekly earnings of workers in New York State factories increased from April, 1922, to January 15, 1923, 9 per cent.

The differences between these various percentages of increase may be largely accounted for by the relation which the items measured bear to the immediate processes of consumption. In general, the nearer an item stands to immediate consumption the smaller will be the change which it shows in periods of business change. The consumption of goods goes forward with relatively little regard to the changes in business conditions, whereas processes far removed from the ultimate consumer, such as the production of basic commodities, are likely to move more widely and in close relation to the changes in business conditions.

State Road Programs

Kentucky appropriations thus far amount to $7,701,157.79. It is probable that additional appropriations to the amount of $2,500,000 will be made during the year.

Mississippi expects to let contracts this year for 50 miles of hard-surfaced roads estimated to cost $1,750,000 and 300 miles of graded and gravel-surfaced roads to cost $4,250,000.

Florida road funds for 1923 amount to about $3,000,000, of which $500,000 is allowed for maintenance, the rest for new construction.

Texas road work is not limited by the seasons, and contracts are being let and new work is being started every month. There are now 19,000 miles under construction at a total estimated cost of $26,415,000.

Arizona's legislature has not yet made appropriation for 1913.

California has not yet outlined its road program.

Oregon has not worked out a detailed program for 1923, but expenditures for the year will aggregate not less than $10,000,000. The work will involve the construction of 60 miles of pavement, 300 miles of broken stone and gravel surfacing, and 300 miles of grading.

Colorado's estimated disbursements amount to $9,236,350, of which $5,272,700 is for Federal Aid projects, the remainder for State and County. Some of the items are: Maintenance, $825,000; property and equipment, $150,000; administration, $281,454.

Minnesota's Legislature has received recommendations for highway bond issues of $10,000,000 each for 1923 and 1924. These proposals may not be acted upon until Apr. 20. Exclusive of bond issues about $6,500,000 is available for state highway work in 1923; while counties, townships and city villages will raise about $19,000,000 for roads.

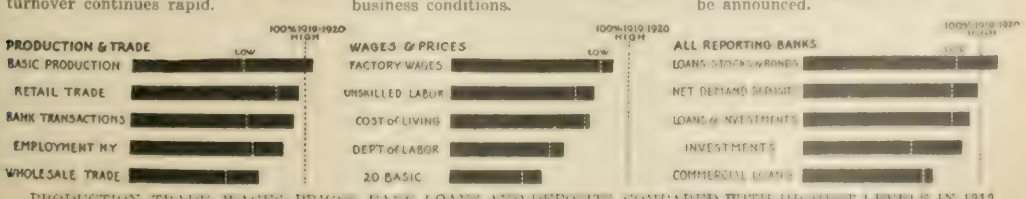
Iowa has now before the Legislature proposals which may greatly affect the 1923 road program. Without additional legislation there is a paving program of 100 miles; a gravel surfacing program of 400@500 miles, and a grading, draining and bridging program of 1,000 miles. This work is on the primary road system. In addition there will be work on the secondary road system, which cannot be estimated at present.

Nebraska appropriations have not yet been made. The road program will probably be available by April 1.

Kansas appropriations have not yet been made. The State Highway Engineer writes: "Our work is handled entirely from Federal Aid funds, which are maintained by the counties. The county funds are raised mostly from Benefit Districts which come up from time to time as work is desired."

Arkansas expects to spend $10,000,000 on improved highways this year.

Washington appropriations will soon be announced.



PRODUCTION, TRADE, WAGES, PRICES, BANK LOANS AND DEPOSITS COMPARED WITH HIGHEST LEVELS IN 1919 AND 1920, AND LOWEST IN 1921 AND 1922

Nevada has $2,500,000 available for construction, and the following projects will be placed under contract this year:

	Miles
Grading and gravel	163.50
Concrete	4.24
Overhead crossing	.75
Asphalt macadam	2.10
Asphalt or gravel surface	10.00
Gravel surface	12.00
Total	192.59

Utah plans to construct 170.398 miles of highways in 1923, as follows: 19.23 miles of graded earth; 133.068 miles of graveled surface; 11.53 miles of concrete; 5 miles either concrete or bituminous; 1.57 miles of road to eliminate grade crossings. This work is estimated to cost $2,056,865.86, of which $1,032,158.61 is for completing projects now under construction, and $1,023,717.25 for new work. The source of these funds: approximately 74 per cent from Federal Aid, and the remaining 26 per cent from county funds.

(Concluded from p. 470)

at docks, but nearly all sold. Fewer reserve brick now in Hudson River district than one year ago; river still blocked by ice.

Philadelphia—Lime, cement, common brick and sewer pipe stocks depleted. Brick yards operating to capacity to meet present demand. Mill shipments of sewer pipe slow. Lumber, all grades, being shipped from local yards faster than replenished. Enough hollow tile but no excess.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of March 1; the next, on April 5.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	+$3.44	$3.95	$4.40	$3.05	+$3.45	$3.95	+$3.45	$3.80	$3.75
Structural rivets, 100 lb.	+4.00	4.60	5.25	3.75	4.00	4.95	4.75	4.25	5.50
Reinforcing bars, ¾ in. up, 100 lb.	+3.34	3.85	3.15	+3.07½	+3.35	3.62½	3.30	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	51%	53%	45%	59½%	55-5%	38%	38.2@46.5%	45%	32.76
Cast-iron pipe, 6 in. and over, ton	56.50	51.00	57.00	53.20	58.50	65.00	57.00	+58.00	55.00
Concreting Material:									
Cement without bags, bbl	+2.70@2.80	2.75	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd.	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd.	1.00	1.24	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.00	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	63.00	37.00	53.00	+60.50	43.75	—51.00	—39.00	29.00	95.00
Lime, finishing, hydrated, ton	16.80@17.10	23.00	22.50	+20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.85	2.50	+1.50	1.25	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	12.00	11.00	11.00	17@19	12.00	15.50	13.00	+16.50
Hollow building tile, 4x12x12, per block	Not used	.0859	.115	....	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	+.1314	.0859	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	+1.01	+1.12	+1.16	+1.07	+1.13	1.21	1.09	.86	1.02
Common Labor:									
Common labor, union, hour	.60	.35	.30@.50	......	....	.50@.55	.56¼	....	......
Common labor, non-union, hour	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.50	.30@.70	.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine casing. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.25). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Steel structurals advanced 10c. in San Francisco and 15c. per 100 lb. in New York and Minneapolis warehouses, during week. The warehouse rise naturally followed a gradual upward trend in mill quotations, which in turn were affected by increased demand and higher costs of labor and raw materials. Trend of pig-iron prices higher due to wage increases in Southern ore and coal mines. New inquiries having stimulated mill prices to the current range of $2.25@$2.40, the minimum of $2.20 per 100 lb. has disappeared from the market. Some makers place a minimum of $2.25 per 100 lb. on plates and shapes, others, $2.35; as high as $2.50 having been quoted as a maximum. Structural buying is mostly in small lots at present, but with a constantly increasing volume of inquiries. Plate mills are overbooked, especially on car materials; quick deliveries being impossible with present heavy demand and limited transportation facilities.

The price of cement, per bbl., has advanced during the last two weeks at the following mill points: Buffington, Ind., 15c.; Universal, Pa., and Steelton, Minn., 10c.; Mitchell, Ind., Mason City, Ia., and LaSalle, Ill., 5c. New York warehouses quote cement at $2.70@$2.80 per bbl. without bags, for immediate delivery, as against $2.60@$2.70 one week ago.

Lumber market firm, railroad material and structural timbers continue to be the most active in demand. Long leaf yellow pine timbers, base sizes, quoted in Chicago at $60.50 as against $56.50 per M ft., b.m., two weeks ago. Douglas fir lumber tending upward in Seattle due to rise in price of logs.

Continued upward trend in prices of paint materials. Raw linseed oil rose 2c. in New York; 4c. in Minneapolis; 5c. in Chicago; 6c. in Dallas and 10c. per gal. in Atlanta, during week.

A Consolidation of Engineering News and Engineering Record

McGraw-Hill Company, Inc.—James H. McGraw, *President*

Engineering News-Record

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren, *Editor*
Frank C. Wight, *Managing Editor*

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Look Out for Floods

IN THE eastern section of the country we are reaching the end of one of the snowiest winters on record. Ever since the middle of December snowfall has been an almost daily recurrence and while the individual falls have not been very great the succession of storms and the continuous below freezing temperature have resulted in a snow cover of dangerously great depth. Such a condition does not necessarily mean a flood, but with the proper topographical conditions it is the essential preliminary that transforms an ordinary rainfall into a tremendous runoff—and a flood. It is too late now to do anything to prevent such floods, but those communities subject to such danger may well lay some plans to ameliorate their effect if they do come. Channel obstructions can be looked into, low land occupancies can be warned and snow surveys can be made—all with an eye toward a possible sudden warm spell and rain. Fighting a flood means organization, and there is still time to prepare such an organization for a contingency which this year in many places is greater than for a number of years.

A New Professional Activity

A REMARKABLE testimony to the growing importance of the technical society is the recent appointment by the Dwight P. Robinson Co. of a consulting engineer to represent that engineering company on the various technical committees in whose activities it is interested. Cloyd M. Chapman, an engineer with long experience in committee work, has been retained by the firm, if not entirely, certainly in a large measure for that purpose. Such committees have multiplied in late years to a point when large organizations, whether manufacturing, engineering or governmental, have to contribute in the aggregate time of their employees no little money and effort to their work. Occasionally there are heard complaints that such expenditure is wasted, but in the main this is unfair criticism. For the most part these committees are doing excellent work which would not otherwise be done in furthering the study and practice of engineering. Providing the organization has sufficient singleness of scope to make it possible to find one man who can represent it on the committees where it should have representation, the method initiated by the Robinson company gives promise of increased benefit both to the company and the committees.

Winter Stockpiling

DESPITE the embargoes on cement shipments and on open top cars for sand and stone it should be the object of every construction operation and particularly of every contractor for road construction to accumulate on the ground by every means as large a stock as possible of these materials. There will be no extensive release of cars from handling coal by the time the road-building season begins nor is this particular call for cars likely to diminish much during the summer. Dealers, who, most of the winter, have been delivering coal to consumers directly from the cars, will set to work to stock their yards, and consumers chastened by a winter of denial and deprivation in their customary supply will fill their bins well ahead of time. It is not only a possibility but almost a certainty that there will be all through this year and particularly in the latter half of the construction season a shortage of cars for construction materials. Last year, state highway programs were curtailed, many construction operations were extended over the winter into another season and many contractors suffered crippling losses because an unprepared-for railway-transportation shortage developed. Poor rail deliveries last year lost more time for highway builders than any other cause of delay. The figures collected in Iowa by the highway department on lost time on 20 contracts in 1922 show that one-fourth of the total was due to shortage of material. Winter stockpiling is not the simple task for the contractor that some of its loudest advocates seem to assume but with state highway officials allowing estimates on material in stock it is more simple than it was and contractors have no call to complain next summer of material shortage unless they have given the possibilities of winter accumulation and storage fair consideration.

A Real Gasoline Tax

MOTORISTS and automobile associations who are flooding the country with protests that proposed gasoline taxes of 1 and 2c. a gallon are confiscatory of property and subversive of human liberties will do well to contemplate the plan of the Roads Department of the Ministry of Transport in Great Britain to impose a tax of 8c. a gallon, as noted in a letter to the editor in this issue. Britain has some 500,000 automobiles and 350,000 motor cycles and has been taxing them on the basis of horsepower. It is interesting to note from the English press that the change to a gasoline tax plus a flat license fee of nominal amount is being generally urged by the large English associations of automobiles.

Incompetence Unrestrained

LAST week a building that was being erected in New York City by a real-estate man who undertook to be his own contractor and superintendent collapsed during construction, fortunately without killing or maiming any one. The owner-contractor directed or permitted some laborers to undermine a wall—an instance of just the sort of thing that is likely to happen at almost any time when incompetent men are permitted to build. This latter evil is at the root of all the troubles that surround building, so far as public safety is involved. Current practice permits any one to build. He may be a barber or an insurance agent, innocent of all knowledge of the technicalities of building, of architecture building craftmanship or engineering. Building inevitably involves hazards; it is difficult work and requires skill and care. Only trained, competent men should be allowed to undertake it, if building is to be on a sound basis. Bad building menaces not only the owner's pocket but human life, the safety of every one in the community. Yet we persist in our slip-shod system, vaguely hoping that the individual men who labor on the building will bring about a safe and proper result regardless of ignorant, incompetent, and often vicious direction. The way out is simple, though some hard fighting may be necessary to bring about its practical realization. Skill and competence being required in building just as much as in a surgeon's cataract operation, its practice should be restricted to those who are competent; and the barber, whom the law restrains from undertaking a cataract operation, should in the same way be restrained from building. In the meantime it is profitable to reflect on the long-standing troublesome question of what we are to do about the professional man who sells plans, knowing that they are quite likely to be used by incompetents and that public danger will result. Are we to regard him as a silent accessory to the crime of unsafe building? Or is he merely the helpless victim of a defective system which the public tolerates?

Making Sewerage a Utility

HERE and there throughout the country municipalities have permitted private companies to construct and operate sewerage systems and charge householders for the removal and disposal of the sewage. Seldom has this been done in places of any size, the most notable exception being Atlantic City, N. J. Rarely has a city proposed to make an annual charge for the use of sewers, although there are instances of this on record and such a charge is included in the carefully worked out financial plan under which the Sanitary & Suburban District of Washington, D. C., is building water-works and sewers. Last week it was suggested in these columns that in view of the financial difficulties under which many Ohio cities are operating, possibly it might be advisable for some of them to charge householders for garbage collection. In our news section this week appears an item outlining a bill authorizing the cities and villages of Ohio to make annual charges for the use of sewerage systems, the object being to provide funds for the entire cost of sewage collection and disposal, including capital charges, maintenance, and operating expenses. The bill is sponsored by the Ohio State Department of Health and it is said that it is receiving favorable consideration from the municipalities of the state. Under conditions now prevailing in so many Ohio municipalities, it may be that something of this sort is very desirable as regards both the sewerage and garbage services. In both cases the plan should be regarded as an emergency measure, rather than as ideal—although there is something to be said for this method of financing both services wherever it meets with general public approval and will not materially deter householders from having their sewage and their garbage promptly removed from their premises. Such a plan as related to either service should be accompanied by regulations compelling householders to avail themselves of the sewage and garbage removal facilities offered by the municipality.

Thinking Through on State Water Power

GOVERNOR SMITH of New York continues his pre-election campaign for a state owned water-power development in a message to the Legislature advocating the passage of laws intended to lead to that end. The message, except in one particular, is vague, and that vagueness is communicated to the people of the state, if the tone of the newspaper editorials commenting on the message can be taken as a criterion. If the Legislature of the State of New York is to decide the policy of the state, some one should proceed to educate that Legislature or at least to educate the people of the state so that they could influence the Legislature to think straight on this matter of state owned water power.

The Governor in his message is sure of one thing; that is, that the controversy between the state and the federal government as to ownership and control of border streams must be settled in the state's favor before any worth-while state development can be started. Beyond that, which is an obvious fact, he contents himself with some generalities of the potentialities of water power, particularly on the Niagara and the St. Lawrence, an implication of undue profits by the existing power companies with the concomitant prediction of cheaper power under state ownership, and a recommendation for the immediate repeal of the existing power act. He offers no suggestion that of the 3,400,000 potential horsepower in the state quite half lies in the border rivers over which the state's future control is, to say the least, doubtful, or that the cost of developing those powers, even though the state be granted control, would run well toward $200,000,000. Power cannot be taken out of the Niagara or the St. Lawrence in small units; the very nature of the rivers requires a comprehensive project involving, unless treaty revisions permit more draft above the Falls, huge dams, and the cost of the whole project would be prohibitive unless charged against the total horsepower possible to develop. By the same token, a large part of the interior development requires river regulation over extensive districts and the construction of numerous control dams, all running into money and requiring maximum use. In other words, it is not possible for the state to enter this water-power ownership slowly or in small amounts, except by the development of little streams whose influence on the power shortage would be negligible.

The Legislature is thus confronted with a much more practical problem than the Governor's message would indicate or than the people of the state seem to appreciate. It must prepare a bill which, if enacted, will commit the state to the expenditure of hundreds of millions of dollars (a similar law defeated last November in California authorized a maximum of half a billion) and to the ultimate purchase of all the power developments and transmission projects in the state. Such a law would put the State of New York into a huge and complicated business with ramifications into politics only too well shown by the history of the Canadian province just across the international river. To recommend the state control of power is one thing; to put before the people the actual text of a law insuring such ownership is another and a much more serious thing.

It will be time enough when such a bill is presented to discuss its possibilities. Just now some one should remind the people of New York that the rapacious private power company is a myth in their state, that the border rivers are not being developed more because of international difficulties, that incidentally would continue to exist under state control, than because of any defect in the current law or neglect on the part of the proper financial interests, and that the interior rivers require for proper utilization extended reservoir control which probably only a state can give. If New York would study Quebec for a proper water-power policy, instead of Ontario, it would find that it is possible for the state to assume complete control of power development and rates with privately owned power companies manufacturing and distributing power developed on rivers whose constant flow, in so far as nature permits, is guaranteed by the state by the construction and maintenance of proper dams and reservoirs. This is a legitimate and successful state function, free from the dangers of public ownership on the scale that state owned water powers inevitably assume. It would work in New York regardless of how the question of state rights in the border rivers is settled and if properly administered would result in a maximum development of the magnificent water powers of the state to the ultimate pecuniary benefit of the people of the state.

Irrigation and the Settler

HOW can irrigation projects be financed, developed and managed so as to be most attractive to settlers? This is a leading question in the West, particularly in arid regions where the problem of getting settlers on the land is almost wholly an irrigation problem. The present situation must be remedied speedily if the further reclamation of irrigable land is to succeed on a large scale and become a permanent factor in American agricultural development. Methods of interesting desirable settlers and helping them to get started on the land must be studied and applied continually, but outstanding above other needs is the fundamental requirement that prospective settlers be told frankly what it will cost, over and above the charges for developing water, to bring the land into production. Unless each settler knows the facts in this regard and has such financial or other help as may be necessary in his individual case, to make his tract of land profitably productive, it is worse than useless to develop water for irrigation and throw land open for settlement.

Optimism still prevails in some quarters, but more often emphatic assertion is made that, since a sufficient number of settlers cannot be secured for projects already under way, further developments are not justified until conditions change. An analysis of the reasons for this latter viewpoint leads to a comparison of the kind of development work done on the various projects. Projects on which the preliminary work has been very complete will find favor when others will not. On the Durham and Delhi colonies in California, for example, where every preparation is made for the settler before he comes to the land, there has been very rapid settlement. The insistent demand now is for land on which the man with very limited capital has a chance to succeed. The major portion of land settlement under present conditions will be made by men of this class and henceforth those projects which offer the most complete preliminary development have the best chance for success.

Formerly the real problem was that of financing the project as a whole. Now the situation has changed and the chief problem is means of financing the individual settler. Colonization ventures are generally admitted to be a desirable means of meeting the present problem and that general feeling has been strengthened by the success of Dr. Mead's experimental colonies in California (see *Engineering News-Record*, Dec. 5, 1918, p. 1015; also an abstract of the annual report of the California Land Settlement Division, elsewhere in this issue). Unfortunately the cost of such undertakings puts them beyond the reach of the thinly populated arid territory that must raise funds for its own development and there is thus also a need for some less expensive method that can be applied in the poorer and less productive regions.

Two points on which it is necessary to safeguard the present day project are (1) some means of controlling the maximum price of land in the area being brought under irrigation and (2) a fixed limit on the maximum amount of land that any individual may hold. Several western states now require that owners of a large percentage of the lands which it is proposed to form into an irrigation district agree on a maximum unit price before the state will guarantee bonds or otherwise lend its support. This does away with the speculation in and exploiting of the newly developed tracts. The economic limit on the amount of land each man may hold varies of course with the class of crops that can profitably be raised. The limitation should be suited to local conditions so as to allow the individual to hold as much land as he can use but no more. These two safeguards are comparatively easy to provide for on federal or state arid projects; otherwise they present obvious difficulties.

On land suitable for coarse foods only (grains, hay, alfalfa, etc.) some Western bond brokers are willing to handle only projects whose development charges are less than $60 to $75 per acre, arranged to be paid off in ten to twenty years. Others favor development costs up to $150 per acre or more, allowing the assessments to extend over a period of twenty-five to fifty years. In support of this latter plan it is argued that this makes possible development of tracts that could not otherwise be used, and that long-term investments in land backed by government guarantees are safe and desirable securities in which to have capital invested. The argument presented to the settler is that payments on such loans do not constitute cause for worry, as a mortgage might, because the development loan is to be considered as a sort of silent partner in the enterprise; a partner on whose account payments would be made annually just as taxes are paid. From the economic point of view this is sound logic because it is fair that several successive owners of the land should each pay part of the cost of the initial development from which all benefit.

Certain general conclusions may be laid down in the formulation of a program on which all interests could unite in the endeavor to improve the present status of settlement and irrigation. (1) Federal aid is needed in the development of arid land on a large scale. (2) Each state should show its good faith and confidence in its own future by co-operating at least to the extent of guaranteeing interest, or in other ways putting state credit back of the better land settlement projects within its own borders. (3) New projects must be developed and equipped as thoroughly as finances permit and then provision must be made for the farmer to get such financial aid as he may need in stocking, equipping and operating his land until it is on a self-sustaining basis.

Bridging the Tanana River on the Alaska Railroad

Ice Conditions Influence Location and Design—Alloy-Steel Pin-Connected 700-Ft. Main Span —Pile Foundations in Deep Gravel—Winter Erection Program

By Frederick Mears
Lieut.-Col., Corps of Engineers, U. S. Army
Chairman and Chief Engineer, Alaskan Engineering Commission

AN EXCEPTIONALLY long truss span which avoids the necessity of channel piers subject to heavy ice pressure and, by being placed at such an elevation as to clear steamers, avoids the undesirable element of a draw span, is the distinctive feature of the bridge now approaching completion to carry the Alaska R.R. across the Tanana River within 56 miles of Fairbanks, the northern objective point of this railroad. Silicon steel is used largely in the main span. The approaches include a riveted truss span of 120 ft., a plate-girder viaduct and a long timber trestle. The site and its southern approach are shown in Fig. 1.

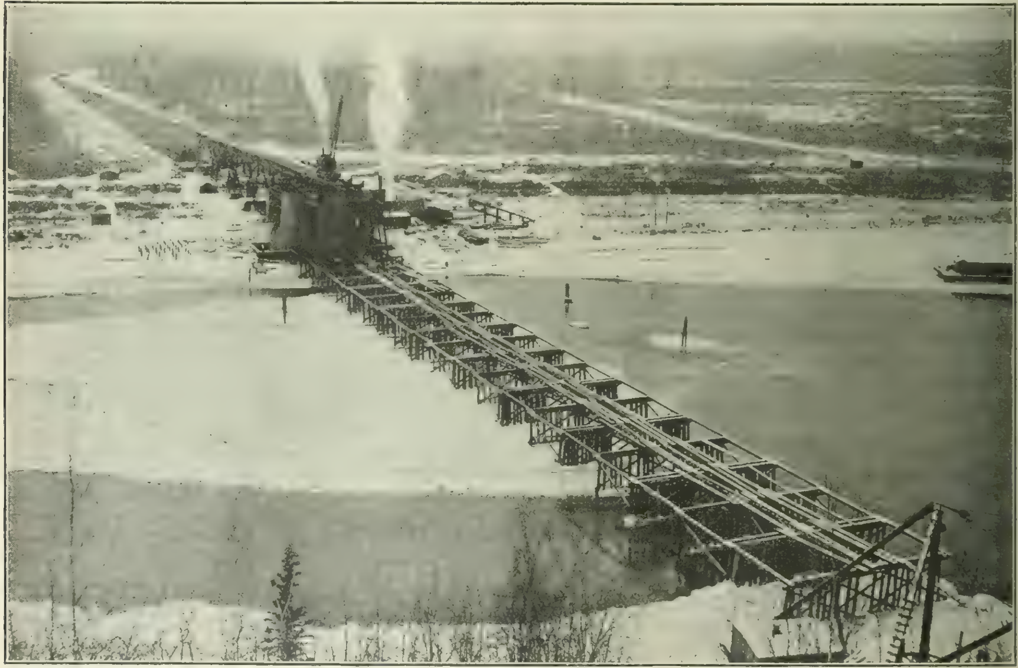


FIG. 1—BUILDING THE TANANA RIVER BRIDGE—ON THE LINE OF THE ALASKA RAILROAD

Lower part of falsework for 700-ft. span is in place. Crane is placing upper bents and floor steel. Approach makes a hairpin curve to reach water front. City of Nenana at extreme right

The Tanana River has its source in Lat. 62° 30′ N. and Long. 141° 30′ W. near the international boundary line between Alaska and Canada. It flows in a general northwesterly direction through north-central Alaska for about 600 miles to its confluence with the Yukon River near Fort Gibbon and is navigable for about half the distance above its mouth. The Alaska R.R., extending from Seward to Fairbanks, constructed and operated by the United States, crosses the Tanana River near Nenana, a town on the south bank of the river, near the point where the Nenana River enters the Tanana.

Alternative Locations—The crossing of the Tanana River presented a problem calling for careful study in view of the peculiar characteristics of Alaskan glacier streams. Near Fairbanks the river flows over a stream bed about four miles wide from bank to bank, shifting from one channel to another year by year, as it builds up or washes away the glacial deposits. A permanent crossing of the river in these flat sections was considered impractical. The range of hills which closely borders the north bank of the Tanana River below Fairbanks, comes to an abrupt end opposite the town of Nenana, which made it possible to locate the railroad and bridge axis on comparatively level grades leading into the flat lands north of these hills, thus avoiding any heavy cutting across the range. The lower end of these hills, therefore, determined the point of crossing of the Tanana River.

From Mile 371 northward the location of the Alaska R.R. followed the east bank of the Nenana River with long tangents and easy curvature, and the general direction of this line was produced across the Tanana River at Mile 411, as indicated in Fig. 2. Such a location called for a bridge 3,544 ft. in length with five concrete piers and having a movable span to accommodate river steamers. The general design for this structure, as prepared by W. J. H. Fogelstrom, former bridge engineer of the Alaskan Engineering Commission, called for a 200-ft. steel lift span and two 350-ft. steel truss spans, together with several pony spans and a trestle approach, estimated to cost $1,221,000.

There were serious objections to this location, however, the Tanana River here flows over a bed of sandy soil with no foundation rock available for piers or foundations. The distance from south bank to north bank is 1,600 ft., with an island forming a secondary channel near the north shore. The average depth of water in the main channel is 20 ft. and the current flows at about 4 mi. per hr. The river freezes about the middle of October. Ice 3 to 4 ft. thick is formed during the winter and goes out at the spring breakup about the second week in May.

It was noted that the ice near the lower proposed bridge site invariably moved out in an unbroken mass extending three-fourths the distance from bank to bank and from 1,000 to 2,000 ft. upstream. The ice upstream from the large bend above the town usually jammed against the bluff on the outside curve of the north bank and broke up in this jam before being carried down stream.

In view of the probable effect of the shock and pressure of the great mass of ice upon channel piers built upon pile foundations, this first plan was abandoned as involving risks out of proportion to the requirements of the project. The site finally selected (see Fig. 2) is 4,000 ft. upstream, avoiding the necessity of building piers in the main channel. The estimated cost of the bridge at this site is $1,289,435.

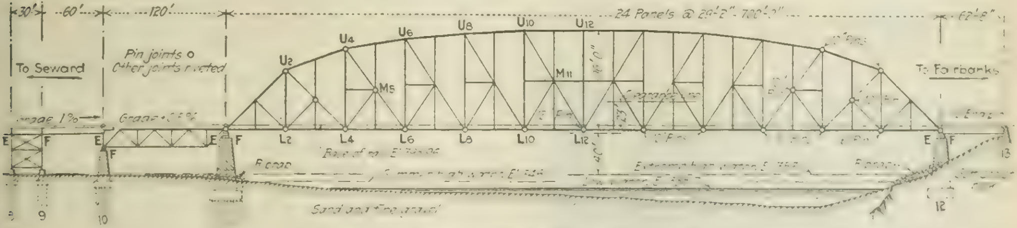


FIG. 3—MAIN SPAN AND STEEL APPROACHES

Although better alignment, with less rise and fall in grade, and with a saving in distance and avoidance of loop development in the south approach, would be secured by the lower crossing, the apparent advantages and small economies effected by this location would be more than offset by certain objectionable elements: (1) This crossing required a vertical lift bridge which would have to be opened frequently during the summer, necessitating continual expense for maintenance and operation; (2) on account of foundation conditions the cost for all channel piers would be high and, due to the menace from ice jams in the spring breakup, extraordinary precautions would have to be taken in pier design and construction. Furthermore, the original cost estimate for piers might easily be exceeded in actual practice, due to the short summer season and adverse climatic conditions under which this special field work would have to be carried on.

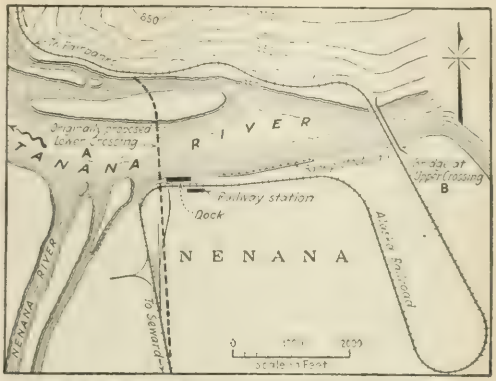


FIG. 2—ALTERNATIVE LOCATIONS FOR TANANA RIVER BRIDGE

On the other hand, the upper crossing, consisting of a long channel span and suitable approaches, was believed to meet the objections raised against the lower crossing, with no offsetting disadvantages except extra grade, distance and curvature in track approaches. The following points in its favor determined its adoption: (1) Its simple truss span 700 ft. in length, spanning the entire river from shore to shore, did away with the necessity of constructing piers in the main channel; (2) the clearance of 47 ft. above mean summer high water made unnecessary any form of movable span.

Topography at Bridge and Approaches — On the adopted location the axis of the bridge is laid across the Tanana River at its narrowest point and just below a sweeping bend where the force of the current is thrown against the bluffs of the Tortella Hills. Below the crossing, the river widens out in front of the town of Nenana. Above the bridge site the left bank of the river is low bottom land and considerable bank erosion has been going on, so that for about a mile this south or left-hand bank will require protection by heavy rock rip-rap to prevent erosion of the railroad grade.

To retain the main line location through Nenana it was necessary to extend the track up the waterfront parallel to the river bank and loop to the south to make the desired crossing of the river. This had the advantage of putting the station in the heart of the town, which is very desirable in a cold climate. A proposed location provided a 6-mi. cut-off line connecting the bridge tangent with the general alignment along the Nenana River, but while this was a little shorter than the adopted location it had the disadvantage that Nenana would have to be served by a spur track. As a considerable part of the freight tonnage for interior Alaska will be delivered to the river docks at Nenana, for transfer to down-river boats, it was not believed advisable to divert the main line from the town. The roadbed leading from the north end of the bridge site is benched in on the south slope of the Tortella Hills and connects with the established alignment of the railroad at North Nenana, about one mile from the bridge.

General Description of Bridge—From south to north the bridge will be made up as follows: (1) Pile and frame timber trestle 2,880 ft. 4 in. long, with 14-ft. spans; (2) a steel viaduct consisting of four 30-ft. deck plate-girder tower spans alternated with five 60-ft. deck plate-girder spans; (3) a deck riveted Warren truss span 120 ft. long; (4) a 700-ft. through pin-connected truss span with subdivided panels; (5) a 60-ft. steel deck plate-girder span. This gives a total length of 1,302 ft. 4 in. for steel and 4,183 ft. for the entire structure. The main span and adjacent steel spans are shown in Fig. 3.

As the War Department required 40-ft. clearance above extreme high water there is a grade of 1 per cent on the long south approach and 0.5 per cent on the smaller truss span. The 700-ft. and north 60-ft. spans are level. Between these grades short vertical curves have been introduced by notching the ties. The entire bridge is on tangent except for 366.2 ft. at the south end of the trestle and 13.7 ft. at the north end.

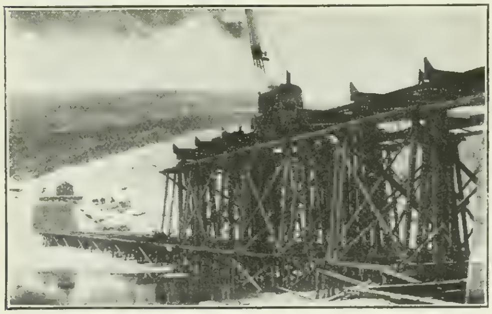


FIG. 1 ERECTING 700-FT. SPAN OVER TANANA RIVER
The lower bents of falsework were placed first to form a crossing. The 100-ton crane then set the upper bents and placed the steel for the floor system.

Foundation Conditions—Fine sandy loam is the soil on the south bank, and 15 ft. below the surface a stratum of sand and fine gravel was tested to a depth of 64 ft. In mid-channel the water is 19 to 33 ft. deep. Since no rock was found within the area covered by Piers 1 to 11, inclusive, pile foundations were designed for these piers. The hills north of the river slope directly to the shore and Pier 12 (at the north shore) was located well back from the water line, as the face of this rocky bluff takes the force of the river current. The rock is of poor quality, being a mica and quartzite schist which disintegrates under the action of the weather. Fortunately the stratification dips into the hill at this point and the pier was constructed on solid rock in an excavation 20 ft. deep below the ground line at river side of pier.

Substructure—Pier 1 was designed for a future pier-abutment. To carry this future pier a concrete foundation resting on 48 untreated spruce piles was constructed, having pedestals to carry a rocker-bent. Piers 2 to 9, inclusive, were built on foundations of nine piles each with an average penetration of 25 ft. Each pier was calculated to carry a combined dead and live load of 17 tons per pile. Pier 10, carrying the south end of the 120-ft. deck span, has 48 spruce piles calculated to carry 22 tons per pile. These pile loads do not allow for intermediate support from the ground.

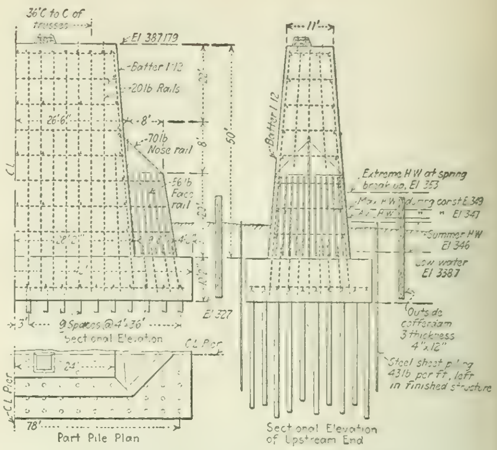


FIG. 5—SOUTH PIER OF CHANNEL SPAN

The important item in substructure construction was the building of Pier 11, carrying the south end of the channel span, shown in Fig. 5. A pile foundation was designed to support a combined dead and live load of 3 tons per square foot on the footing, 30x84 ft. Steel interlocking sheet piling 40 ft. long was used for the cofferdam. At this site the river bed was at El. 345 and high water during construction was at El. 349. In order to get the maximum benefit from the protection of the steel sheeting below the foundation, an auxiliary cofferdam, 44x92½ ft., was made of three-ply wood sheet piling, with its top at El. 352.

This cofferdam was made as watertight as possible and was strengthened by excavating some material from the enclosure and depositing it carefully around the outside of the cofferdam. With a 20-ft. head at the average stage of the river, this method disposed of a great deal of the water and made work easy for the pumps during the operation that followed. The 40-ft. steel piling was then driven inside the enclosure to a uniform depth at El. 306, the top being at El. 346, or 6 ft. below the outside cofferdam and 1 ft. below mean water level.

It was decided to excavate the foundation pit to El. 327, which was 20 ft. below mean water level, 22 ft. below high water level during construction, and 7 ft. above the bed of the stream. It should be noted that the direction of current at this crossing precluded the possibility of any heavy current along the south bank.

Pier Excavation—Removal of the top layer of soil at Pier 11 was done by two skid derricks carrying three-drum steam hoists and operating clamshell buckets. The remainder of the excavation was done by hand, with the use of skips and large bottom-dumping buckets. It was found more economical to remove the gravel and compact layers of soil by hand labor rather than to suffer the delay consequent upon the small output from clamshell and orange-peel buckets. A sump was maintained at the downstream end of the pit and the enclosure was kept unwatered by one 8-in. and one 5-in. pulsometer pump.

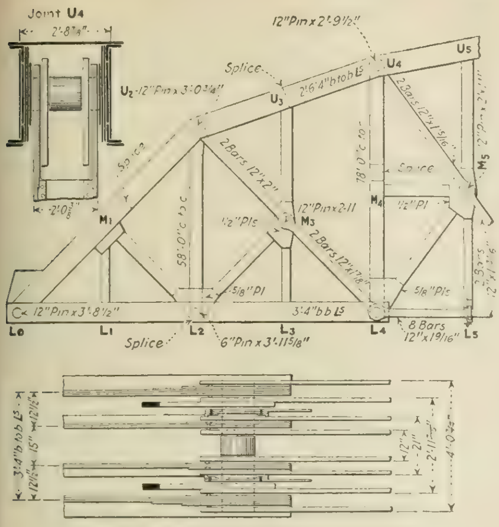


FIG. 6—END PANELS OF 700-FT. TRUSS

A central steam power plant to operate pile drivers, derricks and pumps was built near the pier. This has a 125-hp. marine boiler and a 60-hp. locomotive-type boiler. The excavation of 1,809 cu.yd. for this pier was completed in thirteen days. One pile driver, working on double shift, drove 200 foundation piles with an average penetration of 25 ft. in nine days. Untreated spruce piles of good size were used in all piers and foundations; they will be permanently below water level of seepage water. Piles were jetted into place by means of a 3-in. pipe, 20 ft. long. This foundation was designed to carry 25¼ tons per pile after allowing a load of 1 ton per square foot on the gravel between piles.

Gravel concrete of 1:6 mix was used, with 2,560 cu.yd. in pier No. 11. A grillage of old rails was placed on top of the piles and the foundation slab was further reinforced with rails. The pier shafts was reinforced vertically with 20-lb. steel rails near its outer surface, these rails being spaced 3 ft. c. to c., and well bonded into the foundation slab.

Superstructure—Special alloy steels were used in the design of the channel span, which closely followed that of the McKinley bridge over the Mississippi River, at St. Louis. A simple truss span as the main span over the river was obviously the most suitable type for such a crossing. The location of the short piers to clear the ice flow and provide suitable resistance to the underscouring action of the river determined the proper length of span to be 700 ft.

The entire steel bridge is designed for a live load of two Cooper's E-50 engines followed by a uniform load of 4,000 lb. per lineal foot of track. Wind load on loaded structure was taken at 30 lb. per square foot on area of train and floor as seen in elevation, with an addition of 30 lb. per square foot on the area of two trusses, eliminating that portion covered by train and floor which was treated as moving load. On the unloaded structure a wind load of 50 lb. per square foot was assumed, acting on the exposed area of two trusses and floor and treated as moving load. Some details of the truss span are shown in Figs. 6 to 9.

Grades of Steel—Freight from the fabricating shop to the bridge site was so large an item that the use of alloy steels was especially attractive. Three kinds of steel were specified and used. Carbon steel is used in part of the viaduct and all of the 120-ft. deck span. Silicon steel is used in the main angles and web plates of the 60-ft. girder spans. In the 700-ft. span nickel steel is used for all eyebars, which are annealed; silicon steel for all main material of both trusses and floor system, pins and large detail parts; and carbon steel for the remainder of the span, including subdiagonals, hangers and small details. Shoes and rollers are of cast steel annealed, and bolsters are of cast iron. The designers furnished complete specifications for mill and shop fabrication. Those covering chemical and physical requirements of the alloy steels are in part as follows:

Nickel Alloy Steel—(Specification for specimen tests)—Nickel alloy steel shall not contain more than the following percentage of elements: Manganese, 0.80; phosphorus, 0.06 in acid steel and 0.04 in basic steel; sulphur, 0.045; silicon, 0.15; carbon, 0.40. In addition, the steel shall contain not less than 1.20 per cent of nickel and may contain such percentage of chromium, vanadium or other metals as may be necessary to meet the physical requirements specified. Material containing more than 3 per cent of nickel may contain up to 0.45 per cent carbon. Whatever composition of alloy steel is selected by the manufacturer, it is essential that the material shall be uniform or approximately of the same composition throughout.

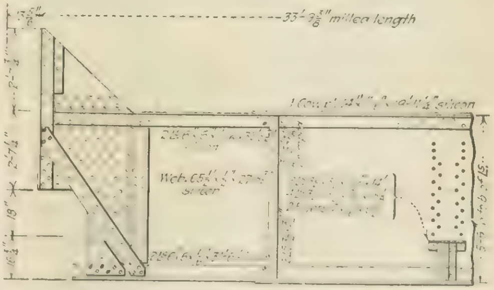


FIG. 7—INTERMEDIATE FLOORBEAM

Bidders are required, therefore, to submit lower and upper limits of percentage of metals in alloy steel they propose to use. The upper limit in each case shall not be greater than 125 per cent of the lower limit. (The manufacturer agreed to furnish nickel in proportions of 3 to 3.75 per cent.)

Physical requirements for nickel eyebar steel annealed: Ultimate strength, 95,000 to 110,000 lb. per square inch; elastic limit, not less than 55,000; minimum elongation in 8 in., 14 per cent; minimum reduction in area, 25 per cent. Tests of full-size eyebars are required to meet the following specifications: Minimum ultimate strength, 80,000 lb.; minimum elastic limit, 47,000; minimum elongation, 10 per cent, this elongation to be measured in 18 ft. including the fracture.

Silicon Alloy Steel—(Specification for specimen test)—Silicon steel shall contain not more than the following percentages: Manganese, 1.00; phosphorus, 0.06 in acid and 0.04 in basic steel; sulphur, 0.05; carbon, 0.40; silicon, 0.45. The percentage of silicon shall be not less than 0.20. Ultimate strength, 80,000 to 90,000 lb.; elastic limit, not less than 45,000; minimum elongation in 8 in. for material 1 in. thick and less, 1,600,000 divided by ultimate strength; minimum reduction in area for material ⅞ in. thick and less, 35 per cent. Certain modifications in elongation and reduction area are permitted for metal thicker than specified above.

Unit Stresses—The unit stresses used in design are:

A. Chords and end posts in compression:

	Alloy	Carbon	
Dead load	28,000	18,000	Top chords of 120-ft. deck span
Live load	14,000	9,000	
Combined (D.L.+L.L.+W)	23,000	16,000	

Least transverse dimension not to be less than $\frac{1}{16}$ of unsupported length. Portion of top cover plate unbalanced by bottom flanges not included in determination of section.

B. All other compression members in trusses:

	Alloy	Carbon
Dead load	$28{,}000-112\frac{l}{r}$	$20{,}000-80\frac{l}{r}$
Live load	$14{,}000-56\frac{l}{r}$	$10{,}000-40\frac{l}{r}$

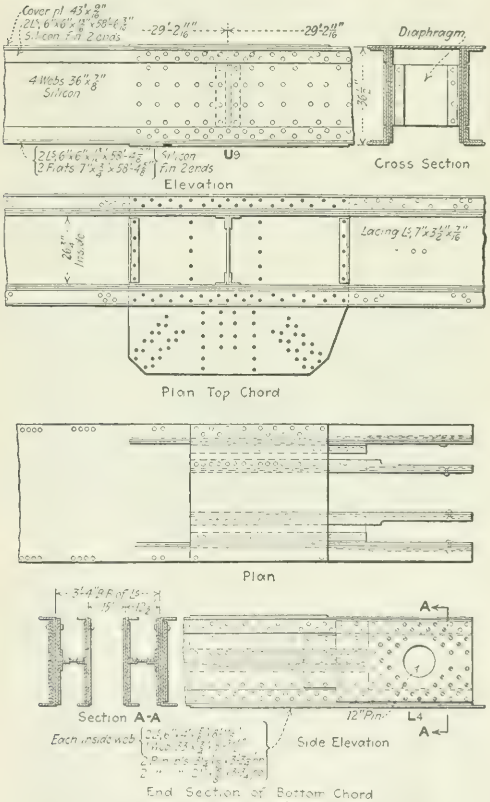

Cover pl 43'x $\frac{9}{16}$"
2Ls, 6"x6"x $\frac{13}{16}$"x58'-6 $\frac{3}{16}$"
Silicon fin 2 ends
29'-2 $\frac{11}{16}$"
29'-2 $\frac{11}{16}$"
Diaphragm
4 Webs 36"x $\frac{7}{8}$"
Silicon
36 $\frac{1}{2}$"
2Ls, 6"x6"x $\frac{13}{16}$"x58'-4 $\frac{5}{8}$"
2 Flats 7"x $\frac{3}{4}$"x58'-4 $\frac{5}{8}$"
Silicon
fin 2 ends
U9
Cross Section
Elevation
26 $\frac{3}{4}$" inside
Lacing Ls, 7"x3 $\frac{1}{2}$"x $\frac{7}{16}$"
Plan Top Chord
Plan
3'-4" B.B. of Ls
15'
12 $\frac{1}{2}$
A
Section A-A
Each inside web
12" Pin
L4
A
Side Elevation
End Section of Bottom Chord

FIG. 8—CHORD DETAILS OF 700-FT. TRUSS

C. All tension members in trusses:

	Alloy	Carbon
Dead load	30,000	20,000
Live load	15,000	10,000
D.L. + L.L. + W.	25,000	....

Live-load stresses in main web members to be increased by an excess load stress (E.L.) as noted below in paragraph K. Certain other live-load stresses are increased by an unbalanced load stress, U.L., as given below in paragraph L.

D. Viaduct columns:

	Carbon
Dead load	$20{,}000-80\frac{l}{r}$
Live load + traction	$10{,}000-40\frac{l}{r}$
D.L.+L.L.+W.+T.	$13{,}000-52\frac{l}{r}$

E. Floor beams, stringers and girders:

	Alloy	Carbon
Dead load	30,000	20,000
Live load	15,000	10,000

F. Laterals and sway bracing:

		Alloy	Carbon
Wind on loaded structure	Tension	25,000	18,000
	Compression	$25{,}000-100\frac{l}{r}$	$18{,}000-72\frac{l}{r}$
Wind on unloaded structure	Tension	25,000	20,000
	Compression	$25{,}000-100\frac{l}{r}$	$20{,}000-80\frac{l}{r}$

G. Rivets (carbon); no allowance for field rivets:

	Bearing	Shear
Dead load	24,000	12,000
Live load	12,000	6,000
Wind load	20,000	10,000

H. Pins:

Alloy	Bearing	Shear	Bending
Dead load	32,000	20,000	36,000
Live load	16,000	10,000	18,000
Carbon			
Dead load	24,000	15,000	26,000
Live load	12,000	7,500	13,000

I. Pressure on masonry.—Dead load, 500 lb. per square inch; live load, 250 lb.

J. Rollers, cast steel.—Dead load, 500 D per lin.in. of roller; live load, 250 D, in which D is diameter in inches.

K. Excess load (E.L.)—Live-load stresses in main truss members (except chords and end posts) shall be increased in the ratio of $\frac{L-d}{L+d}$ per cent, where L is length of span and d is length of loaded portion.

L. Unbalanced load (U.L.)—Live-load stresses in girder spans, floor beams, hangers and sub-diagonals, also viaduct columns, shall increased by ⅓ (100-L per cent), where L is length of span.

The spacing of the viaduct girders is 8 ft., that of the stringers in the 120-ft. deck span and 700-ft. spans 7 ft., that of the trusses in the 120-ft. deck span 14 ft., and that of the trusses in the 700-ft. span 36 ft. Expansion points are indicated on the plans (see Fig. 3); special expansion is provided for stringers in the 700-ft. span at panel points 8. Both field and shop rivets are $\frac{7}{8}$ in. diameter, except that in the 700-ft. span 1-in. rivets are used in the end posts, top and bottom chords and floorbeam connections to bottom lateral plates. Structural details and sections of interest may be found in Figs. 6 to 9.

Weight of Steel—The weights of steel in various parts of the bridge are tabulated below. For the 700-ft. span the total is 4,761,072 lb. or about 2,380.5 tons. For the entire bridge, 5,563,037 lb. or about 2,781.5 tons. These figures include all steelwork except anchor bolts or deck fastenings:

	Carbon Steel, Lb.	Silicon Steel, Lb.	Nickel Steel, Lb.
Viaduct, 120 ft. deck span and north 60-ft. girder span	613,323	188,632	
700-ft. span	1,956,556	2,010,206	794,310
Total	2,569,889	2,198,838	794,310

The heaviest pieces to handle in the 700-ft. span are the lower sections of the end posts, which weigh 24 tons. End bottom chord sections weigh 22 tons and 20 tons, respectively, and the top chord pieces 21 to 26 tons each.

Erection—Material was delivered at the south end. Steel erection started with placing the viaduct and 120-ft. deck span, all of which were placed from a yard track on the ground with a 100-ton locomotive crane. This erection started Oct. 7, 1922, and was completed Oct. 19. Riveting was started as soon as possible and was completed by the first week of November.

Falsework for the 120-ft. span consisted of framed fir bents resting on mud sills. Falsework for the 700-ft. span was built of framed fir bents resting on pile foundation, as shown in Fig. 1 and Fig. 4. Pile driving for this falsework started Sept. 5, 1922, and was completed a month later, except for bents under the two north panel points, which are framed bents on mud sills.

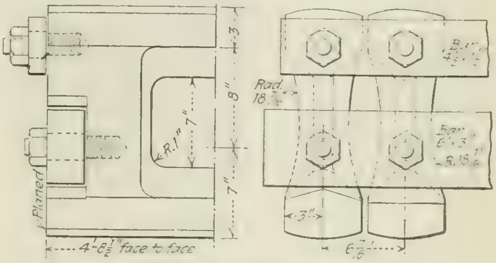
Erection of framed bents and floor system proceeded from the south end, using the 100-ton locomotive crane to handle material from track on top. At the time of writing, Nov. 25, all falsework and the entire floor system had been placed. It is the intention of the erectors to use the 100-ton locomotive crane for placing the balance of the truss span, supplemented by a lighter crane in the yard assembling material and placing it conveniently for the large crane above to handle. On Nov. 2, seven panels of the floor system had been placed. River ice was bearing against the pile falsework on the upstream side, with but little ice formed below. For safety, the work of placing further falsework and floor system was suspended until the river froze over below the bridge, but this delay was only a few days. Figs. 10 and 11 show the falsework construction for the main span. Double bents are used under main panel points and single bents under sub-panel points.

To provide against overturning the 100-ton crane on the 700-ft. span, four 24-in. 100-lb. I-beams are placed with their ends resting on the floorbeams and as close as possible to the ties to support the crane's outriggers. In placing the end posts and the top chord sections the lifts will be made by the crane with load line attached to a balance beam whose ends are so bolted to the piece handled that the piece will balance properly and also clear the boom of the crane better.

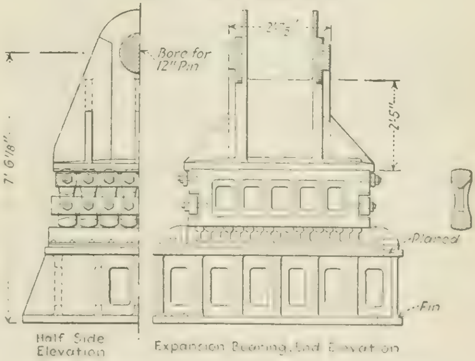
Winter Versus Summer Erection—It is of interest to note that the erection of the main truss will take place during the coldest weather in Alaska, when, for short periods of time, the temperature drops as low as 50 or 60 deg. below zero.

The writer took the responsibility of arranging for winter erection, as it was believed to be the safest plan under the conditions. As the ice goes out of the Tanana River not earlier than May 12, it would be some time in June before falsework could be established across the river, against the current of a spring freshet. This schedule would leave only three months in which to erect the span and swing it clear of the menace of the fall ice-run against the falsework. Furthermore, it was considered that the falsework would be endangered during the summer months should there be one of the big floods which frequently occur, carrying driftwood as large as full-sized green cottonwood trees, with roots and branches intact, which have been swept away by the flood in the process of bank erosion.

As the formation of solid ice is usually complete by the end of October, and the ice remains in place until May, there is available a period of six months in which to erect the bridge and remove falsework, during which period there is no obstacle to steady field work, except the short periods of severe cold weather. During 1921-22 these were so few as to be of no consequence. The good results obtained in carrying on a program of winter erection of a similar structure at the Susitna River, together with the success that we have already had with the Tanana Bridge, fully confirm the wisdom of the policy in thus handling this bridge project.



Details of Rollers



Half Side Elevation

Expansion Bearing, End Elevation

FIG. 9—EXPANSION BEARING AND ROCKERS

Engineering Organization—The field work has been carried on under the personal supervision of the author in the capacity of chief engineer of the Alaskan Engineering Commission, with the following organization: F. A. Hansen, engineer of maintenance and construction, in general charge; F. H. Chapin, bridge engineer; C. G. Jones, superintendent of construction; J. J. Kestly, resident engineer; Jack Hanson, inspector.

The contract for the fabrication and erection of the steel superstructure was let to the American Bridge Co., the field work being carried on by H. M. Braford, foreman of erection, and E. G. Amesbury, assistant engineer. C. S. Garner, manager of foreign erection for the American Bridge Co., has taken a keen interest in this job and it is due to the energy of his persua-

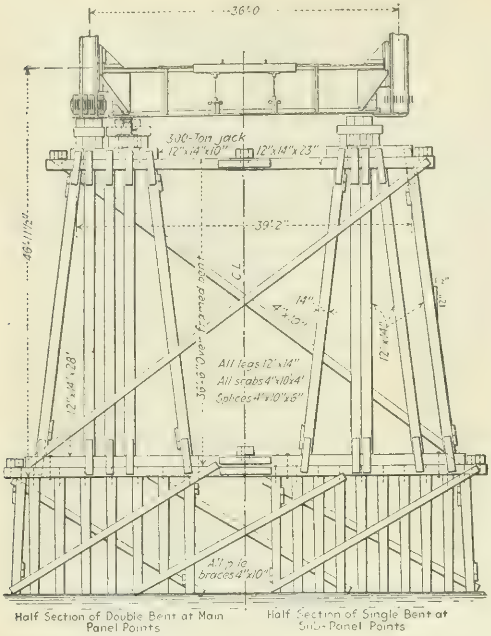


FIG. 10—FALSEWORK BENTS FOR 700-FT. TRUSS SPAN

sion that two full train-loads of steel were moved from Ambridge, Pa., to Seattle, Wash., in the record time of twelve days.

In view of the importance of this bridge in point of cost and physical conditions the U. S. Government retained the firm of Modjeski & Angier, Chicago, as consulting engineers. Mr. Angier visited Alaska in the spring of 1920 and approved the adoption of the upper crossing. This firm was then retained to design the bridge, preparing detail plans for substructure and superstructure and following up the construction of foundations and the steel fabrication. Mr. Angier again visited the job in June, 1922, when foundation work was being started.

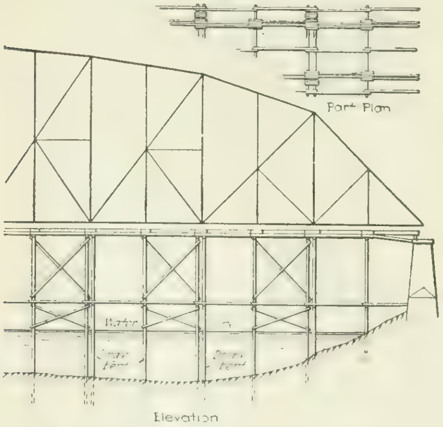


FIG. 11—ARRANGEMENT OF FALSEWORK

Differences Between Heartwood and Sapwood Timber

SAPWOOD is the outer light-colored portion of a tree trunk through which the water passes from the roots to the leaves, and in which excess food is stored temporarily. Heartwood is the central core of the trunk. As new sap is formed on the outside of the tree trunk, the inner sapwood changes to heartwood. During this change the living cells die, the pores of some woods become plugged up with a froth-like growth, known as "tyloses" and the cell walls, and in some species the cell cavities, become infiltrated with various substances, some of which darken the wood.

In over 500,000 tests which have been made by the Forest Products Laboratory, Madison, Wis., on the various species of woods grown in the United States, no effect upon the mechanical properties of the wood due to its change from sapwood into heartwood has ever been noticed. The heartwood of pine, oak and other structural timbers is not intrinsically stronger than the sapwood, as has often been supposed to be the case. Nor is the sapwood of hickory and ash intrinsically stronger than the heartwood, as is sometimes claimed in connection with handle stock.

The essential differences between heartwood and softwood are as follows:

Heartwood, as a rule, is more durable than sapwood in damp locations and less subject to attack by stain and mold-producing fungi. It usually is colored and therefore considered more ornamental than the white sapwood, except in a few cases. In yellow pine interior finish and maple flooring, for example, the white sapwood is preferred. Heartwood is less permeable to liquid and therefore more suitable for tight cooperage, tanks and conduits. It responds more slowly to changes in atmospheric humidity, which often is of advantage when uncoated wood is exposed for a relatively short time to a different humidity.

Sapwood, as a rule, takes preservative treatment better than heartwood. It seasons faster, but when green usually contains a larger percentage of moisture which often makes it heavier. Because sapwood is the outer portion of the tree it contains fewer common defects, such as knots, shakes and pitch streaks. In resinous species the sapwood usually contains less resin than the heartwood. Sapwood is more free from odor and taste, which may be an advantage in some cases, and a disadvantage in other cases.

Lincoln Highway Shows Good Progress

The eleven states traversed by the Lincoln highway built 235 miles of the route, with the aid of the Federal Government, in 1922, this work costing $4,678,041 or an average of $20,000 per mile. Maintenance during 1922 cost $1,388,126.39, so that the total amount expended on the betterment of the route last year was $6,046,168. The total mileage of each class of road completed as of Feb. 1, 1923, is:

Concrete	578.66
Brick	128.76
Bituminous macadam	327.80
Macadam	287.10
Graded gravel	1,189.22
Natural gravel	62.10
Graded earth	404.39
Natural earth	108.60
Paved city streets	218.50
Total	3,305.13

The total expenditure to date has been $47,000,000.

Reinforcing a Wooden Roof Frame Five Centuries Old

Hammer-Beam Roof Frames of Westminster Hall in London Weakened by Beetles—Steel Auxiliary Members Installed

CENTURY-LONG weakening and sagging of the wooden roof structure of Westminster Hall, in London, recently led to elaborate reinforcement of the work, just completed after being in progress for six or seven years. The hall, which adjoins the Parliament buildings, was built in the years 1394-1399, and long was the place where the kings of England were crowned. The original roof framing is still in place, although repeatedly repaired in past generations, as the attack of wood-boring beetles (the so-called death-watch beetle, *Anobium tesselatum*) endangered the structure. An account of the latest repair and reinforcement work is herewith abstracted from a recent issue of *The Engineer.*

Nearly three centuries ago the work of the boring beetle attracted attention and led to repairs being undertaken. The attack continued, however, "with the result that some of the main timbers have been hollowed out until they are mere shells within which a man might lie." At the same time shrinkage of the timber was going on, and there was some settlement and tilting of the walls due to the thrust of the roof. The aggregate result of these actions was that the ridge of the roof settled about 18 in., while the ends of the hammer beams dropped 12 to 15 in.

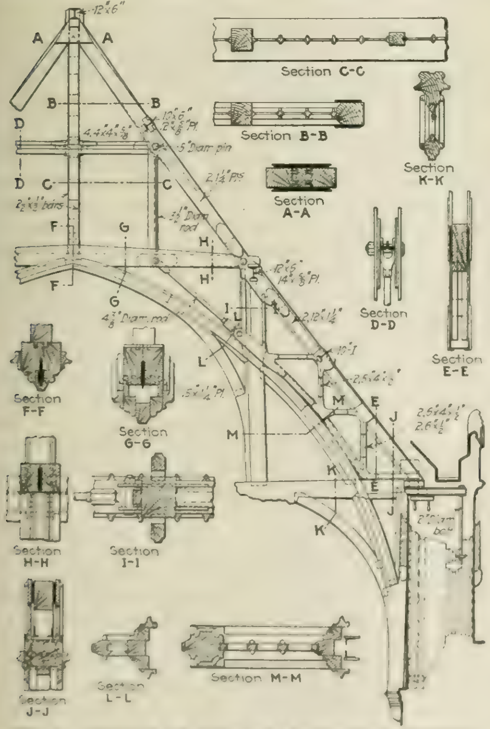
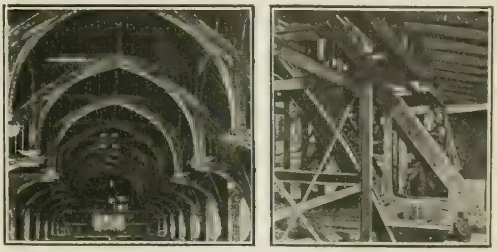


FIG. 3 DETAILS OF ROOF FRAME REINFORCEMENT

The material of the roof frame is oak ("English peduncular oak"), and was framed and erected without very long seasoning. In the present repair work the same variety of wood was used. Comparative strength tests of sound pieces of the original wood and similar modern timber indicate that there has been no loss of strength in the wood during the more than five centuries since cutting, except by decay and insect attack.

Fig. 1 gives a view of the roof as reinforced, but represents the original roof in all particulars, as the reinforcement has not changed its appearance. In the drawing, Fig. 3, the structure of the old roof may be seen, together with the present steel reinforcement. In the original structure the large arch and the auxiliary arches merely served for lateral bracing or stiffening of the roof but because of the settlement of the roof the large arch gradually came to carry most of the roof weight, receiving its load through the tracery members filling the space between the arch, the rafters and collar beam.



FIGS. 1 AND 2. WESTMINSTER HALL ROOF UNCHANGED IN APPEARANCE BY STEEL REINFORCEMENT

Fig. 1—In foreground, truss reinforcement completed; in background, traveling falsework.
Fig. 2—Reinforcement by steel check plates at rafter heel.

Earlier repair work had been done by cutting out decayed parts of the wood and inserting patches to restore the original outlines. Though in one case a large cavity resulting from the work of the borers had been filled with concrete. Additional timbers, bolts, tie-rods, straps, and shoes had been applied at various times, apparently with little regard for the structural principle of the roof.

For the present reinforcement, carried out by Sir Frank Baines, of the Office of Works, the principle of retaining the appearance of the old structure, and in fact retaining the old structure itself, was followed quite thoroughly. Study of the roof showed that it was possible to introduce a steel trussing system consisting partly of cheek pieces on the old timbers and partly of auxiliary tie-rods and truss web members, so as to carry the entire load directly to the walls and yet have the new work concealed by the old framing.

Execution of the reinforcement work was carried out with the aid of traveling falsework fitted to the roof clearance and adapted to carry a pair of trusses while they were under reconstruction.

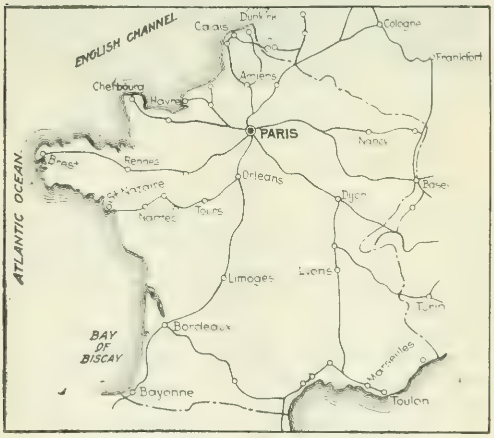
The arrangement of the steel reinforcement is clearly apparent from Fig. 3. It is to be noted that I-beam purlins have been inserted to take the weight of the roof sheathing. To provide for expansion, these purlins are supported on bronze bearing plates. The steel trusses, whose connections are bolted and not riveted, were spread by hydraulic jacks before they were swung, by such an amount as to prevent all further spreading movement under the weight of the roof loads.

Railway Conditions in France, Germany and Poland

French Looking to Electrification—Germany Must Realign System—Poland a Key State—All Have Unbalanced Budgets

This is the second of three articles on the European railway situation by the London correspondent of Engineering News-Record. *The first article, "A Survey of Railway Conditions in Continental Europe," appeared in the issue of Mar. 8.*

THE French railway systems have a lot of leeway to make up before they can give the same service as they did before the war. Prior to 1914 the five great companies of France earned enough to cover their expenses and to have something in hand for development. It is only since the state assumed control that a falling off in efficiency and earning power was registered. And this with rates of 3.4 centimes for passengers, and 4.12 centimes for freight, per kilometer.



MAIN STEMS OF FRENCH RAILWAY SYSTEM

As one might expect, the war completely disorganized the entire system. Though it was only a section of the French system which was directly involved, all the lines were engaged to a more or less extent in the transportation of war personnel and equipment. Under military control the trackage deteriorated, destroyed coaches and cars were not replaced and damage was not made good. On top of this gradual all-round deterioration came total destruction of sections of the northern and eastern systems, the 8-hr. day and increased operating expenses.

Operations of war not only led to the complete destruction of the trackage and rolling stock in the affected areas, but the German army also systematically blew up every bridge in its retreat, as well as railway repair shops, depots and other plants. At the same time the work of reconstruction was hampered enormously by the fact that the areas occupied by Germany were totally devastated, so that working forces engaged in repairing and relaying had to be provided with accommodation just as they would have to be were they engaged in a district previously uninhabited. This naturally added to the expense of rebuilding, which was calculated at the close of the war to be around 3 billions of francs. The position now is that all the destroyed lines and bridges have been rebuilt or replaced, but that the other plant, depots and repair shops are still lacking. This work of track and bridge rebuilding has cost 2,000 million francs and has provided work for 50,000 skilled and unskilled men.

Effect of Eight-Hour Day—This work of reconstructing the northern and eastern systems, as well as other railway operation, has been made more difficult by the introduction of the eight-hour day under the Versailles Treaty. This decrease in working hours has been accompanied by decreased efficiency which means that additional labor to cover both losses has had to be engaged. In fact one French railway authority estimates the increase of working force attributable to these causes to be not less than 40 per cent of the pre-war staff. This additional 40 per cent includes few experienced railwaymen or skilled workers, so that additional supervisory service has had to be engaged, and also, of course, the clerical staff has had to be reinforced in proportion. Before the war the French skilled railway worker was among the most efficient of his type. Many of these men were lost and the general level was lowered so that admission had to be made easier.

The French have always been firm believers in one locomotive, one crew. So as to maintain this principle, which they affrm is essential to economic working, more locomotives have been provided to accommodate the crews.

All the factors, then, have led to enormous increases in expenditure, some of which appears to the foreign observer justified and some not. The railways are now endeavoring to make a cut in this expenditure by so arranging the working hours that a full day's work is done. This is proving difficult in the face of trade union opposition. Even provided that an economical re-arrangement is arrived at, the resultant economy must be negligible in view of the swollen staffs and the decrease in individual efficiency.

The increased prices hit the French railways very hard because they were not able to pass any appreciable portion of the heavier burden on to the consumers as rail rates are under state regulation. Various increases in rates have been made in an effort to balance the railway budget and a 75 per cent increase in fares and 140 per cent rise in freight rates still leaves a margin on the wrong side.

Look to Electrification—There is extremely little technical improvement to record in France during the past five years, aside from experiments on various types of rail traction, such as condensing and internal combustion locomotives. French railway engineers feel their salvation lies in electrifying those parts of the French system near convenient sources of water power. The Ministry of Public Works has begun on a scheme to electrify 6,000 miles in the south of France, which it is estimated will save 3 million tons of coal a year. France's greatest source of water power is in the Pyrenees district. The Midi section is especially favored and has four generating plants available for its service. One, utilizing the Tet, produces 5,200 hp. from a reservoir at 6,500 ft. holding 460 million cu.ft. of water. Another station produces 2,600 hp., and a third 18,000 hp. These stations are to be reinforced by power from Lake Artouste, estimated at 130,000 hp., and from the upper valley of the Tet, estimated at 170,000 hp. The Pyrenees afford plenty of water throughout the winter and their topography facilitates the cheap construction of reservoirs.

In spite of the fact that reconstruction of the destroyed systems has been carried out so expeditiously, the most optimistic of the French railway executives admit it will be years before the railways regain their pre-war standard. The chief factor in the situation is, of course, the politician and, provided Germany remains solvent and meets part, at any rate, of her obligation, there is every hope that one day French railway expenditure will be more than balanced by receipts, and rail transport in France will again be as efficient as it was prior to 1914.

The German Railways—The same factors, originated by the war, have contributed to the present inefficiency of the German railway system as in France, except perhaps, in a more pronounced degree. The chief of these were the employment of the railways for military purposes and the gradual accumulation of repairs and renewals. Germany's wartime railway services differed from those of the other European belligerents in this respect: whereas the Allied nations were mostly concentrating their efforts on one front, the German railways were obliged to serve a number of fronts.

Consequently German locomotives and rolling stock were to be found transporting troops and material to Belgium, France, the Russian front, through Austria to the Balkans and even down to Bagdad. Her allies were not so well equipped with railway material so that Germany had practically to operate the whole of the railway systems of herself and her allies. This fact naturally lowered the efficiency of the German system itself and her losses in rolling stock outside her own borders were enormous. There is evidence, however, that Germany was prepared for such a position and her military railways were not weakened in consequence to the extent they would have been had the war come as a surprise.

Effect of Allied Blockade—Added to this abnormal railway burden were the effects of the Allied blockade which effectively cut off from Germany her normal supplies of railway material which she received from abroad, namely, bearing metal, copper and rolling stock lubricating oils. By this she was forced to employ more or less satisfactory substitutes such as iron fire boxes, which gave railwaymen great trouble in maintaining locomotive efficiency.

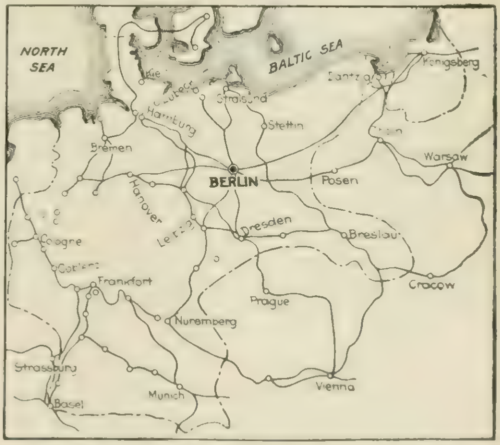
Thus, for four years the German railway system gradually deteriorated, culminating in the demands from the Allies for the surrender of rolling stock. The German railways are very bitter over this and complain that they had to surrender within a very short period 5,000 locomotives and 150,000 cars, all in first-class condition. The Germans maintain that they were forced by the treaty conditions to give up rolling stock for which the Allies had no use, and that cars in really excellent condition and built specially for surrender, were rejected on account of very minor faults.

The Allied commissions, on account of various German subterfuges to evade their obligations, found they had to be extremely careful in what they did accept, and that, in consequence none but the best rolling stock was allowed to cross the frontier. The German railway system was also upset by the surrender of territory which cut off portions of her trackage. In this way depots and junctions have had to be reorganized.

The Personnel Problem—The personnel of the German railways was considerably depleted to fill the army, and the places of skilled men were taken by women and individuals of inferior intelligence and physique. After the war, a number of demobilized soldiers, many incapacitated, were absorbed by the railways. Now the systems are overstaffed but the general efficiency is low, not only due to lack of experience but also to the unsettled conditions produced in the labor ranks by the republican revolution and other minor *coups d'etat*.

In Germany as well as in France the 8-hour day has been responsible for greatly increased expenditure and reduced efficiency. In fact, one German railway executive estimates the staff to be increased by 40 per cent on a reduced system, and the falling off in individual efficiency to be equally high. Although the number of locomotives employed on the German railways has risen by about ten per cent, nearly half of these are under repair at any one time. In fact, of the 33,000 locomotives on the schedule, about 15,000 are undergoing repairs. In addition, the consumption of coal per locomotive has increased nearly 50 per cent.

These factors have contributed to enormously swollen costs of railway operations, which the systems have attempted to recover by increased rates. By far the larger proportion of these rates has fallen on freight traffic, and this is reflected in the fact that the transportation of freight is now only about half the pre-war figure. Passenger fares have taken a share, but a very small share, as German experience has shown that even a small rise in passenger fares brings about a substantial drop in travelers.



PRINCIPAL LINES OF GERMAN RAILWAY SYSTEMS

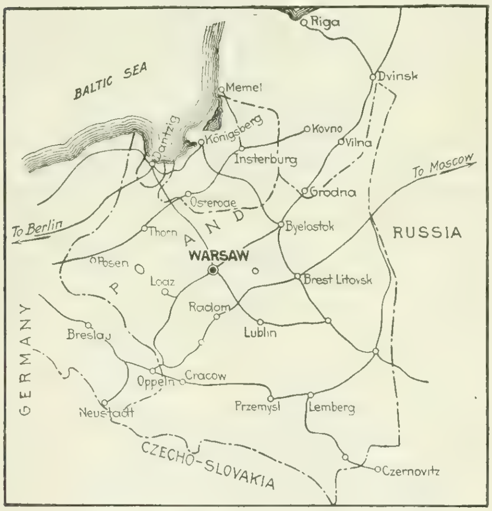
In spite of larger tariffs, amounting in all to an increase of about 1,000 per cent, the deficit on the railways is still very high, and a charge of 450 marks per ton of freight carried, against 4 marks in 1913, leaves a deficiency of 7 billions of marks.

Realignment of System—In addition to the reorganization problems ordinarily produced by a war, the German systems have to adapt themselves to a redirection and redistribution of traffic. The mineral traffic especially has been so affected, chiefly, of course, on account of the ceding of the Saar district to France.

In short the German system may be likened to a body from which the limbs have been amputated. Before the war these limbs carried on enormous international traffic right across Europe to the Balkans. As a result of amputation the arteries and veins must be reconstructed and the system so arranged that the flow of traffic is confined within the outline of the trunk. In consequence not only have interconnecting lines to be rebuilt but other facilities must be afforded for dealing with traffic which formerly passed straight into foreign territory.

This, combined with the arrears of rolling stock repairs and the serious financial situation, is one of the biggest problems yet to be handled by the German railway administration.

The Polish System—The significance of the Polish railway system in Europe lies in the fact that it constitutes a "corridor" between the east and the west. Passengers or freight from Britain, France or Germany to Russia pass over the Polish railway systems. Similarly traffic between southeastern Europe or the Balkans and the Baltic ports is carried through Polish territory. Nearly all these railway lines pass through or near Warsaw. For instance the main line between Breslau-Oppeln-Warsaw-Grodna before the war carried a great international traffic. The other routes of great international significance, all of them from west to east Europe and Asia, are the Breslau-Oppeln-Cracow-Lemberg, Posen - Thorn - Osterode - Insterburg - Kovno, Neustadt-Radom-Brest-Litovsk routes.



IMPORTANT RAILWAYS OF POLAND

The fact that these routes are of such international significance has led to their early reorganization, and express trains are running daily between east Germany and the port of Konigsberg on the Gulf of Dantzig. In spite of the fact that immense material damage was done during the war to the Polish lines, the service generally is tolerable and much better organized than in many other European states. Poland was hindered considerably in her work of reorganization by the turbulence of her Russian neighbor, and also by the fact that the lines near her eastern boundary were laid by Russian engineers with purely a military and not a commercial objective. Most of these lines were only suitable for bringing troops and material to the Russian frontier during a war and were useless, or very nearly so, to Polish industrial development. Again, when the Germans drove the Russians back during the war, the Russian army, to hinder Germany, destroyed every railway bridge in Poland as well as all depots and repair shops, and seized all locomotives and rolling stock.

Work To Be Done—This work of rebuilding is just about half completed, and about three thousand bridges of varying sizes remain to be reconstructed on a permanent basis. In addition 60 per cent of the depots must be entirely rebuilt and many redesigned to accommodate the altered traffic conditions. As might be expected Poland is still very badly off for rolling stock and possesses only about one-quarter of her actual requirements. Possessing around 15,000 miles of railways she has under 5,000 locomotives, and 10,000 passenger coaches and about 120,000 freight cars.

Much of the present trackage is single only, and to provide for the industrial development which is so confidently expected of Poland, much of the existing way must necessarily be doubled. At present the system is only sufficient to carry her own industrial produce, and is not adequate to cope with the potential passenger traffic. In addition, though parts of the railway system are well laid and will carry heavy traffic, much of it needs reinforcing and often entirely re-laying before heavy trains or normal passenger speeds can be carried.

Poland is particularly short of passenger locomotives, and she has only enough to maintain a fraction of the potential passenger traffic. Many of these locomotives are very old and have not been constructed for prolonged service, with the result that nearly half of them are perpetually undergoing repairs.

One of Poland's greatest difficulties is lack of finance to reconstitute the system and purchase fresh rolling stock. Until very recently Poland has maintained a large army in consequence of her situation between two countries in varying states of exhaustion and this has swallowed large sums of money. Even now her railways occupy either first or second place on the national budget with an enormous deficit. The Polish railways have tried in vain to make good part of this deficit by increased fares and freight rates without raising these to a level where all traffic will be scared off.

On the other hand she has a rapidly increasing traffic and, provided sufficient rolling stock becomes available to carry this traffic, the increased fares and rates may help considerably towards wiping off what is a heavy burden to the Polish state railways.

A Switchback Railway in the Khyber Pass

A 26-mile military railway extending into Afghanistan and having three switchbacks or reversing stations is being built for the Government of India by the Northwestern Railway. This line will form an extension from the present frontier terminal at Jamrud to Landi Khana, in the Khyber Pass. Labor is furnished by the several tribes whose territories are crossed, as it is stated that if the railway should attempt to carry on construction with its own forces the tribes would combine to attack the men and destroy the works, but by negotiations with the several leaders they undertake to supply the labor in their respective districts. Even so, military guards are provided as a precaution against raids by other tribes. W. W. Moylan is engineer in charge of the extension.

Fixation of Atmospheric Nitrogen by Activated Sludge

Nitrogen in the Sewage Has Been Increased by 65 Per Cent—Conditions Favorable to B. Crenothrix with Upwards of 2 P.P.M. of Ferric Oxide Seem Necessary

By C. Lee Peck
Consulting Engineer, New York City

THIS paper is based on data obtained by the writer from plants operated and experiments conducted under his observation and direction at Mt. Vernon, New York City, Urbana, Chicago, Decatur and Indianapolis. Important and essential data have been contributed by engineers associated with him and by others interested in the operations referred to.

Research Work at Mt. Vernon, N. Y.—The discovery that atmospheric nitrogen could be fixed by the activated-sludge process was made at the city of Mt. Vernon in the summer and autumn of 1919, where the Dorr Company erected a 50,000-gal. per day plant. Its purpose was research. There was no expectation of direct financial return. The plant was designed by the writer and operated under his direction.

1. Under certain conditions it is possible to fix atmospheric nitrogen by aeration in the presence of activated sludge.

2. The amount of atmospheric nitrogen so fixed has in some cases been equal to 65 per cent of the amount of nitrogen in the sewage.

3. The condition essential to fixation of atmospheric nitrogen seems to be an environment favorable to the growth of B. Crenothrix.

4. Where fixation was successful it was possible to recover 848 lb. per day of dry humus per 10,000 people contributing to the sewage. The humus had an average ammonia content of 7.92 per cent.

5. The presence in the sewage of 2 p.p.m. of ferric oxide seems to be essential.

6. A detention period in aeration in excess of six hours is probably necessary.

7. The quantity of air used is not a controlling factor so long as a healthy aerobic sludge is maintained.

The unusual results obtained were due in part to local conditions. Mt. Vernon collects its sewage in two trunk sewers. The sewage, with one notable exception, is of domestic origin. The high-level sewer carries little ground water. The low-level sewage is diluted probably 50 per cent. The low-level also receives waters containing rouge from a lens polishing establishment. The sewers discharge into a common grit chamber. The volume discharge from the high level was about twice that from the low level. The combined sewages contained from 1 to 3 p.p.m. of Fe_2O_3. The character of the composite sewage is shown in Table I.

The sewage was prepared for aeration by passing grit chambers and a Dorrco screen with 0.017 in. square openings. There were two aerating tanks in series, with sedimentation between. No sludge was drawn from intermediate sedimentation. The excess overflowed with the partially aerated sewage to the second aeration unit. The settled sludge was automatically returned to the aeration chambers. These chambers were of approximately equal capacity. The first received 75 per cent and the second 25 per cent of the 0.66 cu.ft. per gallon of air used. Sand hutches in both aeration chambers collected the separated inorganic material.

The plant was designed for air economy and to eliminate nitrogen-poor solids from sewage and sludge. The screenings average 1 per cent NH_3; the solids passing the screen, 4 per cent and up. Scum was removed from the primary aerator. It contained little nitrogen. These steps in elimination, together with the means used to promote the growth of biological jelly, produced a sludge with an NH_3 content averaging over 8 per cent.

Sludge research started Nov. 21, 1919. The first step was to determine tentatively upon a method for dewatering and drying. After we had fixed upon this, all sludge samples were treated by this method and weights and determinations made on the *dried samples*. Our reported results are therefore comparable to actual practice All losses occurring in treatment are taken into account. All sludge weights and analyses except as otherwise specified, are for dried sludge.

Acidulation of Sludge—The method of treatment determined upon was: Acidulation of the freshly settled sludge, using ½ c.c. of sulphuric acid per liter of 99.5 per cent moisture sludge; draining through cheese cloth immediately and drying the drained sample at 100 deg. C. The NH_3 was determined by Gunning's modification of the Kjeldahl method.

Our first sludge analysis indicated 9.52 per cent NH_3, dry basis, on dried raw sludge and 10.22 per cent NH_3 on a sample of the same sludge prepared for drying as stated above. This concentration of NH_3 was due to solution of alkaline sludge constituents. It was attended with but slight loss of NH_3. The constituents of the dried sludge are shown in the analysis of Mt. Vernon sludge (Table II).

Fixation of Atmospheric Nitrogen—In addition to recovery of the highest possible grade of ammoniate, it had been a part of the writer's program to determine whether atmospheric nitrogen actually was or could be fixed by the activated-sludge process. Reports of the success of work of Dr. Lipman of Rutgers in fixing atmospheric nitrogen with soil bacteria led the writer to consult him. Acting on his advice, some cultures of azotobacter chroöcoccum were secured. We had attempted to grow these in various dilutions of sewage but had met with no success. Some of the investigators of soil fixation of nitrogen had remarked on the apparent necessity for the presence of ferric oxide. Our sludge analyses had disclosed the unusual quantity of ferric oxide present. We began to study the biology of the sewages and the sludge and to look for abnormal conditions. It had long been noted that the low-level sewage contained a flourishing flora. Quantities of biological jelly were discharged. Our biologist, S. L. Neave, identified crenothrix polyspora as the predominant organism in this jelly.

We felt justified in adopting the hypothesis that fixation of atmospheric nitrogen was occurring; and that this was made possible by the presence of ferric hydrate. We proceeded to test this hypothesis as follows: *Equipment:* Two eight-liter bottles fitted with glass tubing and compressed air for aeration. *Reagents:* In Bottle I, 6,150 c.c. of screened upper-level (iron free) sewage and 2,050 c.c. of No. 2 tank sludge. After mixing, 200 c.c. removed for analysis. In Bottle II the same reagents as in No. I. In addition, a number of strips of stove-pipe iron were suspended in the bottle. *Procedure:* Bottles were aerated, decanted and filled daily with upper-level sewage for ten days. Samples of decanted liquors, feed, original charge and final contents were preserved with chloroform and analyzed. *Results:* Bottle No. I showed a loss of ammonia of 17 per cent. Bottle No. II showed a gain of 62.5 per cent.

TABLE I—AVERAGE ANALYSES OF COMPOSITE SAMPLES OF MT. VERNON SEWAGE FOR MONTH OF NOVEMBER, 1919

	P.P.M.
Total solids	596
Suspended solids	245
Dissolved solids	351
Alkalinity	265
Oxygen consumed	154
Iron as Fe_2O_3	2.67

Confirmation Tests by Dr. D. D. Jackson—The Dorr Company recognized the importance of these discoveries. Also the necessity for their confirmation by independent research. Dr. D. D. Jackson of Columbia University was retained. His investigation covered a period of three months. Its results are summarized in the following excerpt from his report:

> The object of this investigation was to study and verify the results obtained by the Dorr experimental plant at Mt. Vernon, N. Y., and to determine whether these results could be obtained, using New York City sewage. The conclusions are as follows:
>
> 1. The Dorr method of sewage treatment requires much less air to activate the sewage and is therefore more economically operated.
>
> 2. A sludge of decidedly greater nitrogen content is produced by this method than by any other form of treatment. This is of great importance as its sale as a fertilizer should more than pay the cost of operation. [Ammoniates were then quoted at $8 per unit, making the recoverable sludge worth $56 per million gallons of sewage treated. C. L. P.]
>
> 3. The time of contact of the air with the liquid and the complete suspension of the sludge not only serve to fix much of the nitrogen in solution, but *the results show that nitrogen is actually fixed from the air blown in.*
>
> 4. In this process, the nitrogen is largely fixed by crenothrix growths which normally contain from 8 to 9 per cent nitrogen as ammonia.
>
> 5. This growth requires the presence of iron in the liquid, so that if the original sewage does not contain a sufficient amount to support the organism, some iron must be added.

TABLE II—ANALYSIS OF MT. VERNON SLUDGE.* DRIED TO 9.24 PER CENT MOISTURE

	Per Cent
Moisture	29.25
Non volatile	27.34
Insoluble	13.50
Soluble	13.84
Volatile	63.35
Ammonia (NH_3)	8.79
Phosphoric acid, (citric sol.)	1.67
Ferric oxide	9.95
Calcium oxide	5.92
Magnesium oxide	0.13

* Not acid treated.

Concurrent with Dr. Jackson's investigation nitrogen fixation was being demonstrated at the full capacity of the Mt. Vernon plant. Two tests were made. In the first (see Table III) 316,150 and in the second 413,110 gal. of sewage were treated. Table III gives the result of the first test. The second test may be summarized thus: There was a loss of 6.1 per cent of total ammonia in the primary aerator and a gain of 6.7 per cent in the second aerator. The total gain in solid nitrogen was 53 per cent. The total solids in the accumulated sludge were 759 lb. Losses incurred in treating the sludge brought this down to 692 lb., having an ammonia content of 7.92 per cent. Reduced to a basis of population contributing to the sewage, this amounts to a daily production of 848 lb. fertilizer, 7.92 per cent NH_3, for each 10,000 population.

These tests were conducted from Dec. 27 to Jan. 24, during zero weather. The sludge was lower in nitrogen than for any other period of plant operation. The bottle tests were conducted at summer temperatures. From all the facts it seems justifiable to assume that, under the conditions obtaining at Mt. Vernon, nitrogen fixation will take place the year 'round and that the quantity of sludge stated as recoverable is a minimum.

TABLE III—RESULTS OF MT. VERNON PLANT TEST NO. 2 SHOWING FIXATION OF ATMOSPHERIC NITROGEN AND PRECIPITATION OF DISSOLVED NITROGEN

	Lb. NH_3
Tank No. 1 received	125.17
Tank No. 1 discharged	112.52*
Loss by combustion	12.65
Tank No. 2 received	120.97*
Tank No. 2 discharged	138.82
Fixation of atmospheric nitrogen	17.85
Precipitation of dissolved nitrogen:	
Tank No. 1 received solid nitrogen	22.14
Tank No. 1 discharged solid nitrogen	27.57*
Gain in solid nitrogen	5.43
Tank No. 2 received solid nitrogen	35.77*
Tank No. 2 discharged solid nitrogen	45.45
Gain in solid nitrogen	9.68
Net gain in solid nitrogen	15.11
Per cent gain	68.2

* This apparent discrepancy is due to taking into account the amount of nitrogen in the tanks at the start and finish of the test.

Further Tests—Bottle tests have been made on sewages at Decatur, Argo, Urbana, Indianapolis. At none of these stations have we been able to induce a growth of crenothrix. Fixation of atmospheric nitrogen has occurred at none of them. Precipitation of nitrogen from the liquor has, with the exception of Indianapolis, been marked. At Decatur, treating a sewage containing gas house and starch factory wastes, sewage undosed with iron yielded 0.525 tons of 6.35 per cent NH_3 sludge solids. Dosing with 4 p.p.m. Fe_2O_3 yielded 1.245 tons of the same NH_3 content per million gallons of sewage treated.

Bottle tests were charged with fresh sewage once each day. They have in most instances been aerated in excess of commercial operation. In plant operation, precipitation of dissolved nitrogen frequently occurred in the primary aerator; fixation of atmospheric nitrogen did not. The effluent from the primary unit always showed combustion of nitrogen and generally of solids. Precipitation of dissolved nitrogen does not depend upon the presence of crenothrix. Fixation of atmospheric nitrogen has never occurred except in the presence of flourishing new growths of crenothrix.

Excerpts from the report of the biologist, S. L. Neave, under the heading "Observations and Deductions on Biological Activity," follow:

Reduction of soluble nitrogen follows crenothrix count.

Reduction of soluble nitrogen inversely proportional to loss of total nitrogen.

Loss is proportional to amount of nitrate and nitrite present.

Nitrate follows nitrite.

Decrease in alkalinity, increase in crenothrix and decrease in soluble nitrogen.

Increase in proportion of crenothrix showing ragged outlines concurrent with increase in loss of nitrogen.

To which the following observations may be added: Satisfactory effluents were consistently obtained without producing nitrates or nitrites.

The crenothrix count in the primary aerator was to the crenothrix count in the secondary aerator as 4:6. The amount of air admitted to the secondary aerator approximated 0.05 cu.ft. per gal. of sewage treated per hour.

The methods described removed the nitrogen from the sewage. From a sanitary standpoint this is preferable to changing the nitrogen to so called stable forms. These, inoffensive in themselves, are food for organisms which may produce nuisance. Fixation of nitrogen, liquid or gaseous, in a solid form and its recovery for use as a fertilizer is of great economic importance. The writer is convinced that means for effecting these ends are now available and at less cost than the methods now employed in the activated sludge process.

[*In a subsequent issue there will appear an article by Mr. Peck on "Economics of the Activated-Sludge Process."*—EDITOR.]

Winter Road Grading and Graveling in Minnesota

Heavy Grading, Gravel Surfacing and Stockpiling Suitable Operations for Cold Weather —Examples Presented

BY J. H. MULLEN
State Highway Engineer of Minnesota, St. Paul, Minn.

Extract from a paper read before the American Road Builders' Association, Chicago, Jan. 18, 1923.

BECAUSE of the nature of road work the problem of winter operations seems rather difficult, but the experience in Minnesota is that it can be greatly simplified by planning well in advance. This is true particularly of grading; every year there are a number of projects on which there is rock excavation or heavy earth work, with deep cuts and large enough quantities to warrant the use of steam shovel equipment, which can operate on that work as well in the winter as in the summer.

An example is a last winter's job 5.1 miles long, involving 172,600 cu.yd. of excavation—of which 110,167 yd. was rock—which was done at a price of 19c. for earth, 65c. for loose rock, and $1.30 for solid rock. Winter work cannot be credited entirely with these low figures, for the work was very heavy, averaging nearly 34,000 cu.yd. per mile, and the rock was a soft limestone, but attention is called to this job as being especially suitable for winter work.

Another project is 40 miles of grading on new location now being performed on which the estimated quantities are 418,000 cu.yd. of earth and 130,000 cu.yd. of solid rock, which was let at a price of 45c. for earth and from 95c. to $1.60 per yard for rock. This is in a timbered country, rather inaccessible, and the prices are low when it is considered that there is no loose rock classification and the solid rock is a tough granite or trap. The variation in rock prices on this job is due to the fact that some of the rock excavation is along the bluffs on the shore of Lake Superior, which allows for side casting without any haul and is being done at a price of 95c. per yard while the rock work involving haul costs $1.60. Letting this work in the Fall also allowed for all of the clearing on the line, about 316 acres, to be done in the early winter.

On the whole it is believed that such conditions as existed on the two projects mentioned and which prevail in a measure on a good percentage of our work, can be handled in the winter, or as combined winter and summer projects, to the advantage of all concerned.

In the northern states most roads are being improved by gravel surfacing. Taking again, as an example, the state of Minnesota, in the past two years there were 1,675 miles of this kind of work done by the state alone, with an average of 1,500 cu.yd. of gravel per mile, or a total of about 2,512,500 cu.yd., of gravel hauled. In addition to this there was 1,750,000 cu.yd. hauled by the counties on secondary roads. A portion of this had to be done in the summer on account of wet pits and the necessity for shipping in cars, but it has been found that a great deal of this material could be hauled most economically in the winter especially when long hauls were involved. This is due in part to the lower labor rates, but is principally due to the fact that when the roads are frozen smooth, and the highway department makes it their business to see that they go into the winter in that condition, the trucks or wagons, as the case may be, have the benefit of a surface to haul over which is as good as a concrete road, and which permits of a maximum loading and consequently a lower unit hauling cost.

As an example, last winter one contractor with a fleet of 26 trucks hauled 28,000 cu.yd. of gravel an average of nine miles in 25 days. The contract price for this work was 20c. per cubic yard mile, and the average truck load was 7 cu.yd. This would have been impossible in the summer, not only because the contractor could not have hauled so cheaply over earth and gravel roads in the summer, but because the highway department would not have allowed such equipment to be used on account of the damage or destruction of roads being hauled over. Summer gravel hauling is restricted for this very reason to pneumatic tired trucks which of course limits the loads to about three yards. In the past winter, Minnesota contracted 1,350,000 cubic yard miles of gravel hauling by truck at an average cost of 22c. per yard mile. This compares favorably with the average cost of 27c. per yard mile for summer haul.

Winter graveling is not by any means confined to truck hauling. Perhaps the greatest benefit of this work to unemployed has been where the material has been hauled by teams. A striking example of this is the experience last winter in a section of the state where farming and financial conditions had made it very difficult for some of the people to get through the winter. It so happened in that territory that a large mileage of grade was ready for surfacing and dry pits were available. Accordingly all the men and teams that could be used to advantage were put to work as an emergency measure and in all about 500,000 cu.yd. miles of gravel was hauled at an average cost of 20c. per yard mile. This cost is low for team haul but the team owners were anxious to have the work and were willing to work long hours to obtain the money so made available, in fact while the engineers were able to place 340 teams on this work there was probably about one-third as many more who would like to have had the same opportunity. It is needless to say that this operation was of financial advantage to the State as well as a means of taking care of a serious unemployment situation.

Gravel hauled in the winter is generally deposited in continuous "windrows" on the grade, and is bladed to the proper section and compacted under traffic the following spring. While there is sometimes considerable loss of winter gravel due to muddy sub-grade conditions in the spring this is more than overcome by the lower cost of the winter work and by the advantage of having the surfacing deposited and in good condition before the road would otherwise be ready to carry any traffic. Even without these advantages, it is good business to haul this heavy tonnage in the winter in order to avoid the damage to earth and gravel roads over which the material must be hauled, and which are badly cut up by such hauling in warm weather

Thirty Years of Bridge Engineering on the Pennsylvania Lines

—An appreciation of J. C. Bland, retiring bridge engineer of Pennsylvania Lines West

THE retirement of J. C. Bland from the position of bridge engineer of the Pennsylvania Lines West on Feb. 1, after nearly thirty years of service in that position, recalls the remarkable development of bridge engineering during the past three decades and emphasizes the part played in that development by his work on the Pennsylvania Lines. Within that period the undeveloped and imperfect practice of the eighties and early nineties, when railway bridge construction was a sharply competitive industry with little of that close control now exercised by the railways through their own bridge engineers, grew to a high degree of technical perfection and thoroughness. The preparatory work of such men as Morison and Schneider had already done much toward initiating this change; and the influence of the high standards and marked independence of thought of a few railway bridge engineers, notably that of Mr. Bland, carried this work forward.

Some of the changes in the development referred to may be suggested by a brief mention of a few of the larger works of the Pennsylvania Lines during Mr. Bland's tenure.

In 1894, when M. J. Becker was chief engineer and Thomas H. Johnson was principal assistant engineer of the Panhandle, the Southwest line of the Pennsylvania system, it became necessary to undertake the rebuilding of the Ohio River bridge at Cincinnati. With its 525-ft. main span, one of the largest simple truss spans in existence at the time, the bridge presented a problem that would be considered important even today, and in the early nineties it was a most formidable task. Mr. Bland was engaged for the work. He had begun his professional career on the Pennsylvania R.R. long before, being assistant engineer on construction work from 1871 to 1874, then had spent a number of years as engineer for the bridge-building firm of Cofrode & Saylor, of Philadelphia, and later had been in practice in Colorado for eight or ten years. Incidentally he had written one of the earliest handbooks for structural engineers, a book prepared for the Pottsville Iron & Steel Co., of Pottsville, Pa., in 1887. He carried through the Ohio River bridge undertaking with entire success, in spite of the special complication introduced by the necessity of keeping open a 200-ft. width of channel through the falsework of the main span. The fact that the new bridge was of pin-connected design is specially interesting because Mr. Bland in later years was the principal exponent of riveted bridge construction, which culminated in his design of the 640-ft. riveted channel span of the Louisville bridge twenty years later.

During or just after the Cincinnati rebuilding Mr. Bland was appointed principal assistant engineer of the Pittsburgh, Cincinnati, Chicago & St. Louis Ry. (the Panhandle), in charge of bridge work. Five years later he advanced to engineer of bridges for the Pennsylvania Lines West of Pittsburgh, including the Panhandle and the Fort Wayne roads. This position he has held continuously until his present retirement.

An even more complicated bridge problem which arose soon afterward resulted in a structure which still, after twenty years, ranks among the country's notable bridges. In 1902 the Fort Wayne bridge over the Allegheny River in Pittsburgh had to be rebuilt, in connection with the construction of the new terminal station a few hundred feet away on the site of the old station but at a higher level. The old structure, consisting of six short spans of multiple-intersection type, was replaced by a very much heavier bridge of long spans, on substantially the same alignment but at a higher level, without interruption of traffic. In order to maintain a freight-yard connection at the old track level, moreover, the new bridge was designed as a double-deck structure, and space was provided for three tracks on each deck, making it by far the heaviest structure of its size ever built; probably the bridge has never been exceeded in this respect by any subsequent structure. The replacement was carried out by rolling the old bridge to temporary supports alongside, at the same time skewing it so as to bring it parallel to the new center line—a most difficult operation—and then erecting the new bridge.

Almost simultaneous with the Fort Wayne bridge work a similar undertaking of only slightly smaller magnitude was carried out, namely renewal of the nearby Panhandle crossing over the Monongahela, a double-track structure replacing an old single-track bridge on the same site.

During this time Mr. Bland was carrying on an extended series of tests of full-sized bridge compression members, begun some years earlier. The results, reported by his assistant, C. P. Buchanan, in *Engineering News* of Dec. 26, 1907, commanded universal attention, and together with the discussion of the Quebec bridge failure of the same year supplied the stimulus to the renewed study of column strength during the next decade.

Two interesting bridge problems arose a short time afterward. One was the combined replacement and reinforcement of the Ohio River bridge of the Panhandle at Steubenville, a structure over twenty years old. The other, a most formidable undertaking, was the reconstruction of the Ohio Connecting Ry. bridge over the Ohio River, just below Pittsburgh. This structure included a 525-ft. and a 400-ft. channel span and a long series of shorter deck truss spans, and was further complicated by a curved approach over the yards of the Fort Wayne line on the north bank. It carried a phenomenally heavy traffic, trains following each other in a continuous series throughout the day, and the service required that traffic should not be interrupted or materially reduced. The reconstruction involved bold and novel procedure throughout, such as the erection of the large channel span around the old span by cantilevering out from either pier, using the halves of the back-channel span as anchor arms, and the replacement of the minor spans by successive erection alongside and rolling in. The successful completion of this work without incident and without traffic interruption represented a notable achievement.

With the Steubenville bridge rebuilding, Mr. Bland began the extension of riveted construction to long spans, which he thereafter steadily extended. The new deck spans of the Steubenville bridge, 213 ft. long, were the first of any size on the Pennsylvania. The very long channel spans of the Ohio Connecting Ry. bridge, with riveted bottom chord, represented further advance in the development of the type. While somewhat later, the bridges over the Muskingum River near Coshocton, Ohio, and over the Miami River at Dayton, built in 1914 and 1915 to replace structures destroyed in the great 1913 flood, may be taken as good examples of his practice in spans beyond the commonly accepted limit for riveted work.

In 1916 the renewal of the Louisville bridge over the Ohio led to still further extension of riveted construction. The old bridge, built by Albert Fink in 1868-1870, was a most remarkable structure, having deck spans of Fink type and two long channel spans of through Whipple type, as described in *Engineering News* of Feb. 8, 1917 (p. 217). The War Department unexpectedly increased its requirements for channel width to such an extent that one of the channels had to be crossed by a span of 640 ft. Riveted construction had been used for the new deck spans, and Mr. Bland applied it also to the channel spans; the 640-ft. span still is by far the longest of the type.

Most recent of the great bridge undertakings in the series was the raising of the Allegheny River bridge at Pittsburgh to a level 13 ft. higher, a most difficult and responsible piece of work. The bridge was the heavy six-track bridge (only four tracks were ever laid) built in 1902, and its great weight, together with the restricted working space available on the piers, formed an essential part of the difficulty of the work. The other factor was that, as usually only 5-min. working intervals between trains were available for the lifting operations, it was necessary to carry on the whole process as a continuous series of small steps (3-in. lifts), with the gradual insertion between pier and bridge seat of superimposed steel grillages, until the bridge was at its new level.

Going back to a somewhat earlier period, peculiar interest attaches to Mr. Bland's connection with the Eads bridge, which he examined and repaired for the Terminal Railroad Association of St. Louis. Having been built long before the modern great increase of railroad traffic weights had fairly begun, this remarkable arch bridge, with its tubular steel rib chords and eyebar web members, required the most painstaking study of its action and condition in detail, and the development of methods for strengthening it as well as making good the deterioration caused at various points by long service. He carried out this detail study with characteristic ability and conscientiousness. At various times the floor was rebuilt, worn pins at the web eyebar connections were bushed, the structure stiffened by revision of the spandrel members, and assurance obtained that the condition of the arch ribs inside and outside as well as the behavior of the structure in all its parts make it amply able for its present-day service.

This brief mention of a few large enterprises brings out only scattered incidents of a long record of activity comprising a great variety of bridge construction and maintenance work smaller in size but often no less important and difficult. All of the work is equally distinguished by individuality and independence of thought and by a quite remarkable thoroughness, plainly directed toward sound engineering results rather than adherence to fixed practices. It is by virtue of these qualities that Mr. Bland's work has exerted a strong influence on the development of the art during the last three decades. Taking up each new problem as one to be dealt with according to its particular conditions, he has always adapted his methods of design to the needs of the case, and at the same time has assured their effective application by personally working out the designs and analyzing their stresses. The ample proportioning and detailing of his bridges are no less characteristic than his steadily maintained dissent from the general preference for wheel-load analysis and from conventional views of proportioning for impact. The performance of his bridges in service has well justified his methods.

Must the Engineering College Teach Its Students How to Spell?

By an Engineering Instructor in a State College

WHILE engineering students, especially freshmen, are by instinct poor spellers, this past semester seems to have produced an extra crop of them. The following article is a compilation by one instructor, of misspelled words taken from written work handed in at the end of last semester by students in engineering.

Graduates, all of them, of accredited high schools. We begin to wonder at the definition, at least the standard, of an accredited high school. We have heard our parents talk of the three "R's" as necessary requisites for an education. The present day requirements for graduation seem to be changed to the three "M's": Manual Training, Movies, More Uselessness.

Our Survaying Probleme

It was an averge fogey Sep. day. The party assembled at the enterence of the Add. Bldg. with the necessary equiptment. A travers was run to the Maden Lain arch. Taking off from the Goverment bench mark, a bronse plait refurred to meen sea level, differencial levels were run over the coarse checking on the last hydrogent. Angles were measured by trianglation with a numbre of repertisions. Barings were observed on each sid with with the cumpus on the transut insterement to the nearest fifteen minuets, dubble centring so as to eliminate all possible eror. Distances were obtained by paseing. The equsion for the length of pase had been found in a previus probleme. It became windey and rainey which increased the work of centreing the plum-bob. The hight of each point was carculated from the differencial levels. The latituds and departurs of the survay were computated and the aria thus obtained. Deminsions from the travers to the buildings were not taken, as a topograffic survay was not requested.

The indevidal knowlede of each student and opinoins aquired by waching the values of the varius survays fluxicate, should be put in righting by him. Future refrence to them will be necessary. In his work after graduation he many times become habil for engery to municipal property. By his inergy and care shall he win.

This is our problem—but how can it be solved? Slide rule, mechanics and the calculus, the engineer's tools—all are useless.

Price Paid for Standing Timber in the West

The Standard Lumber Co. of Sonora, Calif., recently purchased from the government 13,300,000 ft. of standing timber within the Stanislaus National Forest in California. The price paid per thousand feet was $4 for sugar pine, $3 for yellow pine, and $1.25 for white fir and incense cedar.

Arc Welding for Steel Structures

Based on a paper read before the Schenectady chapters of the American Welding Society and the American Society of Mechanical Engineers.

By Frank P. McKibben
Professor of Civil Engineering, Union College, Schenectady

WITHIN the past six or seven years some steel structures have been built with neither pins nor rivets, the members being joined together by electric welding. This development in the art of steel construction is now making rapid progress.

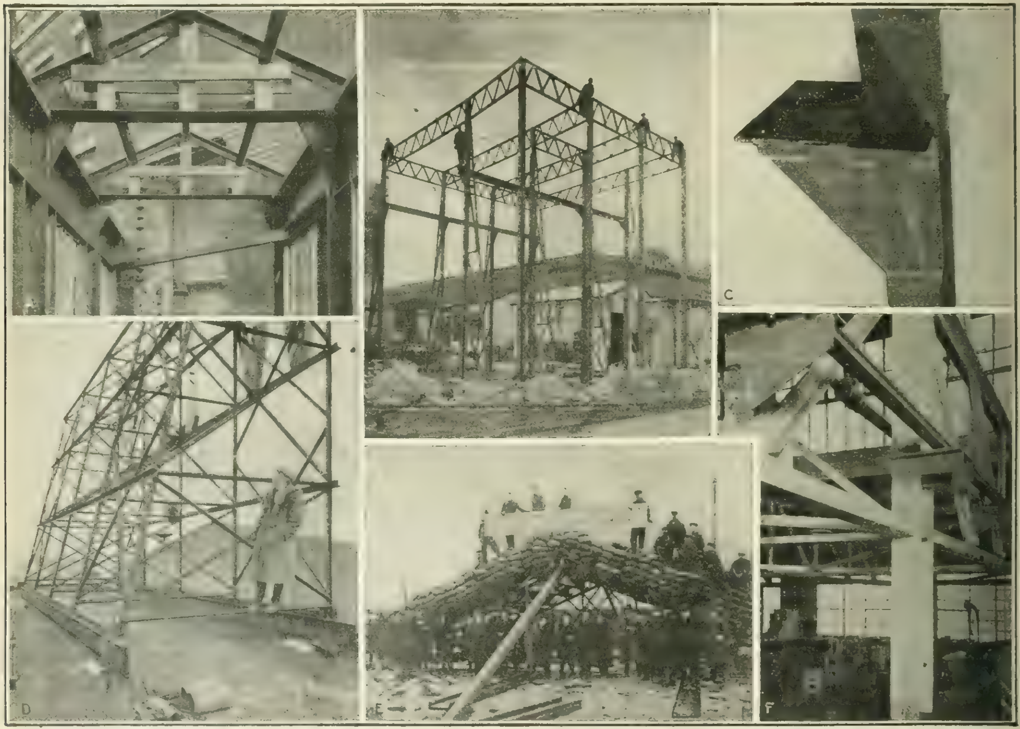


FIG. 1—STEEL STRUCTURES THAT HAVE BEEN BUILT WITH ARC-WELDING OF CONNECTIONS

A—Footbridge, with posts and trusses welded. B—Transformer housing at Schenectady. C—Welded crane runway bracket of transformer housing. D—Steel framework for a large electric sign. **E—Full** size welded roof truss under load test. F—Crane brackets welded to columns and trusses.

It is quite important that structural engineers therefore should give careful attention to the application of electric welding to steel structures with the view of guiding the art along safe lines. Up to the present time most electrically welded structures have not been carefully proportioned with proper regard for the stresses to be carried and the strength of parts necessary to carry them.

Test Data On Arc Welding—It is unfortunate that practically all of the tests have been made on specimens cut from butt welds and tested in pure tension. At the present stage of the application of arc welding to steel structures we are more in need of experimental data on the shearing strength of electrically welded joints than data on their tensile strength. Practically all riveted joints depend for their strength upon the shearing value of the rivets or on the bearing of rivets upon plates connected.

The best data thus far published on shearing strength of deposited metal of metallic arc welds are those of E. S. Humphrys, Jr., from tests made at the General Electric Co.'s Schenectady plant and at Union College. In these tests each specimen consisted of two 4½ x ⅝-in. plates joined together by two 3½ x ⅜-in. splice plates in such a manner that the deposited metal (bead) ran parallel to the length of the plates and therefore parallel to the tensile pull exerted upon these plates, with the result that the beads were subjected to shear. The shearing strength of the bead (see Table I) varied from 31,145 lb. per sq.in. for the ½-in. bead to 42,000 lb. per sq.in. for the ¼-in. bead, averaging 36,310 lb. per sq.in. and the table shows quite conclusively that the smaller the bead the greater is the unit shearing strength.

It should be pointed out here that when these specimens failed in the testing machine the plane of fracture, i.e., plane of shear, was not the base of the triangular fillet but was on a plane of minimum shearing area extending from the apex of the triangle perpendicularly to the hypotenuse opposite. The plates were of ordinary structural quality and the electrode was a standard commercial bare wire, high in manganese and low in carbon, sulphur, phosphorus and silicon. In specimen 3 the length of the bead was so large that failure occurred by tension in the main plates and not

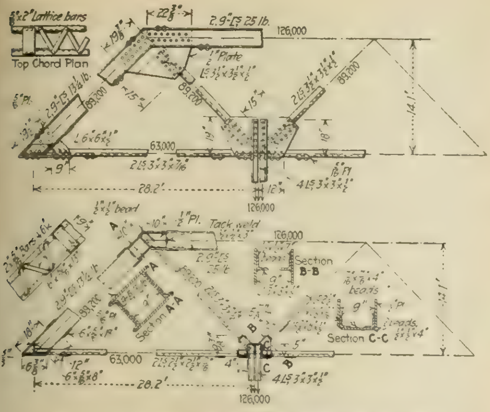


FIG. 2—RIVETED TRUSS AND WELDED TRUSS FOR SAME SERVICE

by the failure of the weld. Each of the results given is the average of four tests; for example, the 142,500-lb. breaking load for test 8 is the average of 146,170, 139,580, 149,990, and 134,250, whose maximum variation from the mean is about 5.3 per cent, while for test 6 the maximum variation in the four specimens was about 1 per cent. These results show remarkable uniformity in the workmanship.

If a factor of safety of four be applied to the ultimate, the allowable shear on the minimum section is approximately 9,000 lb. per sq.in. Using this value a triangular bead ½ in. deep by ½ in. horizontally, with minimum shearing thickness 0.355 in., has a safe working shearing strength of 0.355 x 9,000 or 3,195 lb. per linear inch of bead.

TABLE I—TESTS ON WELDED PLATES

Test No. (1)	Ultimate Load, Lb. (2)	Net Area of Plates, Sq.In. (3)	Tension, Lb. Sq.In. (4)	Dimensions of Bead, In. (5)	Min. Width of Bead, In. (6)	Min. Shear Area of Bead, In. (7)	Max. Shear In Bead, Lb. Sq.In. (8)	Shear Per Lin. In. of Bead (9)	Method of Failure (10)
3	158,420	2.625	60,350	⅜x½x6	3/10	7.2	22,000	6,600	Tension in plate
4	149,500	2.625	57,000	⅜x½x4	3/10	4.8	31,145	9,340	Shear in bead
5	116,320	2.625	44,310	⅜x½x3	3/10	3.6	32,310	9,693	Shear in bead
5-A	45,570	2.625	17,360	⅜x½x1	3/10	1.2	37,980	11,390	Shear in bead
8	142,500	3.00	47,500	½x½x3	0.355	4.26	33,400	11,875	Shear in bead
6	131,110	2.625	50,000	⅜x½x3	3/10	3.6	36,500	10,926	Shear in bead
9	120,000	2.625	45,700	⅜x⅜x3	0.266	3.19	37,650	10,000	Shear in bead
10	96,400	1.750	55,100	¼x⅜x3	0.209	2.44	39,500	8,033	Shear in bead
11	89,650	1.750	51,100	¼x¼x3	0.177	2.13	42,000	7,470	Shear in bead
					Average		36,310	9,840	

A Truss Design—In Fig. 2 is shown a preliminary design for an arc-welded truss supported at its ends, having a span of 56.4 ft. and carrying a load of 126,000 lb. at the center. The unit stresses used in the design are: tension, 16,000 lb. per sq.in.; compression, 15,000 — 50 l/r; shear in beads, 9,000 lb. per sq.in.

All welds are of the fillet type, triangular in cross-section. The 7/16 x 7/16-in. fillet has a safe working strength per lineal inch of 0.31 x 9,000 = 2,790 lb., and the ½-in x ½-in. fillet a working strength of 0.355 × 9,000 = 3,195 lb. To determine the required length of fillet to develop the stress in the diagonal it is merely necessary to divide the stress, 89,200 lb., by the safe shearing strength of a ½ x ½-in. bead, or 3,195 lb., giving 27.8 in., or 14 in. for each of the two angles.

TABLE II—ALLOWABLE SHEAR ON ARC-WELD BEADS AT 9,000 LBS. PER SQ. IN.

Depth, In.	Width, In.	Diagonal Thickness, In.	Allowable Stress, Lb. Per Lin. In. of Bead
[illegible]	[illegible]	0.355	3,195
[illegible]	[illegible]	0.300	2,700
[illegible]	[illegible]	0.266	2,394
[illegible]	[illegible]	0.203	1,827
[illegible]	[illegible]	0.177	1,593

The compactness of the joints in the electrically welded truss is very noticeable and there is a great saving of material in such joints over the ordinary type of riveted joint. Just what the saving in cost may be is at present a matter of conjecture, because we have not had sufficient experience to secure accurate cost data on electric welding of such structures. The welded truss also saves material in tension members due to the reduction of cross-section in riveted trusses caused by the rivet holes. Thus, the bottom chord is made up of two 2½ x 2½ x 7/16-in. angles with a gross section of 4 sq.in., and this is also the net section, as there is no reduction of area. In a riveted truss this lower chord would be made up of two 3 x 3 x 7/16-in. angles with a gross area of 4.86 sq.in. and a net area of 3.99. The saving of weight in the tension members of the welded truss over the corresponding members of the riveted truss due to reduction of area caused by rivets alone is 304 lb.

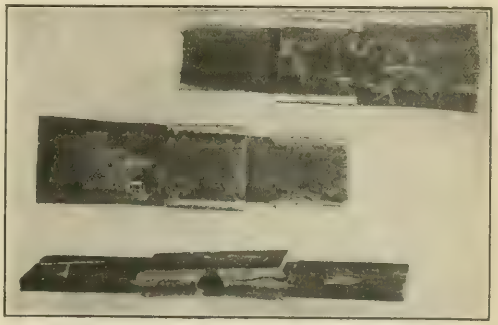


FIG. 3—TEST SPECIMENS FOR SHEARING STRENGTH OF ARC-WELDED JOINTS

No rivets have been used in the welded truss shown, but perhaps a more careful study would show that greater economy could be secured by using rivets in some places and welding in others. For example, it may be desirable to use rivets in the lattice bars of the compression members which are shown welded.

Activated-Sludge Plant in Reading, England

After considerable delay, apparently due to local financial reasons, the Borough of Reading, England, has let a contract for the proposed activated-sludge sewage-works, plans for which were approved by the Ministry of Health in 1920. The contractor is Activated Sludge, Ltd., Westminster, England. According to *Municipal Engineering and the Sanitary Record*, the plant is designed to serve a population of 90,000 and an estimated dry-weather flow of 2.75 Imp. m.g.d. or 3.3 U. S. m.g.d. Activation will be effected by "the diffused air method." Reading is the largest municipality in England that has yet let a contract for treating the whole of its sewage by the activated-sludge process. G. Midgeley Taylor, consulting engineer, Westminster, England, is engineer for the project.

Engineering and Public Health

Retrospect and Prospect Based on 35 Years Editorial and 21 Years Local and State Health Board Experience and Observation

By M. N. Baker

Associate Editor, *Engineering News-Record;*
Formerly President, Board of Health, Montclair, N. J.

Somewhat condensed from one of the DeLemar lectures in hygiene before the Johns Hopkins University School of Hygiene and Public Health, delivered Nov. 20, 1922, and repeated with a slight revision before the Sanitary Section, Boston Society of Civil Engineers, March 7, 1923.

ON THE second Monday in November, thirty-five years ago, I began editorial work on *Engineering News.* Although American engineering then had many notable achievements to its credit they were mostly in the fields of canal, railway, structural, water-power and mechanical rather than sanitary engineering. A notable exception was water-works and a lesser amount of sewerage design and construction; American public health work in 1887 was in its infancy. It then had little scientific correlation with engineering, biology and chemistry, as was bound to be the case before bacteriology and the germ theory of disease had become fairly established. Too well do I remember that in my first attempt at an editorial discussion of water filtration I was misled by the Encyclopedia Britannica to say that English sand filters were mere strainers which remove none of the dangerous impurities from water.

Knowledge and Inspiration from Dr. Sedgwick—It was not until some years after my college days that bacteria and their significance began to register on my mind and not until after an ever-memorable day early in 1892 that I began to grasp the relation between water supplies and typhoid fever. On that day began my long and fruitful acquaintance with that great public health explorer, teacher, guide and source of inspiration, the late Dr. William T. Sedgwick. I called on him at one of the old and crowded buildings of the Massachusetts Institute of Technology to get for publication in *Engineering News* a copy of that classic paper, "Typhoid Fever in Chicago," that he and Allen Hazen had courageously presented before the American Statistical Association on the eve of preparation for the World's Columbian Exposition. The paper was a wonderful marshalling of statistical and other evidence designed to warn Chicago, the Exposition authorities and the country at large that the water supply of Chicago should be safeguarded from typhoid infection before visitors thronged to the Exposition. Dr. Sedgwick gave me double welcome because he found me a willing listener to his gospel of pure water and because he saw through me an opportunity to get publicity for his paper. Full publicity had thus far been denied his paper because, shame to say, there were in 1892 people fearful that knowledge of the character of Chicago's water supply would keep visitors from the Exposition. The paper was secured, printed in full in *Engineering News,* with its illuminating tables and diagrams, and afterwards reprinted and circulated in pamphlet form. Some will remember that finally Waukesha spring water was piped many miles from Wisconsin to the Exposition grounds and that in addition the Exposition authorities built and operated filters to treat water from Lake Michigan. How much the Sedgwick-Hazen paper and its publication by *Engineering News* contributed to those two sanitary measures I will not attempt to say. Unquestionably thousands were thus warned to be on their guard against typhoid-infected water in Chicago and elsewhere.

The Montclair Typhoid Outbreak—About two years after this incident I had impressed upon me by a lesson nearer home the fact that unguarded milk supplies may cause typhoid outbreaks. The incident deserves mention here because its effect in the town where it occurred had much to do with the immediately ensuing establishment on a sound progressive basis of the Board of Health of Montclair, N. J., the work of which, I trust I may be pardoned for saying, has had no small part in the upbuilding of health board work in the United States and of setting a standard for health officers. I was then a member of the Montclair Township Committee, which, together with the Township Physician for the Poor, also served as a local Board of Health. Our health appropriation was $300 a year, for a population of some ten thousand.

Suddenly there occurred in Montclair and vicinity a milk-borne typhoid outbreak with many deaths. By the time it had passed into history a town form of government had been established in Montclair. A Board of Health absolutely independent of the Town Council in all respects except the appointment of the board members and the provision of funds was created and I became one of its first members. With eighty cases of typhoid and a dozen typhoid deaths as a background and full support from the Town Council and the public, the Montclair Board of Health began its work.

Engineer Health Officers—One of its first acts was to engage a full-time health officer. It was realized that no competent physician could be expected to give up his practice for the salary that could be paid by a town of ten thousand. A part-time medical health officer would be either an incompetent practitioner or a rising member of the profession whose private interests and public duties might clash. As an advocate of a full-time, non-medical health officer I was asked how I would go about finding one. I replied that I would appeal to Dr. Sedgwick and I was authorized to do so. Immediately he recommended Theodore Horton, then about to graduate in engineering from the Massachusetts Institute of Technology, where he had taken work under Dr. Sedgwick. Thus we secured the first of a long succession of non-medical health officers for Montclair. Besides Mr. Horton, the Montclair roll of health officers includes M. O. Leighton and Chester H. Wells, engineering graduates; Horatio N. Parker, a one-time M. I. T. student who afterwards served as biologist on the Boston water supply under Desmond FitzGerald, the latter a Past-President of the American Society of Civil Engineers and a pioneer in the sanitary study and protection of water supplies; and, most recent of all, H. B. Larner, who took sanitary biology at the M.I.T. under Dr. Sedgwick and others and was for a time on the staff of the United States Public Health Service. It is worth noting that after leaving Montclair Mr. Horton became chief engineer of the New York State Department of Health; Mr. Leighton took charge of the water supply and water pollution investigations of the United States Geological Survey; Mr. Parker assisted Mr. Leighton for a time in the work just named and afterwards specialized in public milk supplies, wrote an important book on the subject and is now city bacteriologist of Jacksonville, Fla.; Mr. Wells left Montclair after a dozen years of notable work to become special health commissioner of Delaware.

I do not mean to claim any exclusive virtue for the engineer or the sanitary biologist as health officer, but after twenty years of experience with one or the other in the Montclair work and some eight years of subsequent and more impersonal observation of that work, I feel that the engineer and his close allies in sanitation have demonstrated their capacity as health officers.

If anyone were disposed to urge that Montclair, and Elizabeth, and a number of other places in New Jersey and elsewhere that have employed engineer-health officers are small towns, I would reply that for a dozen years the chief of the bureau of health of Philadelphia was John Vogelson, an engineer, while at Detroit another engineer, Harry Vaughan, heads the executive staff of the Health Department.

Allotment for Health Board Work—Reverting for a moment to the Montclair Board of Health and its staff. The milk-borne typhoid epidemic already noted, the able work of the engineer and near-engineer health officers, carefully detailed budgets and straightforward publicity work, all combined to give civic and financial support to the work of the Montclair board. This I attribute largely to the fact that engineering methods and the engineering spirit have dominated in Montclair and that constantly the aim has been to concentrate on work having a direct bearing upon public health . . . so that the 50 cents per capita spent under the name of public health in Montclair for many years accomplished double or treble the amount of real health work that the same per capita appropriation yielded in many other communities. Not only that. With appropriations low and staff small it has been easier to keep the work of the board free from politics than if there were more money to be spent and more positions to be filled. The Montclair health appropriation is now about 75 cents per capita.

A Definition of Engineering—This seems to be a good point to introduce a definition of engineering which may perhaps aid in making plain my conception of a principle which should guide public health work: *Engineering is the art and science of planning and doing a given task as well as it needs to be done at the least cost consistent with that end.* Such a definition involves a clear idea of the aims of every endeavor, the best but least costly means of attaining those ends, and the faculty of discerning the point of diminishing returns. The latter is of great importance in view of the vast amount of engineering work still undone and that must await doing because of lack of money. Let me make this point clearer. In every city there are numerous public improvements and public services constantly making their demand upon the municipal treasury. If each demand were satisfied idealistically the total cost would bankrupt the city and the taxpayer alike. Each improvement or service must therefore be considered in the light of its relative importance and take its place accordingly in a far-looking municipal program—something all too rare in American municipal life.

Returning now to the point of diminishing returns in the field of public health work. Public funds being limited, so must be the pursuit of the ideal in each branch of public health work in order to achieve the largest possible total gain in saving of lives and sickness. The highest ideals in water supply, for instance, should be postponed when additional expense for further improvement will have no probable measurable effect on typhoid or the general death rate and while there is every reason to believe that the money needed to make the water supply ideal would, if expended on the milk supply, effect a notable reduction in tuberculosis and infant mortality. A more striking illustration would be the concentration of health department effort on garbage disposal, as is so often the case, while no really efficient work is being done to control communicable diseases or reduce infant mortality.

Suggested Plan for State Health Survey—I can illustrate still further the engineering way of tackling public health administration by recounting a proposal I made while I was a member of the New Jersey State Board of Health. I submitted a plan designed primarily to utilize data collected, tabulated, summarized, printed and distributed at great expense to the municipalities and the state and then, for the most part, let go unused. I urged that a competent person be engaged to study the vital statistics of the state, most of which were already sufficiently summarized by communities and by classes of sickness and death. The object of such a study would be to show the relative prevalence in each local health district of the state of every disease or other cause of death which, in the light of existing knowledge and belief, could be appreciably reduced by well directed efforts in public health and sanitation. The exhibit would rank the cities and towns of the state according to their death rates: First general, then by those causes believed to be subject to public control—such as typhoid fever, tuberculosis and infant mortality, to name here only three.

Correlated with this exhibit of community vital statistics from greatest to least would be a study of the most potent factors making on one hand for high and on the other for low death rates, general and segregated. Chief among these, at least for first attention, would be the character and control of water and milk supplies; main factors affecting local public health administration, particularly whether a full-time, competent health officer were employed; adequacy of control of communicable diseases; the amount and efficiency of infant mortality work; and analyses of health board budgets, showing not merely the per capita expenditure of the local boards, but also its allocation between (a) real health-protective work and (b) municipal cleansing (as garbage disposal) and nuisance prevention.

Application of the Plan—Once the data were in hand the high general and special death rates in each community would be studied in the light of the corresponding local facts as to character of water and milk supplies, health department administration and expenditure. There would be clearly evident, in many cases, why a community was at or near the highest general or special death rate in the state. As a corrective to possible false conclusions in some directions, the cities with the lowest death rates—total, typhoid, infant mortality, etc.—when studied in connection with their sanitary works and public-health administration and expenditures, might throw much light on the relative values of various lines of sanitary and health board work and prevent the drawing of false conclusions and the unwise expenditure of public funds.

It would be of little use for any state board of health to do what I have suggested and stop with the printing and circulation of the results. Driving home to each local health board and community the lessons to be learned from these correlated studies is the real thing to be done. In New Jersey, at least, there is ample statutory authority for just this driving home. The legislature has authorized the State Board of Health to frame and adopt a Sanitary Code of state-wide application; and it has made it the duty of the director of health to enforce the rules of the board and the sanitary and health laws of the state. The legislature has been even more specific. It has declared that local health authorities must see that the State Sanitary Code and the state health and sanitary laws are obeyed. Therefore the state health authorities of New Jersey could go to communities with high general or specific death rates, point out the facts and the probable causes and demand remedial measures. In case of failure to adopt the measures indicated, the State Board of Health of New Jersey has authority to cause the necessary work to be done and to collect the cost from the community concerned.

I hope I shall live to see the time when our state health departments will not approve plans for water supply or sewage disposal until their engineers and other specialists have taken full cognizance of the entire sanitary and health needs of the municipality in question with a view of determining whether the expenditure necessitated by the plans would produce more and better results in terms of lives saved if the money were used for some other purpose. In other words, if state authorities are to be dictators over one or two classes of outlays for health and sanitation, let them cover the entire field. Then our state health authorities would be able to guard against expenditures in the name of public health that come within the law of diminishing returns until other causes of diseases and death in the community have been cut down correspondingly.

Progress in Public Health Engineering—Let us now return to the conditions of thirty-five years ago and review broadly but briefly what has happened since then in that part of the engineering field that is most closely related to public health. Since 1887, the number of American cities and towns having public water supples has increased from a thousand to eight or ten thousand and sewerage systems worthy the name from a few hundred to a few thousand. Practically all the water and sewage treatment and garbage disposal plants now in existence in the country have been built since I began to follow these matters for *Engineering News* and nearly all the earlier ones and the more typical of the later ones I have described or been instrumental in having described in *Engineering News* or *Engineering News-Record*.

No one knows at the present time how many communities in the United States have water supply and sewerage systems, water and sewage treatment plants, garbage and refuse collection and disposal and street cleaning systems. Even less knowledge have we of the percentage of the population of the country thus served, or of the percentage of officially laid out and accepted streets that have been paved or of other volumetric elements of municipal engineering and sanitation. Less still is our knowledge of the efficiency of such of these works and services as exist, or of the number, character and efficiency of our local health agencies charged with the protection and improvement of the public health.

We do know, but in general terms only, that vast sums have been expended and are being spent yearly for engineering works having more or less effect on public health—some a very direct beneficial effect, others a less direct and some a probable but quite uncertain effect. Most of the engineering works in question were built primarily as necessities and conveniences and luxuries of modern living conditions rather than to protect health, but in countless and unmeasurable ways both the works that have been named and many other engineering works as well have contributed some part to the upbuilding of the general health and welfare of the country, and to the great reduction in the general and in many specific death rates that has taken place since 1887.

I shall not attempt to give exact figures, but you all know that within the era of public sanitation and public-health-protective work of the last three and half decades the general death rate in some cities has been cut in half and typhoid reduced to a fourth or a tenth or a twentieth and in some cases to a fiftieth or even less of its former annual rate. Other diseases have also been heavily reduced and are still falling, which is also true of the infant mortality rate.

Relative Values—Among all the engineering works that have contributed to the reduction of sickness and death and the accompanying suffering and heartbreaks probably none equals public water supplies—at least not on the North American continent. Probably sewerage systems come next, but if so then it is the quick removal of human excreta from our houses and yards and streets rather than its final disposal that deserves the credit. Plumbing, except as means for distributing water to points of use and removing it after it has been soiled, seems to have but a minor relation to health. Garbage collection is more a branch of municipal cleansing or housekeeping than of health, except where garbage uncollected attracts flies that have access to privies or rats that may spread plague. The final disposal of garbage is still less a health matter. The character of paving and of street cleansing, it seems to me, has far more of a bearing upon public health than has garbage collection or disposal. Where mosquitoes and malaria or yellow fever prevail, engineering works in the nature of land drainage are generally the best and cheapest means of control.

House and building design and construction, with particular reference to air, warmth and light, dryness, the saving of labor for housewives, and general convenience play their part in public health. Heretofore, these things have been regarded as the function of the architect, but for years now we have had heating and ventilating engineers, while in various ways the engineer is becoming more and more concerned with the construction of houses and other buildings. From the engineer we may expect a reduction in the cost of housing that can come only from saving labor and material through systemization, quantity production and other engineering methods. With a reduction in the cost of shelter may be expected a relief from the overcrowding and other evils that undermine health and spread disease.

I believe it is to city planning and its results that we must look for much of the future improvement in public health and particularly for a further reduction in the general death rate in so far as these depend upon engineering work; a reduction traceable not so much to any one readily specified measure as to improvement in many inter-related causes that go to make up community convenience, comfort and mental and physical health.

More Knowledge and Better Health Index Needed—With a general city death rate at or near 10 per 100,000, with a typhoid death rate down to 5, 3 and even 2 or less per 100,000; with infant mortality in progressive communities well below 100 and running on down to 50 or less under well-controlled conditions; and with other elements tending to change what has been called the health yardstick to a foot rule scale, the public health official, and particularly the engineer, needs more knowledge than now exists of what has caused these marvelous declines in mortality and morbidity rates in the past and, of greater importance, what further declines he may expect and by what means he may accomplish them.

I say this knowledge is needed by the engineer in particular because, as I have already stated, it is his habit and peculiarly his function to measure the worthwhileness of proposed works and services in terms of costs and of results. Is the game worth the candle? Can the desired end be better and less expensively achieved by some other means? Would the same amount of money spent for some other purpose save more lives or bring more health?

For many years past the engineer measured the results of his efforts in the sanitary field by the typhoid death rate. At least this was true as regards water supply, the improvement of which in the past is believed to have been the most potent engineering factor in reducing the typhoid and the general death rate.

At the present moment the water-supply engineer is often in a quandary as to how much additional expenditure he is warranted in recommending for one supply instead of another on the possible chance that a few thousand or hundred thousand or millions of dollars—according to the size of the city—thus spent will provide water that will lessen by a shade a typhoid rate almost at the vanishing point or perchance in some way which no one can clearly and positively define reduce some other human ill. The engineer, the health officer, the city councilman and the taxpayer, each and all, need a more delicate and certain index than is available, now typhoid has been reduced to so low a figure, of the causes of the past decline in typhoid and the probable cause of future decline. Have the engineer and the health officer come to the bottom of the curve so far as efforts against typhoid in many of our cities are concerned? Can the experts hereafter merely hold what they have already gained? If further reduction may be expected, and typhoid wholly eliminated, then by what means? Would the same, or perchance much less expenditure, capital and operating, reduce by two or by five per hundred thousand the death rate from some of the causes other than typhoid as against a half or a tenth on the typhoid scale?

Before these questions can be answered we need an intensive-extensive study of the causes of typhoid fever; a study taking into account, chronologically, the volume and the efficiency of the several lines of work that have combined to reduce typhoid fever—such as water-supply protection, filtration and chlorination; milk ordinances, inspection and pasteurization; contact control in its many phases; better medical and nursing care; anti-typhoid inoculation. The same kind of study is needed of other causes of death and related or possibly related public-health work.

Optimum Floculation Point for Alum

Alum will not coagulate properly when a solution is either too "acid" or too "alkaline." Investigators in the hygienic laboratory of the U. S. Public Health Service, E. J. Thereault, assistant chemist, and W. Mansfield Clark, chief of the division of chemistry, report on the relation of hydrogen-ion concentrations (see Public Health Reports for Feb. 2) to the formation of floc in alum solutions the following conclusions: When other possible factors are left out of consideration, optimum conditions for floc formation will be found with a narrow zone of pH centered for dilute solutions at pH 5.5. The more dilute the water in total salt content and the less the alum added, the narrower becomes the pH zone with which optimum floc formation is to be found.

Incomplete Development Prevents Success In Irrigation

Engineering Work Is Not Finished When Canals and Laterals Are Built — Preparation of Land for Farmer Equally Important

By Dr. Elwood Mead
Department of Rural Institutions, University of California, Berkeley, Calif.

TOO GREAT a burden for the farmer, due to incomplete development of irrigated land, has been the greatest single factor in the tragic percentage of failures among settlers on newly opened irrigation projects. The construction of an adequate, well-supplied canal system, even when the water is delivered to each individual tract, is only part, perhaps less than half, of the work that must be done before actual farming operations can begin. It is too much to expect the average settler unaided to bridge the gap between raw land and a farm that will support him; financial or engineering aid, sometimes both, are needed.

Before considering the question of how to render such aid, however, the need for it must be recognized. The issue has too often been evaded where it should have been faced squarely. There has been a fear that any such aid would be "paternalism" or "coddling the settler." Paternalism in colonization is an extreme to be avoided but it is not a menace to our rural development. On the other hand, the opposite extreme of leaving the settler to shift for himself on raw, unimproved land is not only a menace, but has been and is actually retarding in a very serious way progress toward the much needed settlement of irrigation lands and the bringing of these areas into production.

As carried out either by the government or the ordinary private enterprise, even our most complete irrigation projects do not clear the land, level it off into suitable checks, and throw up borders; laterals and boxes are not put in, nor are the best methods of irrigation determined and laid out. But all these detailed improvements, which have to be made before the first crop can be seeded, are quite as essential to the success of the new settler and are often more costly than the canals and reservoirs themselves.

It is, therefore, most unwise to leave all this work, which is not farming but rather engineering, for the inexperienced settler. In his hands it is likely to cost twice what it should and at a time when there is no income from the land the necessity for any considerable outlay may spell failure for the individual. It is men with small capital who are most often attracted to the irrigation projects and these are the men we must continue to attract by making the farming of such land a venture within the reach of limited capital.

Preparing the Land for Cultivation—The average settler knows nothing about preparing land for irrigation and if he goes in and tries to do it alone he is quite likely to be bankrupt, discouraged and thoroughly disillusioned before he plants his first vine or tree. To subdivide and unscrupulously sell tracts of "irrigated lands" to inexperienced settlers who are foredoomed to failure is to prevent the development of our arid territory, not only on the areas so sold but also through the "black eye" which the failures of such projects give to irrigation ventures generally.

Recently we made a study of seventy farms, all of them in irrigated districts. All of them had originally been part of grain ranches and were sold to the farmer as irrigated lands. In almost every case we found that the cost of preparing the surface of the land so that water could be spread over it, putting in the distributing gates and the little laterals, building the house and farm buildings, amounted to more than the cost of the water rights plus the original cost of the land.

To sum up, the preparation of the surface of the land so that water can be distributed over it, the determination of the method by which water is to be distributed, and the placing of facilities on each farm for its distribution is not agriculture, it is engineering, and, if this work is not included in the original construction program, expert advice and direction must be provided to aid the settler in doing it. He ought to be fully informed regarding the total cost before he settles on the land and if he is accepted without capital enough to carry out necessary development work, then credit should be extended him with which to complete it. This is essential because this work must be done before he can get any returns and it must be done quickly or the annual irrigation charges, taxes, interest and payments on his land will insure his financial downfall before he gets started.

Community Co-Operation—Another reason why irrigation projects should be settled quickly is to secure from the outset the advantages of community development. It is very important that the settlers shall at least have access to expert advice and direction as to the kind of stock to buy, the kind of crops to plant, and the methods to use in working together to secure wholesale prices on equipment and the best prices on products.

That all this and more can be successfully done has been demonstrated by the Durham and Delhi colonies in California. These colonies, though small in area, are remolding the methods and ideas of every private colonization enterprise in California and are educating bankers and business men on the real problems of rural life; as an educational agency no part of the state government has been more illuminating.

In the interest of developing our arid lands, prospective settlers must be protected from the owners of large areas who profit most by the sale of partially developed tracts. Those who are interested only in selling land are bitterly opposed to the ideas presented in this article because these ideas mean organization expense and continued responsibility for colonies, both of which have been evaded in the past. Looking at it from the economic standpoint, however, the cost of this advice and direction is not one-tenth what settlers waste and lose when left to work out their own salvation.

It is this waste and loss that has led to the failures so discouraging to settlers, and we cannot expect to continue to be a nation of land owning farmers if we leave men to struggle alone and unaided in the purchase and development of farms. The neglected areas of the East equally with the undeveloped areas of the West afford opportunities for the creation of communities organized to work together in business, agriculture and in social affairs. Communities so organized will get returns far beyond anything to be expected from unorganized communities.

Federal aid should not be given to irrigation projects unless (1) provision is made to protect the settler in the price he pays for land and (2) to include in that price all the improvements needed to make the farm a going concern. Great harm is done by irrigation projects that go just far enough to give land a deceptive and inflated price and then leave the settler to find out what is lacking in the hard school of experience.

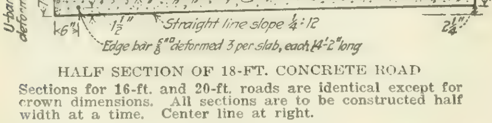
Whenever irrigation projects are carried to the point where a settler can begin as a farmer, or if he is given credit and expert direction so that he can make the land ready for cultivation in an efficient way, and if he is given enough time to make his payments so that the money can be earned out of the land, then there will be no lack of settlers.

The most gratifying feature of the two state settlements in California is the change being wrought in public opinion as to what is needed in the creation of new rural communities and the growing desire that the future development of California shall be carried out under such public direction and by such agencies as will make development the first object to be attained and the selling of land an entirely subordinate feature. The large majority given to the bond issue of the soldier settlement act was largely due to the statement that these settlements would be carried out under the same kind of expert management and personal encouragement that has been so large a feature in the success of the state settlements. Regarded at the outset as an innovation in routine government of doubtful propriety, the vote in favor of its continuance this year shows how the policy has established itself.

New Concrete Road Section for New York

A NEW section, with lighter reinforcement and edges thicker than the center of the slab, has been adopted for New York State concrete roads by Frederick Stuart Greene, commissioner of highways. A half section of the new pavement is illustrated. This drawing gives the crown dimensions for the 18-ft. slab; they are a quarter of an inch greater for the 20-ft. pavement and the same amount smaller for the 16-ft. pavement.

On the top, the slab has a parabolic crown so as to eliminate the sharp crown intersection of two right planes but the bottom has a straight line slope both ways from the center line. Commenting on the structural strength Commissioner Greene says: (1) We have increased the thickness of the slab at the outer extremities and where the greater strain comes, when two heavily loaded trucks pass each other on the pavement. (2) We have cut down the weight of the reinforcement mesh, using now but 40 lb. per 100 sq.ft. We also give the contractor the option between mesh and assembled bar mats. (3) In addition to U-bars at the expansion joints, we are running longitudinal bars 6 in. from the outer edge of the slab. We are going to place expansion joints at 40-ft. intervals.

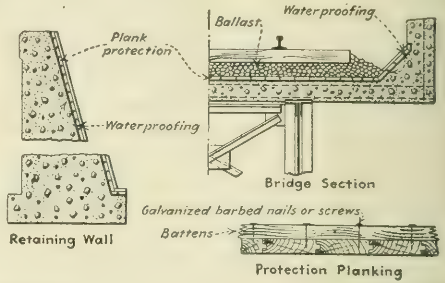

Mesh reinforcement, 40 lb. per 100 sq. ft.
or bar matt reinforcement 48 lb. per 100 sq. ft.
Construction Joint
18'-0"
U-bar 5/8" deformed, 18' long
7"
1 1/4"
2"
Parabolic crown
6"
1 1/2"
Straight line slope 1/4 : 12
2 1/4"
6"
Edge bar 5/8" deformed 3 per slab, each 14'-2" long

HALF SECTION OF 18-FT. CONCRETE ROAD

Sections for 16-ft. and 20-ft. roads are identical except for crown dimensions. All sections are to be constructed half width at a time. Center line at right.

Plank Protection for Concrete Waterproofing

TAKING advantage of the excellent results obtained with creosoted timber in railway bridge work, and particular in timber decks carrying ballasted floor, W. R. Roof, bridge engineer of the Chicago Great Western R.R., Chicago, has worked out the application of creosoted planking as a cover or protection layer for waterproofed concrete surfaces. The plank protection in such a construction replaces the concrete or brick protection layers now required. The advantages of the plank protection are saving of weight and cost, ease of application to surfaces of any position or shape, and the possibility of simplifying construction work by placing the protection, waterproofing and concrete as a single operation instead of two separate ones. The protection planking can be applied to the back form, the waterproofing then placed against the protection, and the concrete poured against the waterproofing, after which it is only necessary to remove the forms and place the backfill.



CREOSOTED PLANK PROTECTION FOR WATERPROOFING

Applied to a concrete slab ballasted bridge floor and to a retaining wall.

Two sketches illustrating the application of this type of protection, to a reinforced-concrete slab bridge floor and to a retaining wall, are shown herewith. They are self-explanatory. The construction has been patented.

Creosoted ballast floor trestles on the Chicago Great Western have been in service for more than a dozen years and are reported to be about as good as when erected. They have 3-in. plank decking carrying 6 in. of broken stone ballast under the ties. In spite of very heavy ballast (E-56) carried on these structures the planking appears to suffer no mechanical damage, and trouble from decay is eliminated by the creosoting. Equally favorable results have been found by other Western roads.

An Estimate of the Cost of London Fog

London Correspondence

It is estimated that five days of fog in London have cost:

Loss to railways, at £40,000 per day	£200,000
Loss on other transport, at £30,000 per day	150,000
Loss of custom by shops, at £100,000 per day	500,000
Deterioration of stock in shops, warehouses, stores, factories, etc., at £100,000 per day	500,000
Deterioration of curtains, wallpaper, upholstery, linen, etc., in houses, at £25,000 per day	125,000
In hotels, etc., at £10,000 per day	50,000
Loss of working hours, at least £20,000 per day	100,000
Extra lighting at £20,000 per day	100,000
Total	£1,725,000

Rock Boring Mollusks Attack Concrete Pile Jackets

Unusual Occurrence of These Clams in Los Angeles and San Diego Harbors Augments Marine Piling Protection Fight

Extract practically in full of a preliminary report from C. A. Kofoid and Robert C. Miller for the biological section of the San Francisco Bay Marine Piling Committee to the American Wood Preservers Association at the New Orleans meeting Jan. 23, 24 and 25.

ROCK boring mollusks of the family *Pholadidae* are commonly distributed along the Pacific Coast, several species occurring in suitable habitats from Alaska south to San Diego and beyond. It has often been supposed that concrete in sea water might be subject to attack by such borers which penetrate rocks of a number of different kinds and often of considerable hardness, but, as mentioned in the first report of this committee (p. 24), no specific instances of the occurrence of these organisms in concrete marine structures have heretofore been reported. Hence the data presented below are of unusual interest to both biologists and engineers.

The writers wish to express their indebtedness to D. E. Hughes, of San Pedro, who first discovered the borers in concrete, for calling the matter to their attention and assisting in the collection of specimens and data. Invaluable assistance was also rendered by J. W. Ludlow, Los Angeles harbor engineer, W. R. Sadler, city chemist, and others.

In the work of widening the channel in Los Angeles Harbor, Nov. 13, 1922, it became necessary to remove some wooden piling which had been jacketed some years previously with concrete. In looking over these piles Mr. Hughes observed that some of the jackets had been attacked by borers, and investigated further. Of eighteen jackets examined under the old Fish Cannery wharf, opposite the foot of Fifth St., San Pedro, sixteen were found to be more or less attacked; five were considered to be badly attacked (six borers or more per square foot of exposed surface); the others contained fewer and some only an occasional borer. The two jackets which did not contain borers stood in shallower water than the others.

The exact date at which these piles were driven could not be determined, but it was probably several years prior to 1908, at which time it became necessary to jacket them with concrete to protect them from *Limnoria* or other wood borers. The jackets had accordingly been in place fourteen years. The length of time during which they were actually exposed to attack by the rock borers, however, is probably considerably less than this as the form lumber was left in place outside the jackets and would deter the pholad borers from entering until the forms were destroyed by wood borers.

One of these piles was examined a month later by Mr. Miller. The jacket was 7 ft. long, and extended from mud line up to mean low water. It consisted of a fairly good mortar concrete, averaging 2½ in. in thickness and so hard that some difficulty was experienced in breaking it up with a 15-lb. iron bar to secure samples.

The outside form lumber was still partly in place. It had originally consisted of 1-in. redwood, as seen at one place where it had been protected by a cleat. Elsewhere it had been badly attacked by *Limnoria* and *Teredo diegensis* so that only a thin shell of it remained adhering to the concrete. This thin layer of wood, however, still covered all of the jacket except about one foot at the top, and one corner, where the form had sprung apart leaving a gap through which the rock borers could enter. The entire surface exposed to rock borers was not more than 5 sq.ft. In this area nearly forty of the borers occurred, averaging seven or eight to the square foot.

The borers were in general a little larger than a man's thumb. The largest one found occupied a burrow measuring 1⅜ in. in diameter at its widest portion. Two borers in this jacket had penetrated the concrete until they came in contact with the wood within but none had actually bored into the wood. One indeed had turned and continued boring in the concrete parallel to the surface of the wood, to avoid entering the latter.

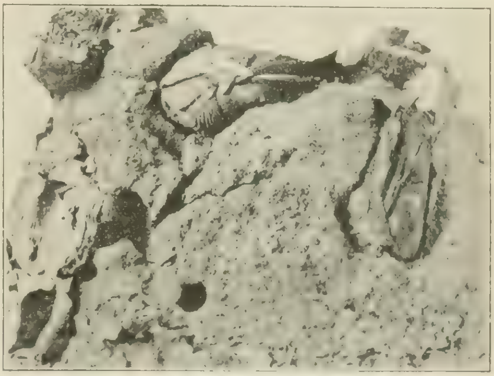


FIG. 1—ROCK BORING CLAMS FOUND IN CONCRETE PILE JACKETS

Sample contains three borers in a space 3 in. square. Two are visible, the third being indicated by opening near the lower margin of photograph.

Mr. Hughes reported that of the jackets examined by him one other was attacked more heavily than the one noted above in proportion to the surface exposed, but the jacket consisted of a very poor concrete, badly disintegrated.

The discovery of the borers in concrete at this locality led to an examination of other concrete jacket piles in the harbor.

Mr. Ludlow stated that of twelve pile jackets examined by him at the old Blinn Lumber Co. wharf, opposite berth 229 in Los Angeles Harbor, three were rather badly attacked by borers. Mr. Sadler reported that he had broken open twelve concrete jackets at the First St. ferry landing, of which three were found to be attacked, one quite badly, the others containing from three to six borers each. Of seventy-five jackets examined by Mr. Sadler at the Kerckhoff-Cuzner wharf, about 50 per cent were found to contain borers and about 20 per cent were quite badly attacked.

Mr. Miller had the privilege of going over this ground again with Messrs. Hughes, Ludlow and Sadler on Dec. 18. A number of other jackets were broken open and a quantity of specimens secured.

The species occasioning most of the damage was found to be *Pholadidae penita* Conrad, known commonly as the "rock clam." It occurred from 2 ft. above mean low water to 1 ft. below, which was the lowest we were able to work. It doubtless similarly occurs on down to the mud, even in deep water, as it has been dredged in San Francisco Bay at a depth of 50 fathoms. (See Packard, E. L., Molluscan Fauna from San Francisco Bay. Univ. Calif. Pub. Zool., vol. 14, p. 288.) This borer, unlike *Teredo*, has the body entirely enclosed within the two valves of the shell, which are ovate, tapering somewhat posteriorly and ending in leathery flaps. During the period of active boring life the foot protrudes through a rather large anterior gape between the valves, but after cessation of boring, and perhaps in the interim between periods of boring activity, this gape is closed over by a calcareous plate, giving the borer the appearance seen in the photograph. The anterior portion of the shell is ribbed and somewhat denticulated either for rasping purposes or to grip the sides of the burrow.

This species is edible and is used for food in localities where it occurs in sufficient abundance to make worth while the labor of removing it from its rocky domicile, which is usually done by means of iron bars.

Another boring species found in concrete pile jackets here was *Platyodon cancellata* Conrad, a near relative of the soft-shelled clam (*Mys arenaris*). This form inhabits normally stiff mud and clay. It was found in pile jackets only sparsely and in very poor concrete.

A third species occurring in the concrete jackets was the so-called "nestler" *Petricola carditoides* Conrad, which is believed not to bore on its own account but only to inhabit natural cavities or holes bored by other organisms.

As regards the extent of the damage occasioned by borers in concrete, a review of the data assembled by Messrs. Hughes, Ludlow, Sadler and Miller indicates that of concrete jacketed piles at four different locations in Los Angeles Harbor—in fact, at every point in the inner harbor where such piles exist—about 50 per cent have been more or less attacked, of which rather more than one-fifth have been very considerably bored. Of those not attacked, a number stood so well inshore as to be but little exposed to the action of the borers. If all such piles were eliminated from the count, the percentage of jackets damaged would be considerably higher.

These jackets were in general of a medium grade of mortar concrete, some being decidedly poor, others fairly hard. The fact that some of the jackets had given service in sea water over a period of fourteen years indicates a composition as good as that of much of the concrete used for such purposes. Samples of the best mortar in which borers were found showed an air penetration of $\frac{1}{16}$ in. in seven weeks when tested with phenolphthalein.

A. A. M. Russel, testing engineer to the State Harbor Board, has made a crushing test of a sample of one of these jackets, finding the crushing strength of a specimen $2\frac{1}{2}$x$3\frac{1}{2}$x$4\frac{1}{2}$ in. high to be 1,726 lb. per square inch. Mr. Russel thus reports grading of aggregate:

Screen	Per Cent Retained
10- 20	1.78
20- 30	0.89
30- 50	4.46
50- 80	51.78
80-100	16.07
100-200	16.07
Pass 200	8.94

Whether or not concrete of greater hardness and a better assorted aggregate would be similarly subject to borer attack remains to be seen. It has commonly occurred in jacketing piles that the concrete has been "drowned," either by the presence of too much water in the mix, or by depositing the material in water, causing segregation and laitance and rendering such structures especially susceptible to borer action. The probabilities of attack on well-made precast piles of other high-grade concrete structures hinge upon whether the action of the borers is mechanical or chemical, evidence accumulated tends to favor the latter view. If the action is mechanical, hardness of the concrete may be expected to prove a deterrent, but if it be chemical, density of material will probably only serve to make the boring more slow.

The fact that borers have not as yet been reported in concrete marine structures in San Francisco Bay is not regarded as signifying that such structures are permanently immune in this locality but only that they have not thus far been much exposed to borer attack. The shores of San Francisco Bay in general are gently sloping mud flats, and, except in the immediate neighborhood of the Golden Gate, rocks affording suitable habitats for pholad borers are extremely rare. The occurrence of such borers about the Golden Gate, however, indicates this as a possible source of future infection for concrete structures within the bay.

The findings set forth above are, to say the least, disturbing, and indicative of serious possibilities. It is entirely to be expected that, when rock borers have penetrated the concrete jacket about a wooden pile, wood borers will be able to gain entrance through the pholad holes and attack the pile itself. There is also a more serious possibility in the case of reinforced concrete piles; a single borer penetrating such a pile would let water in to the reinforcing metal, which would effect corrosion and swelling of the latter, causing the pile to crack and speedily disintegrate. It appears, at any rate, that the use of concrete for marine construction is not so immediate and certain a solution of the marine borer problem as has sometimes been assumed to be the case. Engineers will await with much interest further observations on the permanence of concrete in sea water, as affected by borer action.

Copper Sulphate Keeps Down Najas Gracillima

A recent unusual experience with plant growth in reservoirs at the Trap Falls Reservoir of the Bridgeport (Conn.) Hydraulic Co., has been reported to this journal by J. Frederick Jackson, director, Bureau of Engineering, Connecticut State Board of Health, as follows: "Dr. Barrows of the company named saw a strange filamentous growth floating in the shallow portions of the reservoir. It accumulated rapidly and in detached bunches floated to the center. In one instance it reached the intake and, collecting on the screens, broke them. Raking it out and burning it on the shores was tried but it would not burn readily. Finally, S. G. Senior, general manager of the company, suggested copper sulphate treatment. By using concentrated doses this kept down the growth. A specimen was submitted to Dr. G. B. Clinton, botanist at the Connecticut Agricultural Experiment Station, who identified it as *Najas Gracillima*, a near relative of eel grass. Its noninflammability is due to much salt in it."

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Two Notable Books on City Planning

THE LAW OF CITY PLANNING AND ZONING — By Frank Backus Williams, A.M., LL.B., of the New York Bar. [The Citizen's Library of Economics, Politics and Sociology, New Series.] New York: The Macmillan Co. Cloth; 6x9 in.; pp. 738. $5.

THE PLANNING OF THE MODERN CITY: A Review of the Principles Governing City Planning—By Nelson P. Lewis, M. Am. Soc. C. E., M. Am. City Planning Inst., formerly Chief Engineer of the Board of Estimate and Apportionment of New York City. With the Assistance of Harold M. Lewis, M. Am. Soc. C. E. Second Edition Revised. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6x9 in.; pp. 457; 87 plates and 62 figures and diagrams in the text. $5.

The slightness of the revision of Mr. Lewis' notable book on city planning leaves it substantially as it was when first published in 1916 but it was so fundamentally sound that its new edition, taken with the widely-ranging new text by Mr. Williams, presents a comprehensive up-to-date review of the field of city planning.

After chapters on Scope, Fundamentals and Planning the City as a Whole, Mr. Williams takes up Planning the Public Features under Acquiring the Land; Excess and Zone Condemnation and Replatting in (a) Europe and (b) the United States; Public Utilities and the Water Front; Streets, Setbacks and Traffic Regulations. Under Planning the Private Features there are chapters on Zoning in (a) Europe and (b) Canada and the United States. A short chapter on City Planning Finance is followed by three chapters on Planning Administration in (a) Italy, Sweden and Germany; (b) England, Canada and France; (c) the United States. A Bibliography of 25 pp., Tables of Statutes, Indexes of (a) Cases and (b) Statutes and a General Index close the book.

Mr. Williams' long and thorough studies of city planning in general and the law of the subject in particular, the latter including constitutional authorizations and limitations, statutory law and city ordinances, have eminently fitted him for an ambitious task ably executed. Besides the law of city planing and zoning the author exhibits the fundamental objects and principles of each and reviews the history of both. He also presents many valuable data on municipal taxation and finance, useful to the engineer and the lawyer, as well as to students of municipal government.

The first edition of Mr. Lewis' admirable book was favorably reviewed in these columns Sept. 21, 1916, p. 552. The aim and spirit of the book is well indicated by its dedication, which reads: "To the Municipal Engineers of the United States, the First Men on the Ground in City Planning as in City Building, in the Hope That It May Help Them To Realize Their Responsibilities and Opportunities in Determining the Manner in Which Our Cities Develop."

Apparently there are few changes in the text of the present edition until p. 282 is reached. At that point and later in the same chapter a little new matter on zoning is added, chiefly on the New York City Zoning Regulations of 1916. The other material addition to the body of the book is the chapter, The Environs of the City, where a few pages on the Russell Sage Foundation studies for the Plan of New York and Environs have been inserted. Two appendixes have been added: one of 3 pp. on Control of Subdivision Plans (New York City and State) and one of 16 pp., reprinting the New York City Zoning Regulations of 1916. Besides the slight text changes and additions "there are," according to the Preface, "a few cases where more timely or better plans or views have been substituted" and the "index has been enlarged and improved."

If both these books were on the shelves and frequently in the hands of every municipal engineer it would be greatly to the advantage of the cities they serve; for at last we have reached the city planning era and it behooves every municipal engineer to act accordingly.

A "Filtration" Primer

FILTRATION: An Elementary Treatise on Industrial Methods and Equipment for the Filtration of Liquids and Gases for Those Concerned with Water Supply, Ventilation, and Public Health; Chemists, Mechanical Engineers and Others. London and New York: Sir Isaac Pitman & Sons, Ltd. Cloth; 4 x 6 in., pp. 102; illustrated. 2½s. 85c.

Within the limited space available in the "Technical Primers" series of which this booklet is one, the author has given a good general idea of the chief methods employed in British industrial arts for the removal of foreign matters from liquids and gases—chiefly water, oil and air. Potable water is given some space, but the author frankly states that his own experience has been in the industrial field. "Filtration" is used broadly to cover sedimentation, chemical precipitation, coagulation, straining, centrifuging, vacuum and plate filter pressing, and water filtration of both the slow and mechanical types. The treatment is chiefly descriptive. Mechanical filtration is given more space and favor than slow sand filtration, but the treatment does not reflect the state of the art of either type, at least not in America. This is particularly true of what the author says regarding the American type of mechanical filter, which harks back to the circular tank design of two decades or more ago and ignores the rectangular concrete tanks in multiple with combined capacities running to 100 to 200 m.g.d or more at a single installation.

New Publications of the U. S. C. & G. S.

The following pamphlets have recently been published by the United States Coast and Geodetic Survey and may be obtained from the Superintendent of Documents, Washington, D. C., for the prices given in parenthesis after each title:

Study of the [illegible] Determinations by the U. S. [illegible] and Geod[illegible]

An Investigation of the [illegible] and the Motion of the Pole. [illegible]

Precise [illegible]

Precise Traverse [illegible]

[illegible]

[illegible]

Precise Triangulation [illegible]

Triangulation in M[illegible] (30c.)

Whipple's Vital Statistics Revised

VITAL STATISTICS: An Introduction to the Sciences of Demography—By George Chandler Whipple, Professor of Sanitary Engineering in Harvard University, Member Public Health Council, Massachusetts State Department of Health. Second Edition. Flexible; 5 x 7 in; pp. 579; 89 line cuts. $4 net.

In this edition of Professor Whipple's valuable work, population tables have been revised to include the 1920 census figures and some tables have been added. There is also a new chapter on estimating future population which makes use of semi-log paper and includes diagrams of population growth in various parts of the country. In addition, the international classification of causes of death has been revised in accordance with the changes made at Paris in 1920. Since the first edition appeared in 1919 (see *Engineering News-Record*, June 19, 1919, p. 1216) the book has been translated into Japanese. Translations into Italian and Spanish are being made. Assistance in revision is credited to Dana E. Kepner, assistant in sanitary engineering, Harvard University.

Material Handling and Storage

REVIEWED BY HAROLD T. MOORE

Industrial Engineer, Day & Zimmerman, Inc., Philadelphia, Pa.

THE MECHANICAL HANDLING AND STORING OF MATERIAL—By George Frederick Zimmer, A.M. Inst. C.E. New York: D. Van Nostrand Co. Edinburgh: The Darien Press. Cloth; 8 x 11 in.; pp. 804; half tones and line cuts. $15 net.

The present edition of this comprehensive work aims primarily to bring to date a presentation of British methods and equipment for the handling and storage of materials but includes American practice where it is either on a larger scale or otherwise distinct from European methods. Mr. Zimmer, who has had wide experience with material handling problems and who far many years has been accumulating data on handling and storage equipment, is eminently qualified in this subject.

In the foreword by John Purser Griffith, past president of the Institute of Civil Engineers, special reference is made to the substitution in the last two editions of the term "labor aiding" and "time saving" appliances in preference to the more familiar expression "labor saving" appliances. The attitude of the English working classes against the introduction of improved machinery is deplored by Mr. Zimmer as being a handicap to commercial and technical progress.

Under Continuous Handling of Material, the following subjects are discussed and illustrated in considerable detail: Bucket elevators for materials in bulk, tray and finger elevators for large objects, conveyors of such well known types as screw, push-plate or scraper, belt, slat, pan, apron, pickling, reciprocating, gravity bucket, etc. A discussion of power consumption, speed and wear is included, with chapters devoted to the handling of hot coke in gas works, coal face, special purpose and gravity conveyors, casting machines, and automatic feeding devices. Pneumatic and hydraulic handling systems are described, together with the mechanical ejection of ashes from steamers. Under Intermittent Handling of Material, the sub-divisions include endless rope and chain haulages, aerial rope- and cableways, coaling vessels at sea, monorails and telphers, blast furnace skips, ore-handling plants, and coke handling devices. The chapters assigned to "unloading and loading appliances" describe self-dumping buckets, grabs, lifting magnets, the Hulett unloader, traveling, cantilever and monorail cranes, dock-leg and floating elevators. Portable conveyors, bucket elevators, and stacking machines are also described.

The transportation section takes up self-emptying railroad cars, automatic railways, car dumpers, and mine tipples. The coaling of ships is explained and illustrated by floating elevators, belt conveyor feeders in conjunction with traveling delivery towers, portable dock-legs, skiphoists, etc. Locomotive coaling stations, coal, coke and ash handling installations for boiler plants and gas-works, as well as coal and ore storage and recovery systems and the warehousing of grain, are fully covered. A number of automatic weighing devices for continuous or intermittent use are discussed. A useful table of weights of various materials gives pounds per cubic foot, cubic foot per ton and pounds per bushel.

The book contains a classified trade directory of British manufacturers of handling and storing equipment. It also includes historical references to ancient methods of handling by manual labor as well as evolutionary steps leading up to modern methods and machinery. The work is more descriptive than statistical, covering numerous varieties of installations with a large number of excellent illustrations. The author aims to present what has been accomplished and is in practical use and while his commendable book includes numerous mechanical details, it only partially covers the economics of handling or the comparative advantages of different types of equipment.

Summarizing, the work is a voluminous but worthy general treatment of its subject presented in an interesting but somewhat diffuse style, and discusses types of equipment rather than general principles. It contains much information of use to the designer and plant operator but as it deals mostly with British and European practice it is of more value to the English than the American engineer.

Height Zoning Facts and Opinions

STUDIES ON BUILDING HEIGHT LIMITATIONS IN LARGE CITIES, With Special Reference to Conditions in Chicago: Proceedings of an Investigation of Building Height Limitations Conducted Under the Auspices of the Zoning Committee of the Chicago Real Estate Board—Compiled by Charles M. Nichols. Chicago: Real Estate Board. Cloth; 6 x 9 in.; pp. 299; folding map in colors and a few diagrams and half tones. $2.60 postpaid.

Valuable data and a large body of opinion on height zoning are included in this volume. Naturally, most of the contents relate to Chicago. A considerable amount of space is occupied by a series of talks and answers to queries by Edward M. Bassett, New York expert on the legal aspects of zoning. Dr. W. A. Evans, formerly health commissioner of Chicago, and Charles B. Ball, engineer-sanitary inspector of the Chicago Health Department, contributed talks on the relation of building heights to health. A number of prominent Chicago realtors participated in the conferences reported. A notable outcome of the investigation was a committee report, approved by the Chicago Real Estate Board, recommending a lower-scale of heights for Chicago buildings than had been proposed by the Chicago Zoning Committee. The value of the report would have been increased by a judicious summary of its contents.

A Wood-Preservers Journal

The American Wood Preservers Association, Otis Building, Chicago, has issued the first number of its new official periodical, the "Wood Preserving News." It is a 24-page pamphlet, with numerous items of news and various short articles. Some of the contents of this number are quoted from *Engineering News-Record.*

Airplane Photographic Mapping

THE FACE OF THE EARTH AS SEEN FROM THE AIR: A Study in the Application of Airplane Photography to Geography—By Willis T. Lee, U. S. Geological Survey. New York: American Geographical Society. Cloth; 7 x 10 in.; pp. 110; 82 illustrations, mostly half-tones, including folding plates. $4.

Use of airplane in mapping for military purposes is, of course, well established. As an adjunct of the engineer its position is becoming recognized. Yet the general knowledge of airplane photography's application to engineering is perhaps understood only in its broadest principles. It is a new art with little bibliography. For that reason "The Face of the Earth as Seen From the Air" is timely. The utility of air photography not only in reconnaissance work, but as a check against precise plane and topographic surveying is easily understandable from this volume. The book compares maps made on the ground with the same territory mapped from the air, making intelligible to even the casual reader what an aid to the surveyor and engineer the airplane is. Material from which the book was compiled represents the work of both the U. S. Army and U. S. Navy Air Services. The reliability of these agencies gives to a volume on a new subject an authenticity that recommends it to any and all engineers who are interested in the airplane as an aid to their work.

PUBLICATIONS RECEIVED

New Books and Revised Editions

ACCOUNTING AND COST KEEPING OF DEPARTMENT OF ENGINEERING AND CONSTRUCTION: Technical Reports, Part IX, Miami Conservancy District, Dayton, Ohio—By F. L. Cavis, Chief Accountant. Paper; 6x9 in.; pp. 112; map and 31 accounting forms. 75c. net.

Detailed description of the well-conceived accounting system used on one of the most important engineering construction jobs of the last decade. A short appendix discusses Cost-Plus Variable-Fee Contracts and reprints some paragraphs from one such a contract on the Miami District work.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION: Proceedings, 1922. Chicago; cloth, 6x9 in.; pp. 278; illustrated. $1.

The principal papers include the reconstruction of the Ohio River bridge of the Cincinnati Southern Ry. at Cincinnati; framing bridge timbers before treatment; labor saving devices; painting structural steel; building inspection; driving and handling wood and concrete piles; sewers and drains; wood, steel and concrete tanks.

AMERICAN SOCIETY FOR TESTING MATERIALS: INDEX TO PROCEEDINGS, VOLUMES XIII TO XX (1913-1920). Address the Society (as above) at 1315 Spruce St., Philadelphia, Pa. Cloth; 6x9 in.; pp. 189. $2.50 in cloth; $3.50 in half leather.

BUSINESS LAW JOURNAL: Vol. I, No. 1. New York: The Business Law Journal Co., 71 Murray St. Paper; 6x9 in.; pp. 84. 75c. a copy, $8 a year.

CONCRETE CONSTRUCTION FOR ARCHITECTS: A Concise Treatise on the Design of Reinforced Concrete Slabs, Beams, Girders, Columns and Footings, and a Description of the Actual Design of a Concrete Building Involving the Use of Flat Slab Construction—By DeWitt C. Pond, Author of "Engineering for Architects." New York: Charles Scribner's Sons. Cloth; 6x9 in.; pp. 203; 89 line cuts. $4.

COUNTY AND TOWNSHIP GOVERNMENT IN THE UNITED STATES—By Kirk H. Porter, Ph.D. Assistant Professor of Political Science, State University of Ohio. New York: The Macmillan Co. Cloth; 6x8 in.; pp. 361. $2.25.

CREATIVE SELLING: Making and Keeping Customers—By Charles Henry Mackintosh. New York and London: D. Appleton & Co. Cloth; 5x8 in.; pp. 183. $1.50

DIE METHODE DER FESTPUNKTE zur Berechnung der statisch unbestimmten Konstruktion mit zahlreichen Beispielen aus der Praxis insbesondere ausgeführten Eisenbetontragwerken—Von Dr.-Ing. Ernst Suter. Berlin: Julius Springer. Paper; 7x10 in.; pp. 734; 591 line cuts.

EXPERIMENTS ON LOSS OF HEAD in Valves and Pipes of One-Half to Twelve Inches Diameter—By Charles Ives Corp, Professor of Hydraulic and Sanitary Engineering, Assisted by Roland O. Ruble, Instructor in Hydraulic Engineering. Madison: University of Wisconsin Experiment Station. Paper; 6x9 in.; pp. 143; line cuts. 75c.

HANDBOOK OF STEEL ERECTION—By M. C. Bland, M. Am. Soc. C. E., M. Am. Soc. M. E., Bridge and Structural Engineer, Harrisburg, Pa. New York and London: McGraw-Hill Book Co. Flexible; 4x7 in.; pp. 241; 39 line cuts and half tones. $2.50.

OPTICAL METHODS IN CONTROL AND RESEARCH LABORATORIES—By J. N. Goldsmith, S. Judd Lewis, F. Twyman. Vol. I: Spectrum Analysis, Absorption Spectra, Refractometry, Polarimetry. Second Edition, Enlarged. London: Adam Hilger, Ltd. Limp Cloth; 6x10 in.; pp. 55; illustrated. 1s. 8d.

PLANE TABLE MANUAL—By D. B. Wainwright, Hydrographic and Geodetic Engineer. Washington, D. C.: U. S. Coast & Geodetic Survey. Paper; 5x8 in.; pp. 97; 48 illustrations, mostly line cuts. Free on application to the Survey; 25c. from Superintendent of Documents.

A revised edition of the Coast Survey's manual of instructions for making topographical surveys with the plane table. Also contains interesting historical notes and illustrations.

POLITICS: An Original Investigation Into The Essential Elements and Inherent Defects Common to All Present Forms of Government Together With a Proposal For a Political System Which Will Automatically Produce the Best Government Possible in Any Given Community—By Frank Exline. New York: E. P. Dutton & Co. Cloth; 6x8 in.; pp. 226. $2.

PRACTICAL FACTORY ADMINISTRATION—By Matthew Porosky, Chairman Factory Management Committee, and Member Executive Committee, the Holtzer-Cabot Electric Company; Instructor in Factory Administration, Northeastern University, School of Commerce and Finance. New York and London: McGraw-Hill Book Co. Cloth; 6x8 in.; pp. 244; 51 line cuts. $2.50.

Designed for executives, salesmen, foremen, cost accountants and students of factory and business administration. The "principles, practices and forms outlined are presented from the viewpoint of the average rather than the large establishment." Among other things takes up buildings, handling materials and cost systems.

PUBLIC FINANCE—By M. E. Robinson, Fellow and Lecturer of Newnham College, Cambridge. With an Introduction by J. M. Keynes. [Cambridge Economic Handbooks.] New York: Harcourt, Brace & Co. Cloth; 5x8 in.; pp. 172. $1.25.

ROBERT FULTON AND THE SUBMARINE—By Wm. Barcley Parsons. New York: Columbia University Press. Cloth; 7x10 in.; pp. 154; self-portrait frontispiece and other plates, mostly reproductions of Fulton's drawings. $4.

THE ENGINEERING OF EXCAVATION—By George B. Massey, M. Am. Soc. C.E., Western Soc. Engrs., A. A. E., Consulting Engineer, Vice President, Randolph-Perkins Co. New York: John Wiley & Sons, Inc. Cloth; 6x9 in.; pp. 376; 196 half tones and line cuts, some of the latter on folding plates. $6. 30s. net.

VORLESUNGEN UBER EISENBETON—Von Dr.-Ing. E. Probst, ord. Professor an der technischen Hochschule in Karlsruhe. Zweiter Band. Anwendung der Theorie auf Beispiele im Hochbau, Bruckenbau und Wasserbau—Grundlagen für die Berechnung und das Entwerfen von Eisenbetonbauten—Allgemeines über Vorbereitung und Verarbeitung von Eisenbeton—Richtlinien für Kostenermittlungen—Architektur im Eisenbeton—Amtliche Vorschriften. Berlin: Julius Springer. Cloth; 7 x 10 in.; pp. 640; 71 line cuts and half tones.

WATERWORKS FOR URBAN AND RURAL DISTRICTS: With Notes on the Supply for Mansions and Isolated Buildings—By Henry C. Adams, M. Inst. C. E., etc., Consulting Engineer. London and New York; Isaac Pitman & Sons: Cloth; 6x8 in.; pp. 230; 115 illustrations, including three folding plates. 15s. $4.50.

Reports and Pamphlets in Various Fields

CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING: Annual Report of the President (H. S. Pritchett) and Treasurer, 1922—New York City. Paper; 8x10 in.; pp. 211.

President Pritchett's report contains 3 pp. on "The Extraordinary Rise of College Salaries" and 24 pp. on "The Rising Cost of Education." The latter deals chiefly with public schools rather than colleges. The ground is taken that the increasing burden of school taxes is a menace to free education because it may result in a curtailment of school funds. The burden is attributed largely to the teaching of unessential subjects and to an unwise expansion of trade and professional courses in the public schools.

CONNECTICUT PUBLIC UTILITIES COMMISSION—Report for 1921. Hartford, Conn. Cloth; 6x9 in.; pp. 765.

DIVISION OF ENGINEERING AND IRRIGATION; California Department of Public Works: Report for 1921-22—W. F. McClure, Chief of Division, Sacramento. Paper; 6x9 in.; pp. 58; half tones.

EDUCATION FOR HIGHWAY ENGINEERING AND TRANSPORT; Proceedings of Conference at Washington, D. C., Oct 26-28, 1922, Under the Direction of the Highway Education Board—Edited by Walton C. John, Executive Secretary, Willard Building, Washington, D. C. Paper; 6x9 in.; pp. 246.

HIGHWAY RESEARCH PROJECTS IN THE UNITED STATES: Results of a Census by Advisory Board on Highway Research, Division of Engineering, National Research Council, in Co-operation with the Bureau of Public Roads, U. S. Department of Agriculture, by William Kendrick Hatt, Director, Advisory Board. October *Bulletin* of the National Research Council of the National Academy of Sciences, Washington, D. C. Paper; 7x10 in.; pp. 103.

Classified list of research work, by states, with other information.

INDIANA STATE BOARD OF REGISTRATION FOR PROFESSIONAL ENGINEERS AND LAND SURVEYORS: Report and Roster, 1921-22. Indianapolis. Paper; 6x9 in.; pp. 47; illustrated.

The first printed report of such a board that has come to our attention. Reviews work of board and gives list of registered engineers, with business and residence addresses, branch of engineering and section of Act governing registration. Contains map of United States showing registration boards, with kinds of registration, revised in November, 1922.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS: Proceedings, 1922—Secretary, A. M. Anderson, 10 South La Salle St., Chicago, Ill. Paper; 8x11 in.

MAINE HIGHWAY COMMISSION: Report from Jan. 1, 1921, to June 30, 1922—Augusta. Paper; 6x9 in.; pp. 67; folding map.

MISSOURI HIGHWAY COMMISSION: Report for 1922—Jefferson City. Cloth; 6x9 in.; pp. 237; maps and half tones.

MODULING OF IRRIGATION CHANNELS—By E. S. Crump, Executive Engineer, Public Works Department, Punjab Irrigation Branch, Lahore, India. Public Document. Paper; 9 x 13 in.; pp. 9; folding plates.

A module is here defined as "a device arranged to pass a supply of water independent of water-surface level in channel into which the supply is delivered." Two classes of modules are reviewed: (1) rigid, or those passing a fixed supply; (2) flexible, those "passing a supply which varies, in some characteristic manner, with surface level in the supply channel, divided into (a) orifice, (b) weir or flume, and (e) combination of (a) and (b)."

NEW HAMPSHIRE HIGHWAY DEPARTMENT: Report for 1920-22—Concord. Cloth; 6x9 in.; pp. 143; half tones.

PLAN OF NEW YORK AND ITS ENVIRONS: Report of Progress, May, 1922—February, 1923. Address Plan of New York and Environs, 130 East 22nd St., New York City. Paper; 6x9 in.; pp. 67.

Gives personnel of committee and staff. Reviews work under the four heads, physical, economic, social nad legal, the physical section being by Nelson P. Lewis, consulting engineer. Contains a preliminary report by the noted British town planner, Raymond Unwin, on New York and Environs as a Regional Planning Problem from the European Point of View, written after a visit to New York for conference purposes. Announces an expected report from Jacques Lambert of Paris.

REPRINT OF FIVE ARTICLES RELATING TO BALTIMORE'S SEWAGE SYSTEM—Baltimore, Md.: Sewer Division. City Hall. Paper; 6x9 in.; pp. 37; line cuts.

Three articles by M. J. Ruark, division engineer of sewers, and two by C. E. Keefer, assistant designing engineer on sewer design and maintenance, enlargement of sewer-works and sludge treatment, from *Proceedings* Am. Soc. M.I., *Engineering News-Record* and *Public Works*, originally printed in 1921-22.

SASKATCHEWAN DEPARTMENT OF HIGHWAYS: Report for 1921-22—Regina. Paper 7x10 in.; pp. 99; half tones.

SPECIAL TAXATION FOR MOTOR VEHICLES: (1) Sound and Equitable Principles for Motor Vehicle Taxation. (2) State Taxes in Force Jan. 1, 1923. (3) Total Amount of Taxes Paid in 1921. New York: Motor Vehicle Conference Committee, 366 Madison Ave. Paper; 6x9 in.; pp. 24.

SPECIFICATIONS FOR PETROLEUM PRODUCTS AND METHODS OF TESTING—Federal Specifications Board, Revised Oct. 31, 1922. Washington, D. C.: Bureau of Mines. Paper; 6x9 in.; pp. 88; line cuts.

STANDARDIZING SALARIES—Prepared by J. B. Probst, Chief Examiner, Civil Service Bureau, St. Paul, Minn. Paper; 6x9 in.; pp. 8.

States principles and gives basic salary rates for eight grades of service with 1916 as 100, together with 1921 percentages, increases for the annual adjustment to accord with living costs.

SURFACE WATER SUPPLY OF CANADA: British Columbia and Yukon Territory, Climatic Year, 1920-21—Ottawa: Dominion Water Power Branch. Paper; 7x10 in.; pp. 197; folding map.

SURVEY OF CITY AND REGIONAL PLANNING IN THE UNITED STATES, 1922: With a List of Plan Reports, 1921-22—By Theodora Kimball, Librarian, School of Landscape Architecture, Harvard University. Reprinted from *Landscape Architecture*, January, 1923. Paper; 6x9 in.; pp. 20.

Twenty-seven cities are listed as being the subject of city plan reports in 1921-22; some have from two to five entries.

THE SWEDISH YEAR BOOK, 1922—Edited and Published with the Assistance of Public Authorities—Stockholm: Royal Foreign Office. New York City: Royal Consulate General of Sweden, 70 East 45th St. Flexible Cloth; 5x8 in.; pp. 253; illustrated. Covers succinctly and interestingly the arts, industries, commerce, government, etc., of Sweden.

TRAFFORD PARK: Britain's Workshop and Storehouse—Manchester, England: Trafford Park Estates, Ltd. Stiff paper; 8x11 in.; illustrated with folding colored map, half tones, etc.

Describes storehouses, industrial sites, existing industries, docks, railway facilities, etc., on a thousand-acre tract between Manchester Ship Canal and Cumberland Canal.

TYPICAL ABUSES IN HANDLING MUNICIPAL BONDS: Proposing a Bond Service for Bond Buyers, Bond Bankers and Bond Issuers. New York: Committee on Non-Partisan Facts of the Institute for Public Service, 1125 Amsterdam Ave. Paper; 5x7 in.; pp. 32

VENEZUELA MEMORIA OBRAS PUBLICAS—Annual Report—Caracas. Two volumes; paper; 9x12 in.; pp. 559 and 740; line cuts and half tones.

VERMONT SOCIETY OF ENGINEERS; Proceeding, 1922—Paper; 6x9 in.; pp. 24.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Mr. Hoover's Remarks and Society Co-operation

Sir—In *Engineering News-Record*, Feb. 1, 1923, p. 227, and in *Bulletin* No. 2 of the Federated American Engineering Societies, an account is given of some remarks made by Mr. Hoover at a luncheon in Washington to Charles F. Loweth, the new president of the American Society of Civil Engineers. These remarks seem to me to call for some comments, and possibly I may as well make them as anybody else.

Let me say at the beginning that I have a great admiration for Mr. Hoover, that I am proud and happy that an engineer is a member of the President's cabinet, and that I am glad Mr. Hoover is that member. This does not mean, however, that I necessarily approve of everything that Mr. Hoover says or does. Like all the rest of us, he is not infallible.

Mr. Loweth had stated at this luncheon, as reported in *Engineering News-Record*, that "if the American Society of Civil Engineers should not arrange to co-operate through the American Engineering Council, the organization itself would make arrangements for close co-operation with the government." He meant by this that if the American Society of Civil Engineers should not join the Federation, the society would nevertheless co-operate fully with the Federation and with Mr. Hoover.

These remarks of Mr. Loweth led Mr. Hoover "with more than his usual earnestness" to make some statements which seem open to criticism. He said that the American Society of Civil Engineers "should not raise secondary questions when that course interferes with engineers as a whole doing their duty to the country" (Federation *Bulletin*). He stated further that the American Society of Civil Engineers should join the Federation and help solve the transportation problem; and also that the Federation "was not in a position to throw its total possible weight of influence into the great public tasks that are before it because of the failure of the civil engineers to co-operate."

In other words, Mr. Hoover suggested that unless the American Society of Civil Engineers should join the Federation, it would not be doing its duty to the country, and further that it was failing to co-operate. I trust I may be pardoned if I say that I do not think Mr. Hoover has any right to say or to imply that the civil engineers are any less desirous or capable of doing their duty to the country, or are not doing it, because they do not wish to do it in his way. When a man asks me to co-operate with him, I generally know what he means; he does not mean that he wishes to do what *I* want done, but that he wants me to help him to do what *he* wants done. This seems to be Mr. Hoover's idea of co-operation. For Mr. Hoover to suggest that the civil engineers do not do their duty to the country if they are not willing to subordinate themselves to the Federation, to put themselves in its power, and to let the Federation speak and act for them, perhaps by opinions or acts which the society as a whole might strenuously disapprove, does not conform to the ideas which I had formed of his fairness.

As a matter of fact, many of the members of the American Society of Civil Engineers, and myself among the number, have been doing what we consider our duty to the country for many more years that Mr. Hoover has. The writer has occupied somewhat prominent public positions for more than 25 years; and he has many times gone to Washington at his own expense to appear before committees of Congress, or to urge matters for the public interest, such as the preservation of our forests, water power legislation, conservation, and the passage of the Jones-Reavis Bill for the reorganization of the Department of the Interior. Many other engineers have been doing public work of this kind while Mr. Hoover was still in foreign parts; and I do not think we can be blamed if we somewhat resent the implication that if we believe the American Society of Civil Engineers should preserve its independence, we are not doing our share of public service.

President Loweth had told the members assembled at his luncheon that if the American Society of Civil Engineers should not join the Federation, it would still be willing to co-operate with it, as it has already expressed its willingness to do. It will do this, I am sure, at any time that the government or that Mr. Hoover desires. It will appoint a committee to consider any public question which Mr. Hoover, or any other member of the cabinet, deems of public importance and desires to have it consider. Thus far, however, it has not been willing to abdicate or to allow any Federation or any other society in which it has only a minority interest to speak or act for it.

If Mr. Hoover wants the co-operation of the American Society of Civil Engineers, all he has to do is to ask for it. It will be given freely and fully, as President Loweth assured him. It is not at all certain that the American Society of Civil Engineers cannot do better public service out of the Federation than in it. At any rate, the society must be allowed to choose, and it should not be subject to criticism if it decides not to join. Mr. Hoover also assumes to designate as secondary any questions or arguments against joining the Federation. Should he not leave it to the society itself to judge what questions it considers secondary? GEORGE F. SWAIN.

Cambridge, Mass., Mar. 3, 1923.

Experiments with Cast-Iron and Steel Pipe

Sir—Mr. Tracy's letter on cast-iron and steel pipe at Ogden, Utah, in your issue of Jan. 25, p. 177, demands comment. The statement attributed to the mayor of Ogden that cast-iron pipe was being installed as an experiment was undoubtedly made in all sincerity but the history of cast-iron and steel pipe in Ogden, Salt Lake City and other places where alkali conditions are bad, makes further experiment with these two materials unnecessary. Cast-iron pipe laid in City Creek Canyon, Salt Lake City, in 1875 was dug up in 1919 and relaid in Sunnyside Ave. of that city. After its forty-four years of service, this pipe was found to be in first-class condition. In other parts of the system, where steel pipe was used, replacements have been made because of the failure of the pipe, until the entire distribution system of Salt Lake City now consists of cast-iron pipe. The gas company in Salt Lake City has had a similar experienece. In 1909 when the old gas plant was taken over by the new company, practically all of the steel pipe in the distribution system was replaced with cast-iron. At this same time, the smaller sizes of cast-iron that were laid in 1873 and 1874 were taken up and relaid in the city of Ogden, to replace steel gas mains that were losing 40 per cent of the gas delivered to them.

At Green River and Rawlins, Wyo., cast-iron lines have been in service fifty years, while steel pipe has been replaced at Spring Valley, Laramie, Ranchester, and Buffalo, Wyo. In fact practically every water-works in Wyoming that has ever used anything but cast-iron pipe has been forced to replace the inferior material.

Mr. Tracy admits that there are places where steel pipe has been replaced by the Ogden water department but he says that there are some places where steel pipe has given good service and a long life is to be expected.

Mr. Tracy further states that the difference in cost of cast-iron and steel pipe if placed at interest would make it possible to replace the steel line at the end of twenty-three years. The replacement of pipe involves factors other than the cost of pipe and laying. Tearing up streets; inconvenience to consumers; loss of large amounts of water through leaks previous to replacement; danger of failure of mains during fires; and high maintenance costs for several years previous to the final replacement. There is every reason to believe that one installation of cast-iron pipe will outlast several of steel pipe, and save these costs.

With such a great mileage of cast-iron pipe in the United States and such a small amount of steel pipe in service, one hears of more grief from cast-iron than from steel pipe. One of the larger pipe companies has carried on an investigation of all of the breaks that come to its attention and has found that in the great majority of cases they are due to some outside influence.

The real reason for the use of steel pipe in certain parts of the West in the past has been high freight rates. These have made the cost of cast-iron pipe so high that many towns could not be convinced that it was well worth its extra cost. The fact that many water-works have replaced their steel pipe with cast-iron shows that after having had experience with steel pipes they recognized that the difference in the first cost is represented in the greater worth of cast-iron pipe. THOMAS F. WOLFE,

Chicago, Feb. 7, Secretary The Cast Iron Pipe
1923. Publicity Bureau.

Proposed British Motor-Car Gasoline Tax

Sir—All vehicle taxation, whether horse, mechanical or gasoline, in Great Britain is levied and collected by the central government, that is to say it is what you would call a federal tax, as an annual tax the net proceeds from which are allocated to the improvement and maintenance of the "main" roads of the country. The actual expenditure of the money is, in general, carried out by the particular local authority responsible for the roads in any area. Thus the Lancashire County Council is responsible for the roads in that county; for those which have been designated as "main" roads a contribution is received from the proceeds of the vehicle tax and the remaining expenditure on "main" roads as well as that on the other roads in the county of Lancashire is covered from the Lancashire county taxes.

Some years ago it was agreed between the central government and the gasoline vehicle users that the annual taxation to be paid by the latter should be about $50,000,000 to $55,000,000 per annum. The tax is now levied on all motor cycles, cars, taxis and trucks on a basis of horse power of the vehicle and amounts to about $5 per horse power per annum.

The motor manufacturers and users associations are now pressing for the abolition of the horse-power tax and the substitution therefor of a tax of 10c. per gallon on gasoline with an additional purely nominal fee for the registration of each vehicle. This change they claim will not reduce the gross amount received and will be much fairer in its incidence than the present tax.

A tax of 10c. per gallon, or rather 8c. per American gallon, probably sounds pretty big to you—I think I have seen 2c. per gallon mentioned in *Engineering News-Record* as being the tax in Connecticut—but as compared with the States the ownership of a car is a luxury in England.

Common labor in New York earns $4 per day and the corresponding rate in London is ten shillings or $2.50 (8 hour day. $1 = 4 shillings). The cheapest British car costs £200 as compared with a figure in the States of $600. From these figures it follows that a cheap car in America represents 150 days work whereas in England it represents 400 days work of the same class of labor. It is quite wrong in such a case to make the comparison using rate of exchange, as even before 1914 the purchasing power of $1 in America was not the same as four shillings in England.

It is by reason of this high cost of cars in England that motor cycles, with or without side-cars are so numerous in proportion to the cars. I think that in Great Britain there are about 500,000 private cars and 350,000 motor cycles, which is a much greater proportion than is the case with you. A cheap motor cycle and side-car costs about £80 ($400) in England.

London, England.
Feb 4, 1923. F. J. RICHMOND,
Sir John Jackson, Ltd.

Low Bidding on Highway Work

Sir—Referring to a letter to the editor from Rodman Wiley, *Engineering News-Record*, Feb. 15, 1923, p. 317, the problem of contracts awarded at a sum below cost has reached the point where public welfare calls for a solution. I do not believe, however, that the solution lies in the direction pointed out.

If the low bid were of actual benefit to the public, it would not be a condition that should be changed, no matter what effect it has on the contractor as an individual or on contracting as a business. But we are beginning to realize that letting contracts below cost does not give the public the best that can be had for the money expended.

Generally speaking, the bid below cost is made by the incompetent bidder. There are different reasons why this lowest bid may not be to the best interests of the public. For example, the bidder may not have experience. If one hired a blacksmith to do the interior decoration of a court house, the taxpayer would not get the worth of his money, no matter how little it cost, nor how many efficient inspectors might be on the job. The losses from accidents and non-completion of contract for lack of funds, are added directly to the insurance and bonding rates to be paid eventually by the taxpayer. Loss due to work dragging, poor construction and interference with other operations, are further charges the public must make against the contractor who bids too low.

Since the evil of contracting below cost is a public affair, it is the public through their agent, the engineer or the architect, whose duty it is to make the correction. This is not a problem that the public should turn over to the contractor to solve, even if it is within the power of the contractor to solve.

The letting of construction work by contract has probably reached its highest development in railroad work. Can we not take a lesson from the railroad methods, which are, in short, to invite all contractors who are appropriate bidders for the work under consideration, and then let the contract to the lowest bidder. The lessons we must take from this are: First, the appropriate bidders, as a class, must be segregated from the inappropriate bidders; second, to save confusion in the owner's organization this must be done before the bids are opened, and preferably before they are submitted. This is not so easily done in public work as it is in private work, but still it is not impossible. The certified check has, in the past, been considered sufficient for this purpose, but has proven inadequate. Some engineers have required statements of experience, equipment and finances to be submitted with the proposal. This has kept some inappropriate contractors from bidding. It could be made more effective if a letter from the banker was required stating how much money or credit the contractor had for the work in question.

To avoid this difficulty a practical and effective method would be to require each prospective bidder to submit, a certain number of days before the letting, a statement of experience; the amount of credit obtainable; the amount of credit already employed on other work; a plan of operations; the name and experience of the superintendent; a list of tools which he obligates himself to put on the work, and other data as the peculiarities of the work in question require. The owner and his engineer could go over these statements some days before the letting and notify the prospective bidder whether or not his proposal is requested. This can be done without reflecting on the competency, as a contractor, of the proposed bidder. He may have his money, his superintendents, or his equipment, tied up on some other work, making him an inappropriate bidder at the time, although competent. By not making public the list of those competent to bid, the owner may receive all the advantages of competition, and at the same time be assured of letting the contract to an appropriate bidder, at such a price that the public may get the most for its investment.

Topeka, Kan., Feb. 26, 1923. **Lloyd B. Smith,**
President, Topeka Bridge & Construction Co.

Highways and Light Railways in Argentina

Sir—The 24-in. gage agricultural lines built by the Buenos Aires Great Southern Ry. in the Argentine, as described in *Engineering News-Record* of Feb. 15, p. 307, are interesting examples of methods of bringing the produce of an agricultural district to the main railway lines in localities where road building materials are scarce, or as in this case entirely unavailable except by long haulage. Throughout much of the territory within a radius of 400 or 500 miles from Buenos Aires, and for much greater distances toward the northwest, the soil is first cousin to our western gumbo and there is not a sign of stone or gravel anywhere.

This method of solving the transport problem by the construction of light railways is proper for the railroad company, whose chief concern is serving its public to the extent of facilitating in every way the handling of its tributary traffic. But it is not one which seems to be the most advantageous in the long run for the development of the territory as a whole.

The ultimate solution of this problem is the construction of roads, and there is little doubt that if this were properly and rationally studied, a scheme could be worked out for the establishment of a system of passable highways, which would do a great deal to help the further intensive development of this most fertile section. It is true that road building materials are scarce—that is to say expensive by reason of the long hauls required, and that construction costs are high owing to the fact that the foundations are the black sticky gumbo-like soil. Still the application of our present day knowledge of the treatment of such soils would probably permit a solution within the limits of financial possibilities. In fact, at least one such scheme has been partially worked out and there is little doubt that but for the war, substantial progress would already have been made to develop a system of highways in the Argentine. At the present time it is almost correct to say that except in a very few instances highways usable the year round do not exist in the Argentine and motor cars cannot be used outside of a few of the larger cities and towns.

Coming back to the 24-in. gage railways, it may be interesting to note that one of these little railways has been in existence for many years, running easterly from the city of Corrientes in the northwest corner of the province of that name, to General Paz and San Luis, carrying both passengers and freight. It is now also seriously proposed to cover the two provinces of Entre Rios and Corrientes with a network of similar lines. In these two provinces between the river Parana and Uruguay there is much more easily available material for road building and it would seem that a system of highways might serve more people. The Argentine Government is also proposing to develop northern Patagonia (Rio Negro and Chubut by a system of 24-in. gage railways several hundred miles in extent, and I think construction on some of these lines has already been started.

South America is rather prone to try experiments in gages. The Argentine has had 5 ft. 6 in., 4 ft. 8½ in. and meter gage lines for many years, and it seems rather unfortunate at this late date to start the development of a fourth system, in spite of the fact that much may be said in favor of the particular experiment referred to in your article. Nothing said herein is in any sense a criticism of these feeders built by the Southern Ry. From its point of view the experiments seem to be entirely justified, but it would be regrettable if work of this kind should delay the contruction of the highways the Argentine so greatly needs, or should lead to doubtful experiments in long-distant transportation by lines of this small gage.

In connection with the question of gage, which is a matter in which I have been much interested for several years, it is to be noted that in spite of the fact that the two great railroads in Peru (which start from the coast and cross the western range of the Andes at 15,000 to 16,000 ft. above sea level) are of standard gage (4 ft. 8½ in.), it is proposed to connect them by a meter-gage line. It seems to be difficult to make people realize that a light railway can be built with a wide gage.

New York City, **Fred Lavis,**
Feb. 28, 1923. Consulting Engineer.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The preliminary permit granted James B. Girand for his Diamond Creek project on the Colorado River was entended six months from March 19. Mr. Girand's application for license is being held up pending ratification of the Colorado River Compact.

To avoid any duplication of work, a co-operative arrangement has been completed between the Bureau of Mines and the Bureau of Standards for the handling of studies being made of corrosion. The work is confined mainly to the corrosion problem as it affects metals and alloys exposed to mine waters.

The joint hearing of the New York Port Authority and the Interstate Commerce Commission over the possibility of putting into effect the comprehensive plan for the development of the port has been postponed from March 15 to April 5. Postponement was made necessary through the illness of Chairman Aitchison of Division 5 of the Interstate Commerce Commission.

By a majority of 1,883 votes the commission plan of government was adopted by Camden, N. J., on March 6. At an election to be held about the middle of April five commissioners will be chosen in place of the mayor and 28 councilmen under the present plan. The change was favored by Victor King, the present Mayor of Camden. Most of the cities of New Jersey are already under the commission plan.

French reconstruction work in Alsace and Lorraine to date includes the restoration of 79 per cent of the acreage of agricultural land devastated during the war and about 67 per cent of the number of factories destroyed. About 44 per cent of the number of houses damaged or destroyed have been repaired or reconstructed and more than 1,000,000,000 francs have been spent in the work of restoration, says a recent bulletin issued by the Bankers Trust Co. of New York.

A bill to abolish the engineers license law in Colorado has been withdrawn. The Colorado Society of Engineers which sponsored the act now on the statute books reports that opposition to the law came from mining engineers. The later group seem to have been convinced when it was pointed out that the law would have a salutary effect in checking the unscrupulous man (not qualified) who would make any sort of mining report desired. License fees from the engineers are going into a library for engineers, an arrangement about which the society is enthusiastic.

Tax Exemption of New Dwellings in New Jersey Illegal

The New Jersey law of 1920 exempting from taxation for five years new buildings erected for residence purposes has been declared unconstitutional by the New Jersey Court of Errors and Appeals, thus affirming a similar decision of the Supreme Court handed down about a year ago. Both courts hold that the act is unconstitutional because it creates an arbitrary classification of property. Soon after the law was passed the attorney general of the state ruled that it was unconstitutional and it is reported that many, if not most, of the municipalities of the state have continued to levy taxes against new buildings for residence purposes.

Contractors Ask Federation to Consider Rising Costs

The Associated General Contractors of America some time ago addressed to the Federated American Engineering Societies a letter asking the Federation to appoint an engineering committee to set in motion a nation-wide co-operation movement to combat the rising costs of construction. In response to this appeal the committee on procedure of the Federation adopted resolutions stating that it views with approval the proposed co-operation and authorizing President Cooley to appoint a committee to co-operate with some authoritative agency, such as the American Construction Council or the Associated General Contractors, to consider the problem.

The A.G.C. letter states that "The seasonal demand of construction for labor, materials and transportation which reaches its peak in late summer coincident with the seasonal peak of many other industries, has created a shortage of all of these items each year. This shortage occurring at the peak of the construction season, appears to be growing more acute and the difficulties thereby involved more troublesome each year. In the construction field we believe that the only effective remedy for the situation lies in lengthening the construction season as much as possible, and in performing all work possible during the winter season. This procedure will produce more continuous production of materials in the basic industries and should also enable us to suppress during late summer the peak of the transportation demand." As to climbing costs, the contractors added: "We believe that the construction industry will be seriously damaged unless this trend is stopped and the public be informed thereof, and therefore we ask that you join with us in doing all things possible to publish this with a view of stabilizing the construction industry and keeping it going at a normal rate and to take out of it its cyclical periods."

A report on the question will be made by President Cooley at a meeting of the executive board of the Federation, March 23-24.

Clyde Potts Denies Direct Oxidation Co. Charges

Alleges Attempt to Browbeat State Board and Asks Governor to Investigate Activities of Company

The charges (*Engineering News-Record*, March 8, p. 462) brought by the Direct Oxidation Disposal Corporation against the New Jersey State Board of Health in general and Clyde Potts in particular alleging unreasonable delay, with improper motives on the part of Mr. Potts, in acting upon plans for sewage-works for Trenton, N. J., drawn by Col. George A. Johnson, have been denied by Mr. Potts in a letter to Governor Silzer, as follows:

30 Church St., New York City,
March 12, 1923.

"Honorable George S. Silzer,
Governor,
Trenton, N. J.

"Sir—On Feb. 19 certain charges were made by H. Jerome Hirst against me, specifically, and against the other members of the [State] Department of Health for delay in approving the plans for sewage disposal works for the City of Trenton. These charges were referred by you to the Department of Health, and at the last meeting of the Department of Health [March 6] they were returned to you because of the impropriety of the department examining charges made against one of its members or the members of the board collectively.

"I will be glad to appear before you any time and give you any information concerning this company which you desire.

"Their charges against me personally, are, of course, untrue, as are also the charges against the other members of the board as to their being influenced in this matter. This letter to you and the propaganda which this company is putting out in the newspapers is merely an effort to browbeat and blackguard the State Department of Health into an attitude where it will approve these Trenton plans without a proper investigation.

"As you may know, the State Department of Health approved this system for the Town of Phillipsburg with the understanding that it was to be an experimental plant. So far as the Department of Health is concerned it is still an experimental plant as it has not yet been accepted by the department. It was built two years ago and the irregularities connected with this erection were so serious that Judge Gnichtel was appointed a Supreme Court Commissioner to investigate the Town of Phillipsburg and the proceedings in connection with the erection of this plant. As a result of that investigation the Grand Jury indicted the Municipal Disposal Corporation of Philadelphia as a corporation, and this man H. Jerome Hirst as an individual, for irregularities in connection with the erection of the plant there, and the matter has not yet been brought to trial.

"Under the circumstances surrounding the erection of the Phillipsburg plant and the fact that this system is still in the experimental stage it is strange that there should be such a great demand for speed in connection with the Trenton plans.

"I would therefore suggest to you that in investigating the charges made by H. Jerome Hirst, that you broaden out the scope of the investigation so as to include the activities of the Direct Oxidation Corporation and H. Jerome Hirst, not only in the State of New Jersey but in other states, which will be brought to your attention, as well.

"The filing of these charges and the subsequent acts of these parties shows, I believe, an effort to dominate sewage disposal matters in the State of New Jersey by a patented sewage disposal combine, that is well worth your best efforts in detecting in its incipiency.

Yours respectfully,
Clyde Potts."

At a meeting of the City Commission of Trenton on March 9, Mayor Donnolly, a member of the commission, offered a resolution asking the State Board of Health to postpone the date on which it must have sewage-works in operation on the grounds that the city cannot finance sewage-works without sacrificing its school building program; that the direct-oxidation process is still in an experimental stage; and that already $30,000 has been expended in reconstructing the direct-oxidation plant at Phillipsburg, N. J. The other four members of the commission voted against the resolution and declared themselves in favor of asking Governor Silzer to investigate the charges filed against the State Board of Health.

N. J. Highway Body Confirmed

The eight-weeks battle for control of the New Jersey Highway Commission was terminated on March 13 by the confirmation of the four nominees by the Senate. The new board is now made up of General Hugh L. Scott, of Princeton, and Walter Kidde, Montclair, Republicans, and Abraham Jelin, of New Brunswick, and Percy Stewart, of Plainfield, Democrats. The vote in the Senate was 12 to 7, some of the Senators voting one or two members only.

Tri-State Delaware Water-Supply Again Advocated

Negotiations for a tri-state treaty between New York, New Jersey and Pennsylvania, looking to the joint development of the Delaware River for public water-supply purposes, hydro-electric power and flood prevention, similar to the port authority treaty between New York and New Jersey, is advocated by George J. Gillespie, president of the Board of Water Supply of New York City, in a letter to Alfred E. Smith, Governor of New York.

Mr. Gillespie proposes that the New York Legislature authorize Governor Smith to appoint a commission to co-operate with like commissions representing New Jersey and Pennsylvania for the purpose already stated. This general plan was proposed recently by Morris R. Sherrerd, chief engineer of the North Jersey District Water Commission, and a bill to that end was immediately introduced in the New Jersey Legislature.

Stewart Company Wins Point in War Fraud Suit

Judge Jacob Trieber, sitting in federal court at Little Rock, Ark., has sustained a motion of counsel for the Stewart Construction Co., of New York, to compel the government to file a bill of particulars in its suit charging fraud in connection with the building of Camp Pike. The Stewart company is charged with defrauding the government of $3,000,000 in connection with the construction of the camp. The suit against the Stewart company was filed Dec. 4, 1922.

Boston Sanitary Engineers Addressed by M. N. Baker

The annual meeting of the Sanitary Section of the Boston Society of Civil Engineers was held on March 7, just before the dinner of the Affiliated Technical Societies of Boston. John P. Wentworth was elected as chairman of the section for the ensuing year and H. P. Eddy, Jr., was re-elected as clerk. There are now about 190 members of the section. The average attendance at the meetings during the past year was about thirty. After the business session M. N. Baker, associate editor of *Engineering News-Record*, spoke on "Engineering and Public Health." An abstract of the address appears elsewhere in this issue.

Joint Meeting on Hydro-Electric Power for New York

On March 21 at the Engineering Building Societies' Building, New York City, there will be held a joint meeting of the New York sections of the four national engineering societies to discuss the problem of hydro-electric power for the New York City metropolitan district. The program includes the following:

PART I. A CO-ORDINATED SYMPOSIUM

F. W. Scheidenhelm, consulting engineer (Mead and Scheidenhelm), New York: Co-ordinating Statement of the Problem.

W. S. Murray, consulting engineer (Murray & Flood, Engineers), New York, formerly Chairman, Superpower Survey, U. S. Government: An Approximation of Available Water Power and Cost of Delivery.

George A. Orrok, consulting engineer, New York Edison Co. and affiliated companies: Requirements of Service and Evaluation of Hydro Power.

F. A. Allner, general superintendent, Pennsylvania Water & Power Co., Baltimore (in charge of 100,000 kw. Holtwood plant on Susquehanna River): Quality of Hydro Service.

Lorin E. Imlay, consulting engineer, Niagara Falls Power Co.: Reliability of Long Distance Transmission.

PART II. DISCUSSION

John P. Hogan, consulting engineer with William Barclay Parsons, New York: W. S. Finlay, Jr., New York, vice-president, American Water Works & Electric Co., formerly Superintendent of Motive Power, Interborough Rapid Transit Co.; discussion from the floor.

Arizona and Colorado Fail to Ratify Colorado Pact

Five of the seven states signatory to the so-called Colorado River Pact ratified that pact by acts of their legislatures just adjourned, but Arizona and Colorado failed to do so. Consequently the federal Congress did not ratify and the joint control of the river must go over for another year. In Arizona the treaty became a part of a local political fight started and continued on other issues. For a time it looked as though the pact would be ratified but the final vote was 27 to 22 and the treaty was therefore rejected. Colorado had apparently been waiting to see which way Arizona voted and did not act. Wyoming, Utah, California, Nevada and New Mexico ratified.

Provisions of the compact are explained in an article which appeared in *Engineering News-Record* Dec. 7, 1922, p. 987.

Ketchum Inducted as Engineering Dean at Illinois

Milo S. Ketchum, formerly dean of the College of Engineering at the University of Colorado and later professor of civil engineering at the University of Pennsylvania, was formally inducted as dean of the College of Engineering of the University of Illinois and Director of the Engineering Experiment Station at a University Convocation at Urbana, March 7. The new dean, who is a graduate of the University of Illinois, was inducted into office by the president of the university, Dr. David Kinley, and was welcomed by **W. L. Abbott**, on behalf of the Board of Trustees, and by **Prof. A. N. Talbot**, on behalf of the faculty. The principal address, on "The Importance of Research to Industrial Progress" was delivered by E. J. Mehren, editor of *Engineering News-Record*. In responding to the formal address of induction, Dean Ketchum discussed fundamentals in engineering education and the place of research in the education of the engineer. Extracts from the addresses will appear in an early issue.

Razing High Bridge Authorized by New York Board of Estimate

Removal of High Bridge over the Harlem River, a part of the first Croton Aqueduct built by New York City some eighty years ago, has been authorized by the Board of Estimate and Apportionment. The Department of Water Supply, Gas and Electricity has been directed to prepare plans for conveying beneath the river the water carried by pipes on the bridge, and the Department of Plants and Structures has been directed to prepare plans for razing the bridge. This action follows several years of agitation for either the destruction of the bridge or else the removal of some of its piers for the improvement of navigation in the Harlem River. The old Croton Aqueduct has been held in reserve since the Catskill Aqueduct was put in use in 1917 but recently it has been under inspection in view of possible restoration to service in case the Catskill supply should become inadequate before the supplementary supply from Schoharie Creek is available.

Railroad Problems Theme at Boston Engineers' Dinner

The first annual dinner of the Affiliated Technical Societies of Boston and the fourteenth annual dinner of Boston engineers was held at the Copley Plaza Hotel, March 7. Leonard Metcalf, chairman of the Affiliated Technical Societies of Boston, acted as toastmaster. The speakers of the evening were Dr. Samuel W. Stratton, the new president of the Massachusetts Institute of Technology, Edward E. Whiting, of the Boston *Herald*, and Charles A. Andrews, former president of the Associated Industries of Massachusetts.

Dr. Stratton questioned whether the engineering schools are covering the fundamentals and, after urging the importance of research work, laid stress upon the importance of having it correlated with the practical every-day problems of the engineer.

Mr. Andrews spoke on "The Why and How of Railroad Consolidation," reviewing the subject in general and at the close dealing particularly with consolidations in the New England territory, the whole referring to the requirements of the Transportation Act of 1920. Mr. Andrews urged that instead of making the New England railroads a group by themselves, as it appears some New England people are strongly urging, some such plan should be adopted as combining the New York, New Haven & Hartford with the Pennsylvania and putting the other railroads of New England with either the New York Central or the Delaware & Hudson.

Engineering Standards Committee Adds Sustaining Members

Change of the organization of the American Engineering Standards Committee by the addition of "sustaining members" with a view to developing industrial standardization has been announced by the committee. In this class of membership, dues are fixed on the basis of 1c. per $1,000 of gross receipts of the industry concerned. Twenty industrial executives have been named as an advisory committee in connection with the proposed industrial standardization work.

Heretofore the American Engineering Standards Committee has done its work with funds consisting only of dues paid by nine technical societies and seventeen trade associations, which together with seven departments of the federal government, formed its membership. Deficits were incurred in the operation of the committee, and these were covered by contributions obtained from various corporations. The financing of industrial standardization is expected to provide $50,000 annually.

A. W. Whitney, chairman of the American Engineering Standards Committee, states that industrial standardization may be expected to produce economies "measured in billions of dollars, not millions." So far as plans announced up the present show, the only service now contemplated in addition to that carried on by the committee hitherto is the issuing of information bulletins on developments in standardization work in the United States and other countries.

Federal Government Defends Water Power Act

In answer to the bill of complaint entered by the State of New York in the U. S. Supreme Court to test the authority of the Federal Water Power Act, Solicitor General Beck has set up the claim that the federal government has authority over the barge canal system of New York under the interstate commerce clause of the constitution, a canal system being a part of an interstate and foreign commerce waterway.

In its amended bill, the state claims that it has spent great sums on the development of waterways within the state and has projected hydro-electric developments concerning which it claims the Federal Power Commission had no authority. The government, in its answer, declares the bill does not join essential parties in that no determination can be made of the authority of the United States to enter into contracts with citizens of New York for the acquisition of real or other property useful in the preservation or improvement of navigation in the absence of the citizens whose property is affected. The government further claims that the state does not present any concrete plan regarding its proposal for hydro-electric development or how much plans would affect navigation.

Regarding the state's announced contemplation of hydro-electric development on the St. Lawrence River, the government sets forth that this waterway has been the subject of an international conference by act of Congress looking toward its improvement for oceangoing transportation and that if the state were to make any effort to construct plants there the Federal Power Commission would seek action by the attorney general to determine the effect. The Federal Power Commission, it is pointed out, does not construct plants, and such construction by those licensed to do so by the Commission would not deprive the state from the rights of taxation of such properties.

Boston Technical Societies Study Railroad Consolidation

A special committee of the Affiliated Technical Societies of Boston has submitted majority and minority reports as to the policy that should be followed with regard to the New England railroads under the consolidation provision of the transportation act.

The majority report, which is signed by George F. Swain, chairman, Charles T. Main, Charles R. Gow, Dugald C. Jackson and Leonard Metcalf, recommends that the New Haven R.R. should be consolidated with one of the trunk lines and that the other independent New England lines be consolidated with another of the trunk lines. Although the committee does not state which trunk lines the New England lines should consolidate with, they suggest that the New Haven should go with the Pennsylvania and the northern New England lines with the New York Central or the Delaware & Hudson.

In a minority report, E. C. Hultman, expresses the opinion that the sound solution of the New England transportation problem is a New England consolidated system which would embrace all the railroad lines in New England.

Proposed Bill Enables Ohio Cities to Charge for Sewer Use

A bill designed to provide funds for the proper maintenance and operation of sewerage systems and sewage-works has been drawn by the Ohio Department of Health and introduced in the State Legislature (Senate Bill 93). The proposed legislation is permissive, not mandatory.

The bill authorizes the legislative body of any city or village in Ohio to pass an ordinance establishing "just and equitable rates or charges" for the use of sewerage systems, the charges to be a lien upon the property connected with the sewer. The management of sewerage systems and sewage-works would be in charge of the director of public service in cities while in villages it would be under the board of trustees of public affairs, the director, and the board, respectively, to have the authority to appoint proper officers to take immediate charge of the sewers and sewage-works. The bill also authorizes the director of public service in cities and the board of trustees in villages to make necessary by-laws and regulations for the operation and protection of sewerage systems and sewage-works and for the construction and use of house sewer connections.

All money collected for the use of sewerage systems would be kept in a distinct fund used only to pay operation and maintenance charges of the sewerage system or sewage-works, together with any enlargement or replacement of the same; also in payment of interest on any sewer debts and for the creation of a sinking fund. The sewer fund could not be drawn upon the extension of the sewerage system into unsewered areas or for any other purpose except those named.

Bids Received for Large Addition to Baltimore Water Filters

Bids for the excavation and concrete for a 113-m.g.d. mechanical filtration plant contiguous to the present 128-m.g.d. plant of the Baltimore waterworks at Montebello, were received by the City of Baltimore, Md., March 7. The new plant will be similar to the existing one except for changes shown by operation to be desirable. The bids cover a mixing basin, coagulating basins, filters, head house and filtered water reservoir. The passages, head house, etc., are designed to serve a plant with a total capacity of 165 m.g.d. The superstructure will be let separately later on, except that the bids just received include concrete columns and roof beams above ground.

There were six Baltimore and one New York City bid. The totals of the two lowest and the highest bids were: (1) Carroza-Rowe Construction Co., Baltimore, $1,248,955; (2) Consolidated Engineering Co., Baltimore, $1,310,194; (3) Frederick Snare Corporation, New York City, $2,083,040.

The unit bids on some of the most important items were: Excavation, (a) $0.65; (b) $0.74; (c) $1.30 per cu.yd. Concrete, Class B: (a) $16.30; (b) $19.50; (c) $34 per cu.yd. Reinforcing steel, (a) 5c.; (b) and (c) each 5½c. per pound.

William A. Megraw is water engineer and James W. Armstrong is filtration engineer of Baltimore.

Rigid Rules Attend Award of High Dam to Ford

Must Apply for License by July 1, And Show Contracts for Sale of All Available Power

Washington Correspondence

In awarding a preliminary permit to Henry Ford covering the High Dam project in Minnesota what very apparently is a concession to public opinion in the locality was made by the Federal Power Commission. So as to guard against such non-use as has followed the construction of the Ford dam at Troy, N. Y., and to safeguard the public interest in other ways, the commission imposed very strict conditions in extending the preliminary permit.

In the first place, provision is made to insure the maximum possible utilization of the power. Mr. Ford is required to install four units with the maximum capacity of 4,800 hp.

Mr. Ford is required by the permit to apply for license before July 1. On that date he must present executed contracts for the sale, delivery and use of the maximum power that can be delivered at the dam. This probably means that a large block of the power must be sold to the Northern States Power Co. That company is understood to be ready to purchase such power as Mr. Ford has to sell but since it is now securing dump power for two and one-half mills per kilowatt-hour, delivered, it was brought out clearly at the hearing that the company would not be willing to pay a higher rate to Mr. Ford. It could be discerned that the Northern States Power Co. has some apprehension as to what might develop if one or both of the municipalities, adjacent to the High Dam, should be given power for general use.

Chief Engineer Mayo, of the Ford staff, who appeared in his behalf, told the commission that it is the expectation to use the power principally in electric furnaces. No attempt was made to explain why Mr. Ford is desirous of resorting to hydro-electric power for his St. Paul plant when engineers' estimates are that it will cost three times as much as power he could develop from coal at such a plant.

A further condition imposed by the commission is an annual charge of $95,500 for the use of the government's dam. Mr. Ford is also required to put in a tail race 2,000 ft. long, so as to prevent the silting up of the navigation channel and the lock.

Provide $10,000,000 a Year for Mississippi Floods

Congress passed, and the President signed, on the last day of the last session, a bill authorizing the appropriation of $10,000,000 a year for a period of six years to be spent for "controlling the floods of the Mississippi River and continuing its improvement from the Head of the Passes to the mouth of the Ohio River" under the provisions of the Mississippi River flood protection act of 1917. By this earlier act local interests have to furnish funds up to 50 per cent of those furnished by the federal government.

The new allotment is to be expended under the direction of the Mississippi River Commission.

Staff Changes in Engineering News-Record

Willard Chevalier, who has been associate editor of *Engineering News-Record* for the past year, becomes on Mar. 15 business manager of this journal. Colonel Chevalier, previous to his connection with *Engineering News-Record*, was for seven years engaged in selling work as salesman and sales manager. He succeeds William Buxman, who was business manager of *Engineering News* at the time of the consolidation of that journal with *Engineering Record* and has been business manager of *Engineering News-Record* since that time. Mr. Buxman with the title of assistant to the vice-president, becomes assistant to E. J. Mehren, vice-president in charge of the engineering unit of the McGraw-Hill Co., Inc. This unit comprises *Chemical & Metallurgical Engineering, Coal Age, Engineering and Mining Journal-Press* and *Engineering News-Record.*

Congress Authorizes Over $70,000,000 for Highways

Washington Correspondence

In addition to the $65,000,000 which Congress authorized for federal aid during the fiscal year which will end June 30, 1924, $6,500,000 was authorized for highways in the eleven western states and in Alaska, where there are forest reservations. Due to the differences which arose between the two Houses over this last appropriation, the conference report on the agricultural appropriation bill was delayed until just before the adjournment of Congress.

he House voted $3,000,000 for forest roads. The Senate increased this to $6,500,000. The compromise which finally was reached provides that $3,000,000 is appropriated outright, with authorization to place the remaining $3,500,000 under contract. This means that the $3,500,000 will be carried in the first deficiency bill after the new Congress assembles.

Boston Engineers Request Speedy Trial of War-Fraud Charges

At the annual dinner of the Affiliated Technical Societies of Boston on Mar. 7, participated in by some 300 members of one or more of the nine engineering societies in Boston and vicinity, a resolution was adopted urging the prompt trial of the engineers and contractors formerly connected with the Construction Division of the United States Army who are now under indictment, or against whom civil suits have been instituted. The preamble recites that the 3,300 engineers composing the membership of the affiliated societies "were greatly surprised and shocked by the indictment of certain of" their associates and of "other engineers and contractors, and by the bringing of civil suits by the United States Government to recover millions of dollars for alleged frauds, especially in view of the nature of the specific charges." The resolution expresses the feeling "that justice demands a prompt trial so that the innocent may be freed of the serious accusations which have been made against them."

Arthur St. Laurent Dies

Arthur St. Laurent, chief engineer of the Department of Public Works of the Canadian Government, president of the Engineering Institute of Canada, a member of the American Society of Civil Engineers and the International Congress of Navigation, died in Ottawa last week, aged 65 years. Mr. St. Laurent was elected president of the Engineering Institute of Canada, January 22 of this year, at the annual meeting in Montreal.

Mr. St. Laurent was born in Rimouski, Province of Quebec, in 1859. He was graduated from Montreal University. In 1888 he entered the service of the Public Works Department of Canada at Ottawa as principal draftsman and as principal assistant on harbor surveys. In 1891 he was made assistant engineer in the Winnipeg office which was in charge of the departmental operations in northwestern Ontario, Manitoba, and the Northwest Territory. In 1898 he was transferred back to headquarters at Ottawa as principal assistant engineer in charge of designs and contract plans for a lock and dam at St. Andrews Rapids on the Red River. Other work over which he had supervision included a traffic bridge across the North Saskatchewan River at Edmonton, the lengthening of the dry dock at Levis, Quebec, and alterations to the dry dock at Kingston, Ont.

In 1902 he was in charge of the construction of the Laurier bridge at Ottawa and of grain elevator No. 1 at Montreal Harbor. During that period he was acting as assistant chief engineer and in charge of the chief engineer's office on several occasions.

It was Mr. St. Laurent who introduced concrete in bridge construction in western Canada during the construction of the Edmonton bridge. He proposed the use of concrete in this structure, the proposal occasioning many prophecies of dire disaster. The bridge piers reached their full height and when spring came with its ice-laden current, ordinary structures in the valley were swept away. The piers however, withstood the test and it is recalled that the old "Northcote," a steamboat of Northwest rebellion fame, was completely wrecked against one of them. After this experience the public attitude changed and the young engineer received the credit due him.

Settlers on Reclamation Projects Given Time for Payments

Extension of time for payments due from settlers on United States Reclamation projects is authorized, at the discretion of the Secretary of the Interior, under an act passed near the close of the recent session of Congress. According to a statement issued by the Secretary "three classes of relief will be given that include the extension of time of payment of construction charges on irrigation ditches due during or before 1922 to any date not beyond Dec. 31, 1924; the furnishing of irrigation water during the season of 1923 regardless of delinquencies in payment of past charges by the farmers either for operation or construction due the Government; and the future payment of accrued charges both for operation, maintenance, and construction unpaid in 1922 or previous to that year, over a period of time by installments."

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Spring Meeting, New Orleans, La., April 18-20.

NATIONAL FIRE PROTECTION ASSOCIATION; Boston; Annual Meeting, Chicago, May 8-10.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Detroit, Mich., May 21-25.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

The Florida Engineering Society will hold its annual meeting at Jacksonville March 19 and 20. J. R. Benton, of Gainesville, is secretary of the society.

The New York Section of the Am. Soc. C. E. at its February meeting heard a paper by Albert A. Northrop, of Stone & Webster, on the Caribou Plant of the Great Western Power Co. in California.

Engineering Society of Wisconsin has elected the following as officers for 1923: President, John C. White, chief operating engineer of the power plant of the State Capitol; vice-president, W. G. Kirchoffer; secretary and treasurer, L. S. Smith, all of Madison, Wis.

The San Francisco Section, Am. Soc. C.E., on Feb. 20 held a regular bimonthly meeting at which the main topic of discussion was "Foundation Problems in the Filled-in Area of San Francisco." Speakers who presented prepared discussion on various phases of the topic were: A. A. Brown, J. M. Owens, Frank G. White, and C. Derleth, Jr.

The Texas Section American Society of Civil Engineers will hold its spring meeting in Ft. Worth April 13 and 14. Because of the general interest in Texas of water conservation and flood control the papers will be largely devoted to these subjects. The meeting will be in charge of A. J. McKensie, first vice-president, as the president, E. E. Sands, is seriously ill in Boston.

The Western Society of Engineers March 26 will hear an address on "Relief from Floods" by C. B. Burdick, of Alvord, Burdick & Howson, consulting engineers, Chicago. On March 13 a symposium on "Locomotive Terminals" was held.

The Triangle Club of New Jersey was organized at a meeting held in Jersey City last week. Architects, draftsmen, professional engineers, superintendents of construction, or others whose qualifications are satisfactory to the membership committee, are eligible to join. The purpose of the organization is the promotion of a general spirit of good fellowship. Officers elected were Hugh A. Kelly, president, Harry J. Oste, vice-president, and Peter J. Gannon, secretary.

Personal Notes

Hardgrove Norris, has resigned from the Atlantic Coast Line to accept a position as assistant engineer in the maintenance-of-way department of the Florida East Coast Ry. Co.

J. R. Taft, civil and railway engineer of New York City, has removed his office to Retsof, in Livingston County, New York, where he will continue his independent practice.

J. R. Arnold, former assistant supervisor, maintenance-of-way department of the Pittsburgh Railways Co., has become a partner in the general contracting firm of Pringle and Arnold, Washington, D. C. The firm will also act as sales agents of certain structural specialties.

Shelby Post, until recently a resident engineer of the Hardaway Contracting Co., of Columbus, Ga., has been made a superintendent of construction for the Southeastern Construction Co., of Charlotte, N. C.

M. W. Watson, state highway engineer of Kansas, has tendered his resignation to the governor and commission, effective April 1, 1923. His future plans have not yet been announced. Mr. Watson has been chief engineer of the Kansas Highway Commission since July, 1918. Prior to that time he served as road engineer of the Kansas commission, and in various engineering capacities with the state highway commission of Illinois. He is president of the Mississippi Valley Association of State Highway Officials.

E. J. Cleave, for the past three years superintendent of the Philadelphia division of the Pennsylvania R.R., has been transferred from Harrisburg to Philadelphia, where he will have a special duty in the general manager's office. Mr. Cleave entered the service of the Pennsylvania R.R. in 1881. He has held the position of assistant supervisor at various stations. He was also division engineer at Williamsport. In 1900 he was appointed assistant to the principal assistant engineer at Altoona, a few months later being made principal assistant engineer. Later he was promoted to be superintendent of the Cresson division, and in 1917 he was made superintendent of the Trenton division with headquarters at Trenton, N. J.

Prof. W. K. Hatt, director of the Advisory Board on Highway Research of the National Research Council, will sail for Europe on Mar. 17. He will make a study of highway development in several countries there and will attend the International Road Congress, to be held in Seville in May. He will return to the United States early in June.

Walter G. Black, of Mandan, N. D., has been appointed state engineer of North Dakota, and chief engineer of the state highway commission for a term of 4 years commencing April 1. Mr. Black is a member of the firm of Black and Griffin, consulting engineers, of Mandan. He has had extensive experience in the construction of highways. In the World War he served as a commissioned officer in the engineers, and in the reserves is in command of the 522nd Engineer Train (Heavy Bridge). He is a member of the American Society of Civil Engineers and the N. D. Society of Engineers, and is past-president of the N. D. Chapter of the American Association of Engineers.

H. E. Snow has been appointed city engineer of Brownsville, Tex.

S. J. Treadaway has resigned as county engineer of Bell County to become district engineer of Terrell Road District at Terrell, Kaufman County, Tex.

A. C. Pancoast has been appointed county engineer of Bexar County at San Antonio, Tex.; and Fred M. Percival, recently engineer at Rison, Ark. will succeed Mr. Pancoast as engineer for San Patricio County at Rockport, Tex.

Glenn L. Alt, an instructor in the University of Michigan engineering department, has secured a temporary leave of absence and is employed as a resident engineer for the Ann Arbor R.R. Co. He is stationed at Toledo, O.

Hamilton F. Gronen, former city commissioner of Tacoma, Wash., has been appointed to succeed William J. Roberts, as chief engineer of the inter-county river improvement work carried on under the joint supervision of the commissioners of King and Pierce Counties, Wash.

Osborne Saxton, for many years past head of the engineering and contracting departments of the Whitney Co., and for many years previous thereto assistant chief engineer of the Snare & Triest Co., both of New York, has resigned from the Whitney Co. and has together with Sumner Gerard formed the Saxton-Gerard Co., Inc., a firm which will engage in building construction.

N. B. Ambler, J. T. Brusky, Harrison E. Kleffel, and Thomas Richardson have recently joined McClellan & Junkersfeld, Inc., engineers and constructors, New York. Mr. Ambler for the last ten years has been superintendent of the Toronto Power Co., Ltd., Niagara Falls, Ont. Mr. Brusky was formerly with Stone & Webster, Inc., and the American International Shipbuilding Corp. Mr. Kleffel was with the Peabody Engineering Corp., New York City, and Mr. Richardson was with the M. W. Kellogg Co., New York City.

Lester S. Ready has been appointed chief engineer of the California State Railroad Commission to succeed Richard Sachse who resigned to enter private practice as a consulting engineer. The appointment is effective March 1. The new chief engineer has been associated with the Railroad Commission more than nine years, having been assistant chief engineer, in charge of the Gas and Electric Department, four years. He is a native of Ventura County, and a graduate of the University of California. The commission has appointed A. V. Guillou as assistant chief engineer in charge of the Gas and Electrical Division of the Commission. Mr. Guillou, who is also a graduate of the University of California, has acted as assistant engineer in the Gas and Electric Division for the last three years.

Fred A. Lorentz has been chosen by the Board of Public Utilities, of Los Angeles, as chief engineer of the board to succeed H. Z. Osborne, Jr., who recently resigned, his resignation becoming effective March 1. Mr. Lorentz has been in the department for the past twelve years as engineer in charge of street railway transportation.

F. P. Gutelius has been appointed resident vice-president at Montreal for the Delaware & Hudson Ry. to succeed C. S. Sims, who resigns to return to his profession as engineer. Mr. Gutelius is one of the best known railway men in Canada. He has had long service with the C.P.R., and was for many years general manager of the Canadian Government Rys.

Obituary

Frank Graves, for more than 30 years a builder and contractor in Los Angeles, Calif., died in that city Feb. 26, aged 70 years.

Robert Bain, aged 80, a resident of California for 40 years and a pioneer in the contracting and construction field in Los Angeles, died in that city Feb. 26.

P. H. Wilson, vice-president of the J. G. Wilson Corporation, died in Rochester February 11 after an illness of two years. Mr. Wilson has been general manager of the Wilson corporation for five years prior to his election as vice-president.

Capt. R. B. Rice, president of the Rice Construction Co., of Portland, Ore., died recently, aged 63 years. He was formerly connected with the Crosby Transportation Co., of Muskegon, Mich., but for the past 20 years has been in the contracting business in Portland.

John R. Hansen, assistant to the city engineer of Portland, Ore., died recently in Chicago, where he had undergone an operation. He was seventy years of age. Mr. Hansen, a native of Norway, had been in the employ of the engineering department of Portland since 1891.

William DeForest Stratton, for many years president of the Mobile, Jackson & Kansas City R.R., and also a railroad contractor, died at his home in Middletown, N. Y., last week. Mr. Stratton was 78 years of age. He built a number of important railroad bridges, among them being the Pennsylvania R.R. bridge across the Susquehanna River at Harrisburg, a bridge across the Delaware at North Philadelphia and one across the Mississippi at Ruolo, Neb., for the Illinois Central. He also was in charge of constructing the Baltimore & Ohio tunnel through Philadelphia.

Franklin Cogswell Prindle, a retired rear-admiral in the Civil Engineer Corps of the United States Navy, died at the Naval Hospital, Washington, D. C., March 6, aged 82 years. Admiral Prindle was born in Vermont and received his early education in Arlington, later becoming a student at Rensselaer Polytechnic Institute. However, he was not graduated inasmuch as the Civil War broke out shortly after he entered college and he enlisted in the Engineering Corps of the Navy, subsequently winning an appointment as third assistant engineer. After two years' service at sea he was promoted and returned to a post in New York City. At the end of the war he resigned, but two years later accepted an appointment as assistant civil engineer at the New York Navy Yard. He was commissioned a civil engineer in the Navy in 1869, winning successive promotions until at the time of his retirement in 1890 he was a captain. During his active professional career he served as civil engineer at the navy yards in stations at Portsmouth, N. H., Boston, Newport, Brooklyn, League Island, Norfolk, Port Royal, S. C., Key West and Pensacola, Fla., Mare Island, Puget Sound, Yerba Buena Island, Calif., and Honolulu. In addition to his military career, he served various large corporations in an official capacity. He was elected a member of the American Society of Civil Engineers in 1874 and of the Institution of Civil Engineers of Great Britain in 1883.

William A. Howell, engineer of streets and highways of the City of Newark, N. J., and former president of the American Society for Municipal Improvements, died at his home in Newark, March 12, aged 63 years. He had been in the employ of the city since 1893. Mr. Howell was a graduate of New York University. His first engineering experience was with the Pennsylvania R.R., serving that road in various engineering capacities for 10 years, when, in 1889 he was made chief engineer of the New York, Susquehanna & Western R.R. The following year he engaged in railroad engineering in the West Indies. In 1893 he became associated with the City of Newark as assistant engineer of the Department of Streets and Highways, being later elevated through the grades of engineer of track elevation and principal assistant engineer to engineer of the department. He was a member of the American Society of Civil Engineers.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Turbine Maker Installs Hydraulic Laboratory

Equipment Provided for Making Variety of Complete Tests in New $40,000 Brick Structure

By John S. Carpenter

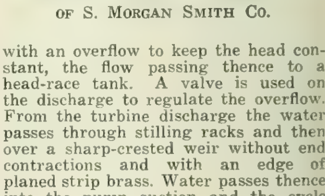
Hydraulic Engineer, S. Morgan Smith Co., York, Pa.

To provide facilities for testing hydraulic turbines, draft tubes and turbine settings, the S. Morgan Smith Co. of York, Pa., has just completed, at a cost of $40,000, the construction of a modern test flume. Previously the bulk of the testing work had to be carried on at the flume of the Holyoke (Mass.) Water Power Co., but owing to the increasing demands for tests at that place it was often difficult for turbine manufacturers to get work done in time to meet shipping dates. With its new test flume, the S. Morgan Smith Co. is in a position to conduct its testing and research work at its own plant.

The new hydraulic laboratory, as shown in the accompanying illustration, is a two-story brick structure 24 x 72 ft. in plan. The equipment includes a double suction, 9,000-gal.-per-minute, 50-hp. pump driven by induction motor, giving a maximum head of 12 ft. on the turbine. This pump takes its water under a head from a weir discharge pit and delivers into a baffle chamber with an overflow to keep the head constant, the flow passing thence to a head-race tank. A valve is used on the discharge to regulate the overflow. From the turbine discharge the water passes through stilling racks and then over a sharp-crested weir without end contractions and with an edge of planed strip brass. Water passes thence into the pump suction and the cycle begins anew.

New Hydraulic Laboratory of S. Morgan Smith Co.

On the operating floor are an Alden oil-type hydraulic brake, Fairbanks scales, and gate operating mechanism. Constant water pressure for the brake is obtained from a standpipe. Turbine speeds are taken from a revolution counter similar to that used at Holyoke. The discharge is indicated by a finely graduated hook gage in a stilling tank in the tail-race. The actual and effective head is measured by the difference beween gages in the head and tail-races and can be checked by a direct-reading head-gage. A view of the operating flow is shown on p. 513.



Head-Race Pit with Test Turbine Casing in Place

OPERATING FLOOR, WITH HYDRAULIC BRAKE, SCALES AND GATE MECHANISM

One of the illustrations shows the floor of the head race pit with test turbine casing in place and gate rigging connected up. The turbine rests on a large cast-iron plate which can be removed if desired. By means of a side opening not shown in the picture horizontal turbine settings also can be tested. A 3-ton hand crane is provided for taking the turbine out of the pit or removing draft tubes.

Regularity in taking readings is provided by a double pendulum electric time clock, which rings every half minute.

The hydraulic laboratory design was prepared by George A. Jessop, of the engineering department of the S. Morgan Smith Co.

First Pipe Made at New Plant

On March 1, the date announced by President J. R. McWane last September, the first pipe was made at the new pressure pipe works of the McWane Cast Iron Pipe Co., Birmingham, Ala., for which the site was acquired last September. The present plant, the first unit of a larger future development, will produce 8,000 ft. of small cast-iron pipe per day. Its 1¼-in. iron pipe, the company claims, is the smallest of its kind made. Larger sizes also are manufactured. The pipe is equipped with the McWane precalked joint described in *Engineering News-Record*, Sept. 7, 1922, p. 413.

The McWane company also announces the opening of sales offices in Philadelphia, Birmingham, Dallas, and Los Angeles, with warehouse stocks at other points.

Lumber Standards Committee Fixes Basis of Measurement

The Central Committee on Lumber Standards, Washington, D. C., announced last week through its executive secretary, R. G. Merritt, that at a recent meeting in Chicago it had agreed, by majority vote, to the "rough green" basis of measurement for lumber—that is, measurement of the lumber sawn full size as it falls from the log and not its size when "rough dry."

A study of the most economical and practical thicknesses for standard boards is now being made by the consulting committee on lumber standards. It is agreed that a board should not be 1 in. thick when the purpose for which it is used can be served by a lesser thickness.

Equipment Exported

According to figures given out by the U. S. Department of Commerce, exports of power shovels and other types of construction equipment for December, 1922, were as follows: 1 power shovel, valued at $7,130; 556,500 lb. of dredging machinery valued at $78,193; nine cranes valued at $60,171; 514 hoists and derricks (except mining) valued at $48,808.

The power shovel was shipped to British South Africa. Mexico was the bigger consumer of dredging machinery, and Japan took two cranes at $25,516.

Contractors Outline Program of Co-operation

From the report of the Committee on Methods presented at the annual convention of the Associated General Contractors in Los Angeles, Cal., Jan. 30-Feb. 3.

As a result of the investigation and activities of your Committee on Methods during the past year, the following recommendations are made:

(1) That the Association continue its co-operative work with other associations in formulating standards and simplifying dimensions in the field of materials and equipment production.

(2) That the contact formed with equipment manufacturers during the past year be strengthened, and that the joint work of these agencies be extended to all subjects of mutual interest.

(3) That a meeting be arranged with officials of the income tax unit to establish rational values for the depreciation of construction equipment, and to provide contractors with information to assist them in properly making out their returns.

(4) That the Association continue to improve safety measures in the construction industry and co-operate with the National Safety Council in its investigation and presentation of improved safety methods and devices.

(5) That the Association join with other associations of engineers, architects and manufacturers to further the study of seasonal fluctuation in industry and devise means, as far as possible, for its elimination in both the basic industries of construction and in other lines of production.

Some Neglected Factors in the Care of Equipment

Lack of Cleaning and Lubrication Boosts Power Consumption—Periodic Inspection Important

By CLARENCE E. BEMENT
Vice-President and General Manager.
Novo Engine Co., Lansing, Mich.

Mr. Bement's organization, which manufactures gasoline engines, pumps, air compressors and hoists for contractors' use, has often been commended for the promptness and completeness of the service rendered to purchasers of its products. One example may be cited:

A contractor ordered some piston rings without specifying size or type. Instead of consuming time in correspondence and keeping a machine idle on the job, the Novo company shipped to him immediately piston rings for ALL *models of its engines, so that the contractor might select those for his particular needs and return the others.*
—EDITOR.

In recent years much publicity has been given the subject of "Service"—meaning that branch of the manufacturer's business treating of proper operation and maintenance of equipment in the field. This extends all the way from such small courtesies as placing a man at the owner's disposal to instruct his operator, to replacing the whole unit if it proves to be unsatisfactory. All manufacturers are alert to the importance of rendering such service in the most efficient and acceptable manner.

Strange to say, the importance of this service is more fully appreciated by the manufacturer than the owner. From the standpoint of a manufacturer of equipment used in the construction industry we find a surprising condition of indifference with respect to the proper operation and maintenance of equipment sold by us, notwithstanding the fact that equipment out of commission becomes a most serious factor of annoyance and expense to the owner. The fact that the purchase of a piece of machinery frequently represents an investment of much money seems to be lost sight of, although its efficient service may mean to the owner the difference between profit and loss on a job.

WHY BREAKS OCCUR

Many constructors do not have a mechanic on the job, but entrust the care and adjustment of expensive machinery to untrained men. The result is that bearings and gears break because concrete is allowed to collect day after day; grease cups are broken off and the hole becomes clogged with dirt. Until the final crash comes the power consumed in overcoming the friction in such plants constitutes a large percentage of the total consumption of power—perhaps 50 per cent or more. On top of this is the expense due to the delay while waiting for the arrival of the repair parts that have been ordered.

With few exceptions constructors do not appreciate how anxious the manufacturer is to put his service departments on the most efficient basis or how much depends upon the contractor's own cooperation. This is not fault finding criticism. The constructor has many problems to solve, and as long as a machine will run at all its proper care seems one of lesser importance.

Lubrication is perhaps the oldest and at the same time one of the most important of all maintenance problems. If a statement representing the expense chargeable to improper lubrication or lack of lubrication could be placed before the individual owners of machinery used in the construction industry, an immediate and far-reaching reform in this phase of the maintenance problem would result.

REPAIR PARTS

In the matter of repair parts, a little foresight on the part of the owner or operator will in most cases eliminate delay and the expense incident thereto. The observance of a few simple rules applicable in all cases would result in a great advantage to both the manufacturer and owner. Care should be exercised in giving complete name, adress and point to which parts should be shipped. Complete part number and name of part should be specified, as well as serial number of machine and size, if so designated. If in doubt as to part number and description send in old part properly tagged for identification.

Constructors can save themselves much money by having their equipment thoroughly examined during idle periods, either by their own mechanics or one representing the manufacturer. Worn parts can them be replaced, bearings rebabbitted and everything put in perfect working order. After this has been done the machines should be repainted, all exposed iron and steel surfaces greased, and then placed under cover.

Machinery given such care and attention will long outlive machinery which receives no attention, until it breaks down. The owner will be repaid in the more efficient and longer service to be had from the machine and this benefit is reflected to the manufacturer in the more cordial feeling toward the equipment sold by him.

Business Notes

ALPHA PORTLAND CEMENT CO., Easton, Pa., has purchased the assets and goodwill of the Continental Portland Cement Co., St. Louis, and will continue the business, maintaining offices in St. Louis. It is the intention of the Alpha management to increase the plant's present capacity of 3,200 bbl. daily to from 4,000 to 5,000 bbl. daily.

RIX COMPRESSED AIR AND DRILL CO., San Francisco, announces the opening of its new quarters, a four-story structure at 505 Howard St.

B. OLNEY HOUGH, for many years editor of the *American Exporter*, has resigned from that position to establish himself as export consultant to manufacturers, banks and exporters under the name of B. Olney Hough, Inc., 17 Battery Place, New York City. During a business experience of 25 years he has been salesman, both domestic and foreign, manager and buyer for manufacturing plants, and has operated as export merchant in the United States and import merchant in foreign countries. He is the author of the book "Practical Exporting."

GIBB INSTRUMENT CO., Bay City, Mich., maker of electric welding equipment, has increased its authorized capital stock from $75,000 to $175,000. Of the increase $40,000 has been sold at par to provide increased manufacturing facilities.

SAMUEL B. COCHRANE, secretary and general manager, Atlas Steel Barrel Corp., Bayonne, N. J., died at his home in Brooklyn, N. Y., Feb. 27. He was 63 years old and became president of the Atlas company 10 years ago.

WILLIAM C. WRIGHT, sales agent for the Wyoming Shovel Works, Wyoming, Pa., and The L. & I. J. White Co., Buffalo, N. Y., has been appointed sales agent for the Philadelphia district, effective Feb. 1, by the Steacy-Schmidt Manufacturing Co., of York, Pa., manufacturers of kilns, dryers, boilers, stacks, gray iron and semi-steel castings, special machinery and builders of complete lime and hydrating plants.

A. W. BERGHOEFER has again become associated with the Gifford-Wood Co., manufacturer of elevating and conveying machinery and ice tools, and will be located at the New York office.

R. VAN HOEVENBERG, formerly general sales manager of the Standard Scale & Supply Co., Pittsburgh, has been appointed general sales manager of the Dravo Equipment Co., with headquarters in Pittsburgh.

CHICAGO PNEUMATIC TOOL CO., New York, announces the appointment of H. J. Bradley as branch manager, San Francisco, succeeding J. K. Haigh who has been transferred to the Chicago branch to resume sales work.

LAIB CO., Louisville, Ky., manufacturer of wrought pipe valves and fittings, has filed articles of charter amendment providing for an increase in capitalization from $150,000 to $900,000. The $750,000 will be raised by the sale of 2,000 shares of preferred stock and issuance of 5,500 shares of common stock at a par value of $100. Part of the 5,500 shares of common stock will be issued as a stock dividend.

OXWELD ACETYLENE CO., Newark, N. J., announces that its western department has recently moved to larger quarters at 1050 Mission St., San Francisco. Leo Romney, manager of the western department, states that the move was made necessary by the rapidly growing business on the Pacific Coast. At the new location the company occupies the entire building, two stories and basement, 20 x 150 ft., which affords better facilities for the warehousing of surplus stocks of welding and cutting apparatus, for private and general offices and for an apparatus repair service department.

STANDARD CONVEYOR CO., North St. Paul, Minn., announces that it has acquired by purchase all the rights, titles and patents pertaining to the Brown Portable Conveying Machinery Co.'s line of portable and sectional piling, elevating, conveying, loading and unloading machinery for the handling of packed and loose materials. This machinery has been manufactured by the Brown company at North Chicago for ten years. Until further notice the plant will be continued in operation by the Standard company.

R. W. HEERLEIN has assumed the duties of vice-president and general manager of the newly organized Flint Structural Steel Co., Flint, Mich. This organization is affiliated with Massillon (Ohio) Bridge & Structural Co., which recently purchased the Flint plant of the Perkins Structural Steel Co. and has in turn sold it to the Flint company.

Equipment and Materials

Price Cut on Portable Conveyor

A reduction of about 16 per cent in the price of its Cub portable conveyor for handling sand, stone, and other loose material is announced by the Link-Belt Co., Chicago. The new price is $585 as against $700 previously charged.

The equipment is mounted on two wheels, is driven by a 2-hp. electric motor, has a conveyor belt speed of 250 ft. per minute and a capacity of 45 cu.ft. per minute with uniform feeding. In explanation of its price reduction the company states that the loader has been placed on a quantity production basis, resulting in substantial savings in manufacturing costs.

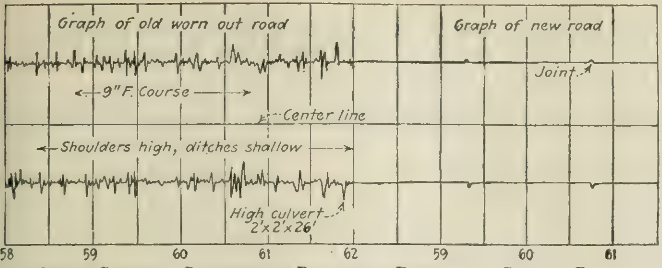
Recording Device on Auto Shows Condition of Road Surface

To indicate to highway engineers the condition of road surfaces a recording instrument known as the Vialog, designed for attachment to a passenger automobile or truck, has recently been perfected and placed on the market by the Universal Road Machinery Co., Kingston, N. Y. As shown in the accompanying illustration of an inspection car of the New York State Highway Commission, the device is installed on the dashboard. It is built almost entirely of aluminum and is light and compact.

DASHBOARD CARRIES RECORDING DEVICE

Within the box is a paper chart 6 in. wide driven by a flexible shaft connected to one of the front wheels; two recording pencils are actuated through a connection with the front axle. The paper is furnished in lengths sufficient for the inspection of 11 miles of road. A clutch is provided so that the instrument may be operated or disengaged at will.

As the automobile is driven over the road the chart moves in direct ratio to the distance traveled (the scale is 1 in. to 50 ft. of road) and the recording pencils make a series of irregular or straight lines depending on the condi-



Graph Showing Comparative Records of Rutted and Smooth Road

tion of the pavement. In this way the depressions and high spots are located, measured and recorded. The moving paper chart is in plain view of the observer so that notes may be made and topography or structures sketched in as the inspection proceeds.

Irregularities in the pavement are also automatically summed up and may be read at any time. This information may be reduced to inches of irregularities per mile of pavement by a simple calculation, for use in comparing various types of pavement or pavements of the same type on different routes. The device is the invention of Harley Dunbar, an engineer of the New York State Highway Comsion.

Portable Air Compressor Mounted on Ford Truck

A recent development in portable road-building and paving machinery is found in an air compressor mounted on a standard Ford truck which has been introduced by the Ingersoll-Rand Co., New York. The compressor is firmly held down to the truck chassis by means of U-bolts, so that it is unnecessary to drill bolt holes or make other alterations.

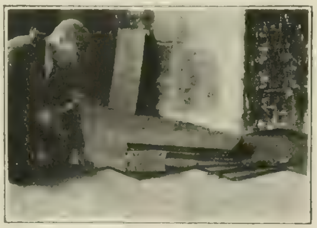
The air-compressing plant consists of a two-cylinder, vertical compressor, direct-connected to a four-cylinder, four-cycle, tractor type of gasoline engine; a radiator and fan for cooling the water for both the compressor and engine; an air receiver; fuel tank and other accessories. A regulator is furnished for automatically throwing the load off the compressor when a predetermined maximum receiver pressure is reached and throwing the load on the compressor at a predetermined minimum pressure.

With the outfit there are also supplied several tool boxes attached to the steel frame holding the compressor and engine. These are used for holding rock drills and pneumatic tools.

This compressor has a capacity of 91 cu.ft. of free air per minute and will operate a Jackhamer rock drill or two paving breakers, or other pneumatic tools such as are used by contractors and public service companies for road building, tearing up asphalt for pipe trenches, erecting steel structures, or for general maintenance work.

Leather-Waste Flooring Improved by Asphalt Impregnation

An improved feature, in the form of an impregnation with a rock-asphalt composition, has been introduced in the manufacture of the leather-waste inductrial flooring slabs developed by A. C. Denning, of the Endicott-Johnson Corp., shoe manufacturers, Johnson City, N. Y., and described in *Engineering News-Record* of Nov. 23, 1922, p. 908. This change in the process followed the taking over of the distribution of this product by the James A. Coffey Engineering Corp., New York City manufacturers of Minralite mastic mix, which is employed in treating the ¼-in. strips of leather fibre which are built up into 16 x 28-in. laminated sheets ⅝ or ¾ in. thick. With the asphaltic treatment adopted the joints between the leather strips are filled and a smoother, more waterproof surface secured than was the case with the untreated leather fibre. The weight of the treated flooring is about 4 lb. per square foot and is being introduced under the trade name "Long Life Fibre Flooring."



The flooring is designed for use in factories, warehouses and offices, and among the advantages claimed for it are: Great durability, as demonstrated by three years' tests at the Endicott-Johnson plant; resiliency, thereby minimizing the fatigue of workers who are on their feet all day; non-slipperiness; fire-resisting qualities; and simplicity of laying. The material furnishes a comparatively noiseless flooring and is recommended for installation where trucking is done.

Publications from the Construction Industry

Elevating Loaders—Barber-Greene Co., Aurora, Ill., has published a 32-p. illustrated booklet entitled "Results on Road Jobs." It presents sketches and photographs of a wide variety of material-handling installations together with brief descriptions of each job and records of progress. The latter portion of the booklet is devoted to portable conveyors of the endless belt type.

Backfiller — Buckeye Traction Ditcher Co., Findlay, Ohio, has published an illustrated booklet describing its Model D backfiller. The machine is mounted on full-length crawler traction and has a boom with a swinging range of 160 deg.

Rail Steel Reinforcement — Laclede Steel Co., St. Louis, has published an attractively printed and illustrated volume of 84 p. on rail steel for concrete reinforcement. Information is given as to the source and manufacture of steel bars, both from rail steel and billets, the various grades of reinforcing steel and the properties peculiar to each. It is the aim of the publication, by presenting a full description of the manufacture, physical properties and use of rail-steel bars, to answer attacks on this product made by distributors of billet bars. The text, however, is technical, not controversial, among the topics discussed being a comparison of the different grades of steel, with particular reference to crystallization, uniformity, brittleness, and bending. The latter portion of the volume is devoted mainly to photographs of structures reinforced with rail steel bars, including large public buildings, office and industrial structures, grain elevators, dams, sewers and other public works, bridges, roads and docks. The text concludes with standard specifications for concrete reinforcement bars.

Centrifugal Pumps — The Allis-Chalmers Manufacturing Co., Milwaukee, has just published a 58-p. illustrated bulletin entitled "Centrifugal Pumps and Centrifugal Pumping Units." The first half of the text deals with the company's standard types of centrifugal pump ranging upward from a size of 1½ in. and a capacity of 150 gal. per minute. Advice is given regarding the application of both single-stage and multi-stage units and the best types of drive under different conditions. Curves of tests are reproduced to show wide ranges of high efficiency with variable speeds. A number of applications of the multi-stage pump to city pumping service, hydraulic elevators, fire service, boiler feed supply, unwatering mines, irrigation, and general industrial use are illustrated and described. The latter portion of the bulletin is devoted to special pumps for unusual services, among them a rubber-lined pump handling liquids containing gritty matter and large horizontal and vertical centrifugal pumps. Several pages are devoted to head-capacity and to friction tables. The bulletin concludes with a valuable chapter of instructions on the installation and operation of horizontal centrifugal pumps.

Water Softening — Graver Corp., East Chicago, Ind., has issued an 8-p. bulletin on its Zeolite water-softening equipment for industrial and home use.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Why Construction Cost Is High and—Will It Go Higher?

Volume of 1922 Contracts 49 Per Cent Heavier than for 1921—Further Cost Inflation Depends on March-May Awards

A glance at Chart I shows what appears to be a paradox: construction cost rising steadily month after month, while contract volume declines. When prices of building materials were at the minimum, in May, 1922, the volume of large contracts awarded was 79 per cent above 1913. In February, 1923, the cost index had mounted to 197.40, and contracts stood at 105 compared with 100 in 1913. At present the *E. N.-R.* Cost Index registers 205.25, with the trend still upward.

Chart II, however, largely explains the anomaly. Cost declined throughout 1921, while contract letting was 8 per cent below the 1913 par. Furthermore, in the last seven months of 1920 the Construction Volume Index (C.V.) averaged 30 per cent below 1913. The lowest cost point occurred in March, 1922, when the general decrease from the peak was 38 per cent. The very next month showed a 3-point increase, and thereafter construction cost began its re-inflation. In March, also, the heavy contract-letting of 1922 began, the C. V. being 162 on the basis of four issues of Construction News. The peak (179) occurred in May. In these three months over half a billion dollars worth of large contracts was awarded. Volume fell off heavily in June and July, but nevertheless has remained consistently above 100, and has thus permitted the maintenance—and even the continued inflation—of cost.

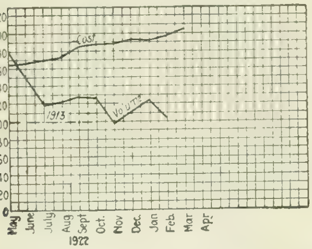


CHART I—PRESENT SITUATION: COST RISING, VOLUME DECLINING

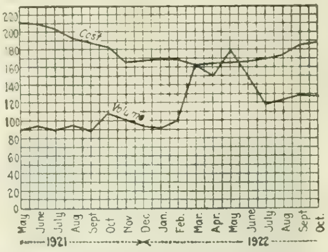


CHART II—CONSTRUCTION COST AND VOLUME SINCE MAY, 1921

Whether cost will continue to advance and, if so, for how long, will depend very much upon the amount of work placed under contract in the next three months. A C.V. of less than 120 would probably check the rising tide of prices. Indications are that March contracts will considerably exceed those of the previous month. Anything more would be a mere guess.

At present the mill price of structural steel is $2.25@$2.50 per 100 lb., with a decided leaning to the higher figure. Lumber has been steady for the last month, as have brick and lime. In the last few weeks two large cement companies have announced advances.

What It Cost to Build North Carolina Roads

On Feb. 1 the North Carolina State Highway Commission let contracts amounting to $3,030,099. Bids were received from 165 contractors. There were twenty-one projects totaling 193.67 miles, of which 63.68 miles were concrete or asphaltic paving and cost $1,933,937 or about $30,370 per mile. This included grading, draining, bridges, culverts, etc., but did not include the usual 10 per cent for engineering and contingencies. The widths of pavement were about equally divided between 16 and 18 ft.

The remaining 129.99 miles were of sand clay top soil or earth, costing $1,076,290, or about $8,279 per mile, including grading, draining, structures, etc.

The concrete bridges and culverts included in the above figures amounted to $378,877 or $1,956 per mile. Such structures throughout the entire state average about $1,975 for each mile of road built.

There Are 1910 Miles of South Carolina Roads

The total miles of roads under maintenance at the end of 1922 was 1909.72 as compared to 1313.5 at the beginning of the year. The total cost of maintenance work supervised by the department during the year was $474,120.78, of which $382,360.77 was for labor and materials, and $91,760.01 was for the purchase of equipment. The average cost per mile per year was $240.68. In a number of counties the funds were insufficient to take care of the roads completed on the State Highway System, and this condition became worse as the mileage increased during the year. It is estimated that the funds for 1923 will be insufficient in almost one half of the counties.

State Road Programs

Indiana's plans will probably be ready for announcement in two weeks.

Oklahoma reported on Mar. 2 that a bill was pending which provides for 50 per cent of the automobile taxes, which aggregate $3,500,000, to be placed in a state road fund. Another bill provides for a tax of 2c. per gal. on gasoline, and the revenue ($2,500,000) would be placed in the road fund. This state money is to be appropriated to the counties according to their state road mileage, and will be spent for construction and maintenance of state roads, under the direction of the state highway commissioner.

Montana legislature has appropriated $150,000 per year for the two fiscal years beginning July 1, 1923, and July 1, 1924, to be matched with county road funds and Federal Aid on the basis of 15, 32 and 53 per cent, respectively. This will develop $1,000,000 worth of road work for these two years, providing the counties put up $320,000 per year. The present list of projects which are reasonably certain to be constructed with county and state funds matching Federal Aid, and which will probably be placed under contract this year, totals about $650,000.

It is possible that projects on the Federal Aid 7 per cent system, within Indian reservations, totaling $1,200,000, will go under construction this year.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 141 to 159, are the following:

Apartment, Philadelphia, Pa., for L. H. Cahan and Sons, $6,000,000.

Depot, Kansas City, Mo., for Interurban Central Station Co., $3,000,000.

Office building, San Francisco, Calif., for Pacific Gas and Electric Co., $1,500,000.

Pumping station, Milwaukee, Wis., for Commissioner of Public Works, $1,500,000.

Temple, Milwaukee, Wis., for Milwaukee Lodge of Elks, $1,000,000.

Auditorium, Los Angeles, Calif., for Al Malaikah Temple, A.A.O.N.M.S., $1,000 000.

Hotel, Portland, Ore., for P. Wessinger, $1,000,000.

Steel and Sheetpiles Placed for $89 per Ton

Contract price for furnishing and erecting 1,360 tons of structural and 1,920 tons of steel sheetpiling for an addition to the shops of the Interborough Rapid Transit Ry. at Lenox Ave. and 148th St., New York, was $293,888, McClintick-Marshall Co. The engineer's estimate was $292,400.

Heaviest February Steel Ingot Output in Last Two Years

While the February pig-iron output reached a daily average of 106,935 tons, surpassing all previous records for that month and showing the heaviest tonnage reported since March, 1920, the steel ingot production rate fell off 10 per cent from the month preceding.

Steel ingot production totals as reported by the American Iron and Steel Institute show 2,919,017 tons for February as against 3,251,694, in January. Although the January tonnage is the heaviest reported since 1920, the total for February is nearly 30,000 tons greater than any month during the last two years.

STEEL INGOT OUTPUT IN GROSS TONS

	1923	1922	1921
January	3,251,694	1,593,482	2,203,186
February	2,919,017	1,745,022	1,749,477
March	......	2,370,751	1,570,978

A steady falling off in the production rate characterized the first quarter of 1921 as compared with a gradual gain in output during the corresponding period of 1922. With the steel industry operating at about 90 per cent of capacity as against 80 per cent last month and 55 per cent one year ago, the output for the current month will probably greatly exceed the totals for either January or February.

Bond Market Strong

The bond market, particularly for municipal securities, has continued strong throughout February and well into the first half of the current month. This development is due to the great number of small municipalities taking advantage of the current money market to obtain loans for improvement purposes.

According to the National City Bank of New York, the City of Philadelphia sold $8,000,000 4 per cent bonds, due in 1953, which were taken on a 3.88 per cent basis. Some of the larger municipal issues of the month, also included: $5,000,000, State of Oregon 4s and 4½s, to yield from 4.15 to 4.30 per cent; $5,000,000, State of West Virginia 4s and 4½s, at an average price of 99½ and interest; $4,721,000, Cleveland, O., 4½s and 4¾s, to yield from 4.10 to 4.25 per cent.

Several issues of 5 per cent Canadian bonds were offered in the American market at a discount from par. The larger issues included: Montreal, $13,000,000; Quebec, $1,872,000; Vancouver, $725,000 and London, $673,000.

The average price of forty standard bonds listed by the *Wall Street Journal* was 87.95, Feb. 24 as compared with 88.10, January 24 and 86.28 on Feb. 24, 1922.

Of the thirty-seven representative issues listed in the accompanying table, eleven sold at par, twenty-four above and two below par; the yields ranging from 4.05 to 5.44 per cent.

Rates varied from 4¼ to 7 per cent. The single 4¼ issue was located in Connecticut with one at 7 per cent in California. The only issue drawing 5¼ per cent was sold in South Carolina, with one each at 5¾ per cent in South Dakota and Oregon. All the 6s were disposed of in Southern states with the exception of one in Oregon. The 4½s were confined to the Middle Atlantic and Middle Western states while the bulk of the 5½s were in the lower Mississippi valley. Securities drawing 5 per cent formed the bulk of the thirty-seven disposals, and were fairly well distributed throughout the country.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 141 to 159, are the following large projects:

Double track railway, 60-mi., California, from Daggett to Bagdad, to Sharp & Fellows, Los Angeles, $3,000,000.

Apartment, Cleveland, O., to Kravitz and Yokelson and E. F. Gibbons Construction Co., $1,500,000.

Hydraulic machinery, Quebec, Canada, to Canadian Allis-Chalmers Co., Ltd., Montreal, $1,500,000.

Telephone exchange, Toronto, Ont., to Jackson-Lewes Construction Co., and Dominion Bridge Co., $1,000,000.

REPRESENTATIVE PUBLIC BOND SALES DURING MARCH, 1923

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Minnesota	Armory building	$146,000	4½	102.477	4.33	Jan. 1, 1923	1938–42	Lane, Piper & Jaffray, Inc., of Minneapolis
County								
Brown, Wis.	Highway improvement	605,000	5	102.93	4.58	Oct. 1, 1921 and Apr. 1, 1923	1923–40	The First Wisconsin Co. and others, of Milwaukee
Burlington, N. J.	Road	134,000	5	102.76	4.42	Apr. 1, 1923	1924–33	Barr Bros. & Co., Inc., New York
Campbell, Tenn.	Road	126,000	6	110.55	5.09	Apr. 1, 1923	1933–49	I. B. Tigrett & Co., Jackson, and others
Chautauqua, N. Y.	Road	250,000	5	103.897	4.20	Apr. 1, 1922	1928–29	Barr Bros. & Co., Inc., and others of New York
Hancock, O.	Road	6,000	5½	100.82	4.92	Mar. 1, 1923	1924	W. L. Slayton & Co., Toledo
Madison, Va.	Road	263,000	6	105.25		Feb. 1, 1923	1953	Lewis S. Rosentiel Co., Cincinnati
Martin, Ind.	Road	75,000	4½	100		Feb. 10, 1923	1943	First National Bank of Loogootee
Pulaski, Ind.	Gravel road Road Road Road	6,300 51,500 7,200 8,000	5 5 5 5	102.13 102.08 102.09 102.10	4.59 4.60 4.60 4.60	Feb. 26, 1923	1924–33	Breed, Elliott & Harrison, Indianapolis
Township								
Alliance City, School Dist., Stark Co., Ohio	School	70,000	5	104.60	4.40	Mar. 1, 1923	1926–48	Jelke-Hood & Co., Chicago
Kansas City School Dist., Jackson Co., Mo.	School	1,000,000	4½	102.81	4.28	Jan. 1, 1923	1943	Harris Trust & Savings Bank of Chicago and others
Busti Union Free School Dist. No. 1, Chautauqua Co., N. Y.	School	150,000	5	107.229	4.39	Mar. 1, 1923	1928–52	Western Reserve Securities Corp. of Buffalo
Carquinez School Dist., Contra Costa Co., Calif.	School	240,000	5	102.64		Mar. 1, 1923	1924–41	Bank of Pinole
Municipality								
Belgrade, Mont.	Water-works	46,000	5	100		Jan. 1, 1923	1943	Belgrade Water Co.
Blackwell, Okla.	Park	50,000	5	100		Feb. 3, 1923	1928	City Sinking Fund
Bradentown, Fla.	Street paving Sewer extension	76,000 10,000	5	98.28		Mar. 1, 1923	Serially	Hanchett Bond Co., Chicago
Cottage Grove, Ore.	Improvements	13,000	6	104.05	5.44	Dec. 12, 1923	1933	Robertson & Ewing, Portland
Crystal Springs, Miss.	Sewer	15,000	5½	100.81				Merchants Bank & Trust Co.
Davenport, Ia.	Paving	250,000		101.99	4.30	Mar. 1, 1923	1924–43	Geo. M. Bechtel & Co., Davenport
Ellis, Kan.	Paving	22,694	5	100		May 1, 1922	1923–42	Fidelity National Bank & Trust Co., Kansas City
Elton, La.	Water-works	35,000	5½	100				Hibernia Securities Co., Inc., New Orleans
Falls City, Ore.	Electric light plant	15,000	5¾	100		Feb. 1, 1923	1933–43	[illegible] and others, Portland
Fort Smith, Ark.	Paving	150,000	5	[illegible]		Apr. 1, 1923	1924–33	First Nat. Bank of Ft. Smith
Gowanda, N. Y.	Paving	234,000	5	[illegible]				O'Brian, Potter & Co., Buffalo
Highland Park, Mich.	Sewer	135,000	4½	102.30				Harris, Small & Lawson, Detroit
Hot Springs, S. D.	Sewer	75,000	5¾	100		Dec. 1, 1922	1932–42	Ballard & Co., Minneapolis
Liberty, N. Y.	Water supply	130,000	4	[illegible]	4.31	Nov. 1, 1922	1927–52	Sherwood & Merrifield, New York
[illegible], Kan.	Electric light	12,000	5	[illegible]		Nov. 1, 1922	1942	Kansas Securities Co.
New Britain, Conn.	Sewer	100,000	4¼	[illegible]	4.05	Aug. 1, 1922	1923–42	[illegible], Boston
Phillipsburgh, N. J.	School	150,000	4½	[illegible]	4.44	Sept. 30, 1922	1924–50	[illegible], New York
Pine Bluff, N. C.	Water	8,000	6	100		Nov. 15, 1922	1925–40	[illegible]
Port Chester, N. Y.	Improvements	84,000	5	[illegible]	4.52	Apr. 1, 1923	1924–32	Sherwood & Merrifield, New York
Rayne, La.	Water-works	90,000	6	[illegible]			1953	Caldwell & Co., Nashville
[illegible], W. Va.	Streets	40,000	5	100		Sept. 2, 1921	1951	The State of West Virginia
San Jose, Calif.	Improvement	[illegible]	7	100		Jan. 29, 1923	1924–33	[illegible] of San Jose and others
Tippecanoe, Ind.	Road	14,300	5	[illegible]	[illegible]	Jan. 6, 1923	1924–33	Meyer Kiser Bank of Indianapolis
Winnsboro, S. C.	Paving	50,000	5¼	100		Nov. 1, 1923	Annually	John W. Cathcart

Bituminous coal production reached an estimated average daily output of 1,800,000 tons for the week ending Mar. 10, according to the Geological Survey. Production stood at about the same figure for the week ending Feb. 10, but in the meantime dropped to 1,735,000 tons for the week of Feb. 24. The present rate of output is 33⅓ per cent above the average for the same week in 1919 and 50 per cent higher than the corresponding period in 1921.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of March 1; the next, on April 5.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.44	$3.95	+$4.50	+$3.20	$3.45	$3.95	$3.45	$3.80	$3.75
Structural rivets, 100 lb	4.00	4.60	5.25	3.75	4.00	+5.15	4.75	4.25	5.50
Reinforcing bars, ¾ in. up, 100 lb	3.34	3.85	3.15	+3.10	3.35	3.62½	3.30	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	51%	53%	45%	59½%	55-5%	38%	38.2@46.5%	45%	32.76
Cast-iron pipe, 6 in. and over, ton	56.50	+52.50	57.00	+54.20	+60.50	65.00	57.00	58.00	55.00
Concreting Material:									
Cement without bags, bbl	2.70@2.80	+2.90	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd	1.00	1.24	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd	1.75	2.00	+ 2.50	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	63.00	+38.00	53.00	60.50	+44.75	51.00	39.00	29.00	95.00
Lime, finishing, hydrated, ton	16.80@17.10	23.00	22.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	3.00@3.25	+1.95	2.50	1.50	1.25	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	+13.00	11.00	11.00	17@19	12.00	15.50	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.0859	.115	....	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1314	.0859	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal	+1.02	—1.07	1.16	+1.12	1.13	+1.25	1.09	.86	+1.17
Common Labor:									
Common labor, union, hour	.60	.35	.30@.50	......	....	.50@.55	.56¼	....	.....
Common labor, non-union, hour	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.50	.30@.70	.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars. other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine casing. Sand. stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.00). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Steadily advancing mill prices reflected in higher steel warehouse quotations throughout the country. Dallas reports rise of 10c. on structural shapes; Chicago, 15c. on shapes and 3c. on reinforcing bars and Denver 20c. per 100 lb. on structural rivets, during week. Last week similar advances occurred in New York, Minneapolis and San Francisco warehouses.

Mill prices of steel shapes quoted at minimum of $2.35 and maximum of $2.50 per 100 lb. for early deliveries. Plate mills are booked up for next three or four months due to heavy demand; quotations of $2.25 nominal, actual buying at an average of $2.35, with some makers asking $2.50 per 100 lb. Reinforcing bars now $2.25 on regular contract tonnages, but $2.35@$2.50 quoted for prompt deliveries. Basic, bessemer and No. 2 foundry iron higher at Pittsburgh, with growing scarcity of iron and steel scrap. Cast-iron pipe, 6-in., quoted in Atlanta at $52.50 as against $51; in Chicago at $54.20, up from $53.20 and in Minneapolis at $60.50 as compared with $58.50 per ton, one week ago.

Concreting materials firmer as to price. While there have been no changes in New York cement prices during the last week, no quotations are being issued by dealers unless orders can be covered by the mills. Atlanta, however, reports rise of 15c. per bbl. in cement and Dallas, 50 per cu.yd. in crushed stone. Atlanta also quotes advance of 10c. per bbl. in lump lime and $1 per M. on common brick.

Lumber demand, particularly for yellow pine, has not slackened perceptibly and prices hold firm with a stronger tone. Pine timbers advanced $1 per M. ft. in Atlanta and Douglas fir sustained a similar increase in Minneapolis.

Linseed oil rose 1c. in New York, 4c. in Denver, 5c. in Chicago and 15c. per gal. in Montreal, since last week. Atlanta, however, reports drop of 5c. per gal. in 5 bbl. lots. Linseed oil has risen steadily since Jan. 1.

Mines, lumber mills and logging camps in the Seattle district reported operating to capacity; building construction exceeding record established during March of last year. In Denver, seven building trades organizations have filed applications with the State Commission for increases in the wage schedule, to take effect April 1, and amounting to a general rise of $1 per hour.

Wages in the northwest Pacific Coast lumber mills have recently increased approximately 5c. per hr. in virtually all the districts of that section. A general advance of 4.9 per cent in wages of skilled and commmon labor and an increase of 6.4 per cent in the common labor rate alone, is seen in the annual survey of the Southern Pine Association as of Jan. 1, 1923, compared with Jan. 1, 1922.

A Consolidation of Engineering News and Engineering Record
McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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To Smooth Out the Curves

IN THE depressed period just after the war, when unemployment steadily increased and construction languished, repeated demands were made upon the government to "take up the slack," that is to start much-needed construction which would call for the use of men and materials and tide over the depression. Unfortunately, the government agencies were not then organized for such quickly responsive action and the curve of business had to take its course unaided. Since then, however, a more scientific view of business depressions has arisen at Washington and the Department of Commerce, under Mr. Hoover, is watching construction closely enough to attempt, at least, to smooth out its curve by the expedient of restriction or expansion of the government's own construction. Hence the Hoover letter to the President, noted in the news pages. Construction is going ahead now fully up to the capacity of labor and material to fulfill. The curve of volume is on the rise and the curve of prices is going along with it. The saturation point will soon be reached and beyond that prices may go anywhere, with the invariably succeeding dead slump in volume and a consequent long period of depression and then a rise to the original level. It is only the part of wisdom to keep out of this saturating market those government demands which can just as well wait for a time when men and material are seeking use rather than the contrary. If the President will now follow the Hoover advice with absolute orders we may see to what extent the new theories of influencing economic trends are applicable.

The Sentimental Engineer

COLD-BLOODED, calculating, utilitarian—so runs the popular characterization of the engineer; a man of figures and machines, necessary for the workaday things of the world but devoid of sentiment and a sense of beauty. Once in a while, though, he surprises the world, and his latent and too frequently suppressed emotions shine through the overlay of practicality. Just now the city of New York is witnessing such a revelation. Old High Bridge, the finest example of masonry viaduct in America, is threatened with removal. Two years ago the engineers of the city thought they had won their campaign to have the arches which constrict the Harlem River replaced with a single span in keeping with the fine symmetry of the remaining spans and clear of any possible boat traffic in the river, but last week the city fathers, driven by obscure demands, moved to rescind their prior action and ordered the entire structure removed. The combined engineering forces in the city immediately took arms and at a public hearing forced reconsideration of such unnecessary ruthlessness. A monument to a pioneer American engineer, a model of a fast disappearing art in structures, an inspiration to all who glimpse its graceful arches from passing train or wooded path, High Bridge is more than a mere mass of stone and mortar to be torn down and thrown away after less than a century of use. The iconoclasts who urge its destruction have at least done the engineering profession one service. They have shown the people of New York that to the engineer the things of the spirit are of some value in the progress of the world.

An Experiment in State Ownership

NEW JERSEY has followed in the wake of several of her sister states to the west and has ordered the construction of a state cement plant. It remains to be seen whether she will follow the lead still further and neglect to build such a plant. Resentment against the high price and slow deliveries of cement is not confined to state highway departments, but it remains to be proved that these evils are the result of private ownership. The cement companies have put up a pretty fair argument in defense of prices, and one that can be answered only by the construction and operation of a state-owned plant. As to deliveries, that is something beyond the control of the manufacturer. Only actual operation can determine whether a state-owned plant means cheaper cement to the state. There is not the danger of political control that lies in the state ownership of utilities, but there are still the possibilities of false accounting, the loss of taxes and the necessity of production over and above the needs of the state. If the state is to sell cement to its citizens, why not underwear or coughdrops? However, if New Jersey wants to try the experiment there are several other states that will be glad to have her try. It may prove pretty costly to the Jerseyites.

Activated-Sludge Progress and Problems

AMONG the newer methods of sewage treatment none has been studied as closely and by as many technically trained men as the activated-sludge process. This is due to the promise of the process as a whole and to the hope that at last a means has been found for recovering the fertilizing value in sewage. That the process may go beyond the mere recovery just mentioned and add to the nitrogen in the sewage is the belief expressed and elucidated by C. Lee Peck in his article in this journal last week on "The Fixation of Atmospheric Nitrogen by the Activated-Sludge Process." In our present issue Mr. Peck presents other possibilities and opinions under the heading, "Economies of the Activated-Sludge Process." Mr. Peck's conclusion in favor of paddle or other mechanical means of inducing activation rather than diffused compressed air is all the more significant because his conclusion was reached before George W. Fuller made his recent visit to England and recorded the fact that British practice points towards mechanical agitation (*Engineering News-*

Record, Feb. 15). The fact remains, however, that some of the British engineers still hold to air diffusion while mechanical agitation has gained no foothold in the United States and Canada, although tried here and there. Doubtless we shall be quick enough to change to paddles or wheels whenever their economy over diffused air has been established as of general application. Among Mr. Peck's other notable conclusions are: That it is desirable to settle, skim and aerate the sewage before it is mixed with activated sludge and to acidulate the surplus sludge as a part of the sludge dewatering process; and that possibly power consumption for activation may be reduced by the use of catalysts. Further observations and experiments will be needed before final conclusions on all these points can be reached. Meanwhile Mr. Peck has rendered a valuable service by summarizing his several years of painstaking study of this interesting subject.

Sounder Municipal Finance

THE displacement of long-term by short-term serial bonds is one of the encouraging signs in the municipal field. Not so many years ago, municipal bonds with a redemption date long after the possible life of the improvement were common. If these bonds had sinking-fund provisions they weighed lightly on the municipal authorities. Gradually city charters or general state legislation (the latter notably in New Jersey a few years ago) restricted the life of city bonds to that of the corresponding municipal improvement and established less easily evaded requirements for the redemption of the bonds when due instead of permitting the perpetuation and piling up of municipal indebtedness by refunding. Alternative to sinking funds were serial bonds. These restrictions, combined with a growing public sense of the evils of the old methods and an increasing appreciation of the merits of at least an approach to the pay-as-you-go plan, have not only made serial bonds common but have also shortened the length of the series. As a current illustration which presumably is fairly typical: Of 19 separate bond sales reported by the New York *Times* for the week ended March 2, no less than 16 were serial, while of the three not serial, one was for but three years, one for 15 and one for 20 years. Of the 16 serial issues, 7 were to be fully paid within 25 years and 11 within 31 years while 5 were to be paid within from 22 to 10 years. Of the entire 19 sales, 6 were of bonds to be entirely paid within 25 years. The longest life periods were a 2-45-year serial, giving an average life of less than 25 years and a 30-40 year serial issue.

Interstate Co-operation

ONE or two men sitting in the Arizona Legislature at Phœnix have on their consciences the postponement of the interstate compact which would have set in motion the development of the Colorado River and the protection of its lower areas against floods. By a tie vote that legislature refused to ratify the treaty which had been accepted by five states and the ratification of which by the remaining state and by Congress awaited only favorable action by Arizona. It is impossible, however, that local politics, tempered with a trace of justifiable self protection, should long hold up this novel solution of a troublous problem. Interstate co-operation in matters of public works is not unknown but it is rare. The growing interdependence of the states in the utilization of their natural resources makes it more and more imperative that they join together or else submit to a nationalization which each state resents. The Colorado pact is the most important of such agreements because it involves such tremendous sums and such serious consequences of neglect, but it is not unique. Transportation, water supply, sewage disposal and power utilized in one state must reach over into a neighboring state to make that utilization complete and secure. Only by interstates agreement can full development be had. And such agreements will tend to become more involved and implicative. New York, for instance, seeking the co-operation of Pennsylvania in the distribution of the waters of the interstate Delaware—waters necessary for the future water supply of the metropolis—may lose some of her enthusiasm for sole control of power from her international border waters now that Pennsylvania has protested against that selfish view of water-power development. Governor Pinchot has not gone so far as to threaten but he has at least indicated wherein lies an enlightened self interest. Similar instances are bound to multiply. With the widening demands of industry and of the cities no state will be able to live to itself alone, nor will federal domination satisfy. Interstate co-operation is the sensible solution.

A Suggestion for the A. R. E. A.

DURING six sessions at last week's convention of the American Railway Engineering Association there were presented reports from twenty-four committees, most of them dealing with from three to a dozen subjects. All this matter had been printed in advance but the discussion was practically nil. Even in the absence of controversial subjects it seems strange that so much material should be accepted or adopted with practically not a word of real discussion in a well-attended meeting. Much of this material was simply "submitted as information" and thus perhaps failed to arouse much interest. It is true also that all of the material had been prepared and threshed out by committees, so that it was ready for formal action by the convention. Granting freely that all this material was good and useful, it seems impossible that all of it was to such an extent the "last word" as to offer no room for difference of opinion or even for expressions of confirmatory opinion or experience. Is it not a fair suggestion, that the sheer amount of material, especially in the absence of any one strong point, may have had a soporific effect, inducing a desire to let matters pass formally in order that the program might be carried through? In planning the program of work for 1923, the association's officers may well consider the possible advantages of some limitation of committee work, to see whether a smaller output of material during 1923 may result in greater activity and interest on the floor at the 1924 meeting, since it is discussion which adds life and value to the proceedings and the convention reports. For many years the American Railway Engineering Association has enjoyed an enviable position as a hard-working society. It cannot afford to lapse entirely into a committee-appointing body or to accept credit, as a body, for the work of separate groups of a few members each.

Primary Education and the Engineer

SOME weeks ago the Carnegie Foundation for the Advancement of Teaching startled the educational world with a well-considered, though none the less violent, attack on the sub-college educational system of the United States. It is the opinion of this authoritative body, made up of some of the leading educators in the country, that the public school system, partly because of its alarmingly rising costs and partly because of the inefficiency of its resulting product, is endangered and that unless we soon begin some reforms free education will cease to exist and the general average of intelligence and industry will decrease. These are serious charges disturbing indeed to a people who has been priding itself on the universality and efficiency of its instruction of youth. They are charges, moreover, which have more than passing interest to engineering educators.

It is the contention of the Foundation that a very large part of the rise in cost of education is "due to the change in the primary conception as to what the school is for and to the fact that that it is no longer conceived as primarily an intellectual agency, but rather as an agency through which the child shall learn something of every form of knowledge in existence, and in which he is not only to absorb such a knowledge but is to acquire the preparation for a trade or profession." In other words, the frittering away of time and effort on the sideshows of art and science and philosophy goes hand in hand with the forcing of the many through the paths that lead to the college which only the few ever reach, while meanwhile an amateurish manual training is offered in substitute for the serious trade school instruction necessary for those whose pursuits will be along manual lines.

Unfortunately, the Foundation only states the dilemma; it offers no solution. There are hints, promptly resented in the public press, of a classification of children into prospective intellectual and manual workers, but this is so manifestly impossible in our present social system and so contrary to the American ideal that it can hardly be taken seriously. The saving suggestion is for a return to fundamentals, for an elimination of the fancywork in the primary schools and a concentration on higher elements in the high schools, so that the finished product has a broad basis for future performance in any line, rather than a smattering of the outlines of every line.

These, the pity is, are mere words, the like of which have been heard for some time in discussions of engineering education. They intentionally avoid an attempt to predict or discover the unknown propensities or possibilities of youth, itself careless of its future. We do not know what man the child is father of; we do not know what specialty the embryo engineer will embrace. To that extent the insistence on fundamentals is sound. The difficulty arises, in primary school and technical school alike, when we attempt to define the fundamentals. Engineering educators are gradually feeling their way toward such a definition with increasing success. And that success will be expedited if the primary schools begin to solve their problem.

The ridiculous list of misspelled words cited in these columns last week by a western professor is a case in point. We are firmly of the opinion, and we say it in all seriousness, that a freshman in an engineering school who writes "dubble" should be summarily dismissed. There are words in the English language which it is permitted even the best educated man to misspell. Double is not one of them. To spell it "dubble" indicates a lack of common observation which is primary evidence of an untrained mind. A boy who at eighteen is capable of such inattentiveness simply has not the mentality required of an engineer or at least that mentality has not been developed to a point where he is capable of absorbing an engineering training. Who can doubt that the difficulties of engineering education are increased many fold by the defects of primary school instruction which thrusts such material on the engineering school?

Engineers, then, should be interested in the problems of elementary education, not only as citizens and fathers but as engineers, because the coming generation of their profession is involved. They should cease, both as citizens and as engineers, to leave these complicated questions to the appointed and elected boards of education and teachers. They can share the hope voiced in the concluding words of the Federation's report "that educated men outside the profession of teacher shall interest themselves in the general policy of education and in the fundamental conception under which the schools are to be operated."

Advanced Thought on Road Maintenance

LOCAL pride and observation is a controlling factor in road maintenance, according to J. T. Donaghey's recent paper at the roadbuilders convention. The technical advantages of direct state maintenance, he contends, are wiped out by the greater inspiration to improve the upkeep of the highways that maintenance through the counties give the people. They must be sold through the bumps or lack of bumps on the roads which they themselves travel.

The case for county maintenance is proved by mileage figures of maintenance extension. These figures deserve attention. Whether or not it is agreed that the reason given for them is correct the fact remains that in Wisconsin in some way the voluntary extension of state standards of road maintenance to a large mileage beyond the state system has been secured. This is accomplishment of an unusual kind.

Wisconsin experience proves, also, that road maintenance and tourist income are directly related. Roads are well kept to help sell the state as a vacation ground. The gross sales to tourists in five years are estimated at $300,000,000 and the profits perhaps $60,000,000. Both amounts are largely accounted for by the policy of keeping a great mileage of road perfectly surfaced, plainly marked and well mapped. While the tourist travel is always only incidental to the main use of the road for local transport, this through travel is definitely in mind in planning maintenance, as a means of earning the cost of keeping the roads in repair. This is an important thought and too few states are giving it consideration. Any state which has the natural attractions of woods, mountains and streams which invite tourists can by well-planned maintenance of its roads cultivate travel that will return all the cost.

There is no greater duty of highway departments than to sell road improvement to the people. Both of the practices described are powerful selling agencies. They have sold the policy of large and continuous road expenditures more completely than it has been sold in any but a few states other than Wisconsin.

Economics of the Activated-Sludge Process

Sedimentation, Skimming and Aëration Before Activation, with Acidulation of Surplus Sludge Proposed and Use of Catalysts to Reduce Power Consumption

By C. Lee Peck
Consulting Engineer, New York City

I. Where power costs do not exceed 2c. per kw.-hr. and the amount of sewage treated exceeds 1 m.g.d. the net cost of treatment should range between $20 and $30 per million gallons. This includes sludge disposal; also interest and amortization at 10 per cent per annum.

II. Plant design should include: (1) Preliminary treatment by sedimentation and skimming. (2) Shallow aëration, rapid removal of surface film, mixing it with the body of the liquor. (3) If bubble aëration is used, introducing the bubbles in as fine a state of division as practicable and prolonging contact with the liquor. (4) Maintaining dissolved oxygen at about 25 per cent of saturation. (5) Agitation by mechanism. (6) Acidulation of surplus sludge.

III. Suggested innovations: (1) Aërating the skimmed and settled sewage before mixing with activated sludge. (2) Use of catalysts to decrease power consumption.

This discussion is divided into (I) Theory of Aëration. (II) Aëration Practice. (III) Sludge Dewatering and Marketing. The purpose is cost analysis. Details of the process are necessarily omitted.

I. Theory of Aëration

IN THE economics of activated sludge, aëration is of first importance. The wastefulness of present methods is evidenced by the difference between theoretical and actual air requirements. The oxygen demand of a gallon of sewage might be satisfied with 0.05 cu.ft. of air and the actual requirements be 1.5 cu.ft. Intelligent effort to increase aëration efficiency must be based upon an understanding of the air needs of the sewage and the factors which influence the efficiency of the air applied.

In the activated-sludge process an accumulation of aërobic sludge is relied upon to clarify and otherwise remove objectionable constituents from the sewage. For the purpose of the present paper it is not necessary to speculate upon how this is done. It occurs in the presence of a healthy sludge. The problem is one of maintaining a congenial environment for the sludge. Aërobic organisms thrive where the sewage contains 2 p.p.m. of dissolved oxygen, or of oxygen held in lightly bound chemical compounds which may be reduced by the organisms. Raw sewage is not suitable for the propagation of aërobic organisms. It should be made suitable by preliminary treatment before adding the sludge.

Classification of Oxygen-Consuming Agents—The oxygen consuming constituents of sewage fall within the three following classes: (1) Substances capable of direct and practically instantaneous oxidation. (2) Dissolved or colloidal substances which oxidize slowly. (3) Suspended organic solids.

The sludge itself consumes oxygen at a fairly uniform rate. When raw sewage is aërated its oxygen demand is satisfied at an extremely rapid rate for the first thirty to sixty minutes. This is not affected by the presence of activated sludge. During this first period the sewage loses the greater part of the gases which are toxic to aërobes, CO_2, CO, SO_2, H_2S, etc. This period might be defined as the period of *direct oxidation*. It terminates rather abruptly. Classes (2) and (3) remain to be disposed of. Micro-organisms can economically oxidize by digestion practically all of Class (2) and the extremely finely divided portion of Class (3). The remainder of Class (3) can be more economically disposed of by preliminary sedimentation. Theoretically, sewage should first be settled, then aërated until the directly oxidizable substances are satisfied and treatment finished by aëration in the presence of activated sludge. Until recently this was impracticable. The disposal of the sludge from preliminary sedimentation by known methods was too expensive. The Maclachlan process seems to have solved the problem of raw sludge disposal. Maclachlan's experiments at Indianapolis, Brooklyn and Plainfield, N. J., have demonstrated that such sludge can be rendered inoffensive and easily drainable. The sludge is acidulated by injecting hot sulfur dioxid gas. When a hydrogen-ion concentration of pH 3.8 is approached the sludge turns straw color, the colloids coagulate. In this condition it dewaters readily. Dewatering follows immediately after gassing and is accomplished by collecting a sheet of the solids on an inward-flow drum screen and squeezing the water from the sheet with a felt-covered idler. The idler picks up the solids, which are scraped off by a doctor. In this condition they contain about 80 per cent moisture and may be stacked or dried in the open without nuisance or attracting insects. Raw sewage sludge which has been treated and dried, or dewatered to a proper condition for local transport, contains from 4 to 5 per cent ammonia (dry basis) and should be salable locally as a manure.

During the period of biologic digestion air must be supplied in quantity sufficient to balance the demands of the process and to maintain a congenial environment. Using filtros tile, this has been accomplished with as little as 0.03 cu.ft. free air per gallon per hour under 10 ft. head. This is insufficient to keep sludge in suspension. Mechanical agitation is less expensive than compressed air, which should not be used.

Factors Affecting Oxidation—Assuming agitation by mechanism, there remain to be considered and applied the factors of absorption of oxygen by sewage. Some of them are: The amount of oxygen absorbed is proportional to (1) the *area* and (2) the *time* of contact and is (3) inversely proportional to the amount required for saturation. That is: A liquor 80 per cent saturated will begin to absorb twice as fast as the same liquor 90 per cent saturated. (4) The character of film between gas and liquor affects the rate of absorption.

As a corollary to (3): The presence of unsatisfied radicles (such as ferrous iron, nitrites, etc.) accelerates the rate of absorption. These factors modify one another. For instance: If factor (1) alone were considered, dividing the air into bubbles of twice the area would double the quantity of gas absorbed, and if this resulted in doubling the period of contact, absorption would be quadrupled. This does not work out. Nordell, in his study of bubbles at Milwaukee, came to the conclusion that the smaller bubble gave up its oxygen more slowly in proportion to its area than the larger bubble. At Milwaukee also it was found that the amount of oxygen absorbed from a given quantity of air did not increase proportionally with the depth of the basin. Power economy favored the shallower basin. Although oxygen absorption may not be proportional to increase in time and area of contact, these factors are helpful and plant design should consider them.

There seems to be no factor modifying (3). Efficiency demands that dissolved oxygen be kept as low as is consistent with a healthy sludge. The microscope is the quickest means of determining the condition of the sludge. Oxygen determinations are necessary to prevent aërating beyond requirements.

The character of the surface film is of great importance. Gases passing through greasy or soapy liquors become filmed with these substances, which are resistant to the passage of oxygen. In the initial stages of aëration considerable scum is brought to the top. It should be removed from the preliminary aërator and separately disposed of. A typical analysis of scum from a strictly domestic sewage is given in Table I. This scum was taken from the primary aërator and at times amounted to 10 per cent of the suspended solids in the sewage.

The factors affecting surface aëration may be demonstrated in the laboratory, using a solution of pyrogallic acid which turns black with oxidation. The effect of a drop of kerosene on the surface of a beaker, acceleration of oxidation by stirring or rapid removal of the surface film, indicates what takes place in the aëration basins.

It is possible to measure with reasonable accuracy the area of contact between air and liquor undergoing aëration. At Mt. Vernon, when sewage was being aërated with 0.66 cu.ft. of free air per gallon under a head of 10 ft. it was calculated that the area of contact between the liquor and the bubbles was 3,500 sq.ft. The volume of liquor being aërated was 45,000 gal. per day. The period of contact, six hours. Now, if oxygen were absorbed from the open air at the same rate as from the bubble an area of 0.778 sq.ft. per gallon per day and a period of contact of six hours would be required. That is, 1,000,000 gal. would require 778,000 sq.ft. tank area! Haworth aërates 1.3 m.g.d. per acre. After making allowance for air emulsified by agitation we are forced to the conclusion that a square foot of open air is far more efficient than a square foot of bubble. Reasons need not be discussed here but without doubt oxygen absorption at the surface is important.

Catalysts Factors in Oxidation—Each of the factors which have been discussed has been established by ample research. There is another factor the value of which has not been determined: The presence of catalysts—in this connection defined as radicles which absorb and store oxygen in a condition available for the digesting organisms. It may be that this is the factor which accounts for the wide differences in aëration requirements of apparently similar sewages. Experimenters have frequently noted that some sludges "kept" better than others. The presence of ferric hydrate has been mentioned in this connection; nitrates also. These may be supplied by trade waters, such as pickle liquors, gas-house waste waters, ground waters, or may with propriety be added.

In the paper on "Fixation of Atmospheric Nitrogen," *Engineering News-Record*, March 15, 1923, p. 487, the effect of iron in fixing liquid and gaseous nitrogen was discussed. Tests have shown that ferric iron will give up part of its oxygen to sewage organisms. When the reduced salt comes in contact with the air it is instantly reoxidized to the ferric salt. Each time this happens, an amount of oxygen equal to at least 10 per cent of the weight of the ferric iron is stored in a form available for the biological demand. This reaction probably occurs many times in the process of aërobic digestion. When it is considered that the sewage itself can be made to store but 8 to 10 p.p.m. of oxygen it is evident that a small quantity of iron may play an important part in air economy.

TABLE I—TYPICAL ANALYSIS OF SCUM FROM STRICTLY DOMESTIC SEWAGE

	Wet Per Cent	Dry Per Cent
Moisture	81 04	
Fats (combined)	13 65	72 94
Fats (free)	.91	4 84
Calcium	.90	4 75
*Organic matter	3.05	16 10
*Inorganic	2.43	2.27

* Other than stated.

Dr. Buswell calls attention to the fact that when the influent sewage contained 5 p.p.m. of nitrites and nitrates the air consumption was 0.7 cu.ft. per gallon of sewage. When nitrites and nitrates dropped to 1 p.p.m. the air consumption rose to 1.4 cu.ft. per gallon. Dr. Buswell seems inclined to believe that the nitrites and nitrates were partly responsible for the differences in air consumption. If this be the fact, then they must have acted as catalysts. If we could assume such economy to be effected by nitrates, $2 worth of Chilean saltpeter would save $14 worth of compressed air. While no such economy can be expected, this lead is worth investigation. Soluble reagents should be added to the sewage as near the source as practicable.

In working out plans for the aëration of Indianapolis sewage I had to meet the question of what to do with gas-house wastes. My preconceived judgment was that they should be eliminated because of their supposed toxicity and great oxygen absorbing power. Tests conducted on sewage containing gas wastes in their greatest concentration, in parallel with tests on uncontaminated sewage, gave some surprising results. Aërobic organisms flourished in the gas contaminated liquor. When, as frequently happened, the air supply failed the straight sewage sludge died. The gas contaminated sludge survived. The gas sludge was eventually smothered by accumulation of tar but a presumption was raised that the reducing agents in the gas-house liquors acted as catalysts.

The nature of sludge organisms makes it necessary to consider one more factor, *violent agitation.* This is destructive of some of the organisms and tends to increase turbidity. It should be avoided.

This is one of the reasons for lack of success which has attended aëration by circulation through centrifugal pumps.

II. Aëration Practice

A period of 30 to 40 minutes' detention in preliminary sedimentation is sufficient for removing the quick settling solids and a considerable part of the scum. To insure satisfactory performance all sedimentation chambers should be equipped with mechanical means for collecting and removing the sludge. No septic sludge will rise in a mechanically cleaned basin. There are two types of mechanical sludge removers which are now performing satisfactorily: (1) The revolving type. This is the Dorr clarifier. It operates in a cylindrical basin, the bottom of which is slightly coned. The settled solids are moved to the center of the basin by a slowly rotating mechanism and thence removed by appropriate means. Milwaukee has adopted the Dorr clarifier after experiments covering a number of years. The second method consists of a submerged flight conveyor operating in a long and narrow basin. When properly designed, both these types perform perfectly. Neither requires more attention than an eight-day clock. Power consumption will not exceed ½ hp. per m.g.d. capacity. For small installations first costs favor the flight conveyor. When its unit capacity is reached, the clarifier has the advantage as its capacity may be increased by enlarging its diameter without proportionate increase in first or operating costs.

TABLE II—COST OF COMPRESSING AIR

(1) No. 3 Hytor, compressing 350 cu.ft per min. to 5 lb requires 10 hp., equivalent to 10 kw at the meter Power cost to compress 500,000 cu ft. in 24-hr @ 2c. per kw -hr.	$9.12
(2) No. 8 Hytor, 2,250 cu.ft. per min. to 5 lb., 97 hp. (97 kw.) Power cost to compress 3,250,000 cu.ft. in 24 hr.	46.56
(3) No. 5 B. F. Sturtevant positive-pressure blower, delivering 696 cu.ft. per min., 28 hp. (28 kw.) Power cost to compress 1,000,000 cu.ft. in 24 hr.	13.44
P. H. & F. M. Roots Co. blower, power cost to compress 1,000,000 cu.ft. in 24 hr.	10.56
Adding interest and amortization at 20 per cent per annum, transmission, motors, housing, maintenance and supervision, the costs of compressing 1,000,000 cu.ft. free air to 5 lb. will approximate:	
Nash No. 3 Hytor	20.00
Nash No. 8 Hytor	15.00
Sturtevant No. 5 positive-pressure blower	15.00
Roots blower.	12.00

Economical Application of Compressed Air—Filtros tile has been the medium generally adopted for diffusing compressed air. Distribution of the tile and control of circulation are important. Proper placement of the tile may result in an air economy of from 20 to 40 per cent. The plants at Urbana and Mt. Vernon required an average of less than 1 cu.ft. of free air per gallon of sewage treated. At Urbana, an earlier activated-sludge plant using a different distribution of filtros tile required 2 cu.ft. of air per gallon.

At Indianapolis the same theory of circulation was applied. This unit operated in parallel with one of the conventional type. By the conventional type is meant rows of tile laid across the aëration channel at right angles to the direction of the flow. In the improved method the tile are laid along one side of the channel in rows parallel to the direction of the flow. An example of this type is the Woodstock, Ont., plant, designed by F. J. Ure & Son, Woodstock. Messrs. Ure report that this plant is operating satisfactorily with a consumption of 1 cu.ft. free air under a head of 12 ft. The cross-row method of laying tile prevents any definite vertical circulation and encourages short circuiting. The improved method insures positive circulation, prevents short circuiting and reduces the area of filtros required.

Costs of Compressing Air—Cost data have been supplied by manufacturers of compressors as shown by Table II. Larger size units will reduce these figures somewhat. Economical use of power requires adjustment to meet varying seasonal and weekly conditions. This means the installation of two or more units, even if variable-speed motors are used. For cities under 100,000 population small compressor units would be required and the table figures would hold. If the flow sheet suggested in this paper be followed and air supply be adjusted to requirements, average municipal sewage can be aërated the year round with an average air consumption less than 1 cu.ft. per gallon under 10-ft. head.

TABLE III—ANALYSES OF DRIED ACID-TREATED ACTIVATED SLUDGES

Mt. Vernon, N. Y.	Per Cent
Moisture	9.25
Ammonia	8.79
Bone phosphate of lime	3.70
Insoluble	13.50
Ferric oxide	9.95
Calcium oxide*	5.92
Magnesium oxide	.13
Houston, Tex.	
Moisture	5.74
Ammonia	7.75
Bone phosphate of lime	5.66

* Included also in bone phosphate of lime.

Other Methods of Aëration—Aëration through centrifugal pumps, inspiring and mixing the air directly with the sewage, has been tried at a number of places. One of the latest commercial installations of this type is at Turlock, Calif. There are several patents on different ways of applying this principle. Diffusion of air by this method is ideal. Power consumption is low. The disadvantage has already been mentioned.

"Paddle aëration" has been under development for a number of years. Three types have been used: (1) Haworth places his paddles in narrow channels at right angles to the flow, like a stern-wheel steamboat. (2) The Stott & Jones patent paddles rotate axially with the flow of sewage and create a helical direction of travel, similar to that of the Ure filtros design. This should be more economical of power than Haworth's design. (3) In the Borst patent the paddle hangs vertically in a cylindrical tank. All three of these methods have produced satisfactory effluents. Some very low power consumptions have been reported. There is another method which is a cross between centrifugal and paddle circulation. This consists of a cylindrical tank with a central well of fairly large diameter. The central well is expanded at the top to form an inverted cone. A paddle with a vertical axis is operated in the cone close enough to the surface to beat air into the sewage. Mixed air and sewage overflow the cone and bottom liquor is drawn up to take the place of the overflow. Some of these paddle methods have had sufficient success to induce their commercial adoption. This indicates that in some localities the paddle method is considered more economical than the compressed air-filtros method. My own experience with paddle aëration leads me to believe that this is the method of the future. Plants of this type can be made so fool-proof and simple that aëration will require only casual supervision and night attendance be eliminated.

Paddle aëration has been developed to a point where it demands the consideration of the engineer contemplating plant design to produce a clear and stable effluent. Aëration units can be designed to be convertible to filtros aëration without loss of first cost. If paddle aëration produces satisfactory results, it means a cheaper plant and lower operating costs.

III. Sludge Handling, Dewatering and Marketing

Discussion of sludge disposal may be divided into: (1) Factors affecting cost of disposal. (2) Factors affecting value of product. Since value may be affected by preparation methods they are discussed first.

The valuable constituents of dried activated sludge are phosphoric acid and ammoniates. Where care is taken in preparing the sludge for market it should contain from 3 to 4 per cent of bone phosphate and from 7 to 9 per cent of ammonia. The analyses of two sludges dried by commercial processes are given in Table III. Ordinary dried activated sludge contains from 4 to 6 per cent of ammonia ana no other constituent in sufficient quantity to be of value.

TABLE IV—DEWATERING BY PECK FLOATING PROCESS

These figures are averages covering 2½ weeks testing period.

	Per Cent Moisture
Influent sludge....	99.4
Floated sludge....	89.2
After draining one day....	77.1
After draining two days....	66.5
After draining three days....	59.7
After draining three weeks....	26.4

The chief factor affecting the value of the dried sludge is its proportion of valuable constituents. Drying and handling costs for the inert portion are charged against the valuable portion. Example: Assume that methods which disregard the character of the sludge produce one ton of 4 per cent ammoniates per million gallons sewage treated, and that the cost of drying the sludge is $15 per ton and freight and handling charges to destination are $5. The cost of sludge disposal is $20 per million gallons. *If* by exercising care in eliminating inert materials, one half ton of 8 per cent ammoniate is produced, the cost of sludge disposal is reduced to $10. This is the reason why, when high-grade ammoniates are quoted at $4 per unit, low-grade may be marketed with difficulty at $1.50 to $2.

Activated sludge is unknown commercially. For this reason brokers will not pay market price for its fertilizer constituents. Market quotations should be discounted 25 per cent in estimating the product's value and should not be taken to mean those given in trade magazines as obtaining at Chicago, New York, Baltimore, or any other trade center. They mean the quotations of the nearest market which will absorb the product. For cities of less than 200,000 population this should be within trucking radius of the plant. Local sale will save *round trip* freight to fertilizer plant, broker's and manufacturer's profits. Specifically, it should obtain 50 per cent better price than brokers will pay.

The consumption of fertilizer is seasonal. Storage reservoirs must exist somewhere between production and use. For most crops dried activated sludge is not a balanced fertilizer. It must be used as a base. Crop tests indicate that it is a slow-acting ammoniate. This brief review indicates the necessity for a careful survey of markets.

Factors Affecting Costs of Disposal—These are two: (1) The quantity of sludge produced. (2) The character of the sludge. The quantity of sludge can be controlled within considerable limits. Excessive aëration decreases the quantity of the sludge. It also lowers the grade of the sludge produced. High-grade sludge will certainly sell for more than the cost of preparing it for market. Elimination of grit, coarse solids and flotable solids from the sewage insures a high grade product. Slow and sparing aëration means a double economy, more and better-grade sludge, an effluent lower in nitrogen and less power expenditure. As byproducts with high-grade sludge there must be disposed of: The floated and settled solids from preliminary sedimentation, grit and screenings. The last two will be disposed of by the usual means. Preliminary sedimentation solids will contain on a dry basis, 4 per cent ammonia. The amount will be 200 to 400 lb. dry solids per million gallons. Gassing or acidulating and draining to 70 per cent moisture will cost $1 per million gallons sewage. The scum will range from 50 to 100 lb. dry solids and will drain to 75 per cent moisture. In this condition it will contain about 19 per cent grease. It has no value and may be disposed of by incineration or lagooning at a cost of 50c. per million gallons sewage.

The character of activated sludge is such that until recently it has defied all attempts at commercial drying. High-grade sludge is essentially a biological jelly. Chemically and physically it is closely allied to gelatin. Like gelatin it cannot in its normal condition (bicarbonate alkalin) be dewatered by pressure. When rendered slightly acid its character is changed and it may be readily drained to 60 per cent moisture. Three methods have been developed for successfully applying this principle. (1) Floating, developed by the writer. (2) Gassing, developed by The Maclachlan Reduction Process Co. (3) Vacuum filtering, developed by the Oliver Filter Co.

TABLE V—COST ESTIMATES FOR COMPLETE 1-M.G.D. PLANT

Estimated cost of completed plant	$64,011	
Daily operating costs include interest and amortization at 10 per cent. Compressed air-filtros aëration included. Paddle aëration would reduce first cost $10,000 and operating costs $5 per million gallons.		
Estimated operating cost....	$44.25	
Apportioned as follows:		
1. Racks...	.58	
2. Raw sewage sedimentation.	2 13	
3. Aeration	15 73	
4. Aerated sewage clarifier	1 63	
5. Preliminary dewatering	7.24	
6. Sludge circulation	1.66	
7. Drying	8 63	
8. Supervision (city engineer)	3 60	
9. Miscellaneous....	3 15	
Total gross cost per million gallons treated		$44 25
Sale of dried sludge		20 80
Net cost of treatment ..		$23 45

My first experience in dewatering sludges by floating was in 1916. The sludge was a gelatinous precipitate from hide treatment waste waters. Upon adding sulphuric acid, the sludge rose to the top, where it drained to about 80 per cent moisture. In this instance, the method was too expensive for commercial application. Later, in designing the Mt. Vernon activated-sludge plant, I included a "frothing tank," intending to separate the sludge in this manner. Sludge floating tests in this tank were unsuccessful. In the laboratory, agitation with sulphuric acid resulted in floating about one-third of the sludge. On gentle stirring this sank. Mr. Neave and I continued our sludge dewatering research at Urbana. Here we found that if the acid and the sludge were mixed with but little agitation and then gently heated, *all* the sludge would rise to the top. The Urbana activated sludge when settled to 99 per cent moisture indicated an alkalinity of about 450 p.p.m.; 1.5 c.c. of sulphuric acid per liter was required for successful floating. The floated sludge contained from 84 to 90 per cent moisture and drained in a few hours to less than 80 per cent moisture.

J. Frederick Jackson, chief of the Engineering Division of the Connecticut State Department of Health, used one of my floating units at New Britain. Using 1 c.c. of sulphuric acid and heating to 30 deg. C. he obtained the results given in Table IV.

The drying sludge was at all times odorless and free from insects and larvae. Dr. Jackson states that with proper operation the water discharged from the floater contained less than 100 p.p.m. of suspended solids and under 10 per cent of the original nitrogen.

In this connection it may be stated that some activated sludges seem amenable to *flotation*. By flotation is meant the separation due to selective affinity of gas bubbles for certain solid particles. Where such affinity exists, bubbles admitted to the liquor will seek out the particles for which the affinity exists, attach and float. Activated sludge in general does not adhere to gas bubbles. It may be floated only by *entrapping* gas bubbles in the sludge, making them rise en masse.

Maclachlan's process has already been described. It is in successful operation at Gastonia, N. C., in connection with a plate and frame press. The dewatered cake averages about 78 per cent moisture. At Houston it is operating in connection with the "decker" (the dewatering screen described above). The product contains about 80 per cent moisture. The remaining moisture is evaporated in a Buckeye drier. It is estimated that the cost of dewatering to an average of 83 per cent moisture will be about $6 per ton of finished product, equivalent on the basis of 1,300 lb. of dry sludge per million gallons to $3.90 per million gallons of sewage treated. This estimate includes all maintenance and depreciation charges.

Milwaukee proposes to use heat and acidulate and dewater with Oliver vacuum filters to 80 per cent moisture, finishing in direct or semi-direct heat driers. Indianapolis and Pasadena have awarded contracts for the Maclachlan process.

Cost comparison of the dewatering processes would at present be guesswork. The unknown factor is depreciation. Allowing for heavy depreciation and, in the case of the Peck process, for further drainage and handling, the cost of dewatering to 80 per cent moisture by any of these methods will not exceed $6 per million gallons of sewage treated. The proponents of any of the processes probably will not admit half that.

Drying to the ultimate 10 per cent moisture can be accomplished in direct heat driers. One pound of coal will evaporate 6.5 lb. of water. Power, supervision, depreciation, interest and other changes will not exceed the cost of coal. Losses will be under 5 per cent. If 1,000,000 gal. of sewage be assumed to produce 1,200 lb. of activated-sludge solids and coal in the furnace costs $10 per ton, the costs of evaporation will be $7.20 per million gallons of sewage treated. If the methods described above are followed the product will be 1,300 lb. of 10 per cent moisture, 8 per cent ammonia and 4 per cent B.P.L. (bone phosphate of lime) fertilizer base. If this can be marketed at $3.50 per unit for ammonia and $1 for B.P.L. the value of the produce will be $20.80.

The estimate in Table V is based on unit costs of $25 per cubic yard for reinforced concrete and $2 for excavation, with excavation equal to half the cubic contents of plant. The plant is rated as 1,000,000 gal. per day capacity. It is expected to discharge a six days' stable effluent when operated at a daily 3-hr. overload of 100 per cent and a constant overload of 25 per cent.

Building a Dam in Bolivia

A View of Native Labor and an Exposition of North American Engineering Ingenuity

By R. A. Bennitt

Of Bennitt & Sawyer, Engineers and Constructors, La Paz, Bolivia, South America

CONSTRUCTION in the Andes Mountains is little like construction work in the States. High prices of materials, when they are available, bring into play all one's resource to keep costs down. Native labor is peculiar to handle and understand and its methods are more or less laborious. These factors are often complicated, as they were in the case at point, by the remoteness of the job, the rough character of the country and the scarcity of local materials. How such a job is tackled is outlined in this article, which treats of building a dam 15,200 ft. above sea level.

The dam was built to furnish additional power to operate the mines and mill at the Chojñcota tin mines, controlled by the Metals Thermat Co., of New York City. Chojñcota is situated in the province of Yaco, approximately 100 km. from a railroad, at an elevation of 15,200 ft. and derives its name from Lake Chojñcota (Aymara, or Green Lake). This lake, about 30 acres in area, and used as the reservoir for the water impounded by the dam, is fed by the glaciers 2 km. away. However, in the dry season insufficient water is furnished to supply the needs for power—about 4 sec.-ft.

The power house built in 1915 can develop 230 hp., but under the present scale of operations but 140 hp. is used. Of this 75 hp. is used by the concentrating plant and 65 hp. by the compressors in the mines. As the shortage of water precluded operating more than twelve hours per day during the dry season, it was decided to raise the existing dam an additional 4½ m., which would give a storage of 840,000 cu. m. and allow an additional draw-off of 2 sec.-ft. for twenty-four hours during the six months of dry weather.

The dam site is a narrow rocky gorge at the foot of the lake, whence the floor of the cañon pitches steeply. No flow conduit was necessary, and the 12-m. steel penstock therefore drops directly to the power house with a gross head of 560 ft.

Securing Materials—By far the greatest cost on construction work in this part of the world is for materials, and for that reason it was decided to build the dam of rubble masonry. Quartzite beds in slate on either side of the cañon settled the rock question, but peculiarly enough sand is difficult to secure because of the swift-flowing streams. However, after a sieve analysis, it was decided that the fine sand deposited at the head of the lake would be suitable if screened. Accordingly a small washing and screening plant was built which passed the finer sand particles through a .005-m. mesh.

To transport the sand to the dam site a flat-bottom scow was built into which were loaded bags of screened sand. But when the "Mauretania" was launched it was discovered that the personal equation had been lost sight of, for no native dared row a boat across the lake! They are not accustomed to water in any form, but being good laborers, *i.e.*, with strong backs and weak minds, they would tow it. A long rope and a lashed rudder solved this problem.

Description of Dam—The dam was laid out on a curve with a radius of 210 ft., except for a short straight section over part of the old dam; and an angle was made at a 16-ton anchorage so to locate the west wing as to require the least amount of masonry. The upstream face of the dam was made vertical, and the downstream face given a batter of 0.6:1. A coping wall, 0.5 m. x 0.5 m., was provided, in which was built a small spillway with provisions for flash-boards to within 2 in. of the top of the coping.

The cross-section of the dam was determined from calculations as a straight gravity section for hydrostatic pressure only, giving a nominal factor of safety against overturning of 2.3, no allowance being made for uplift, wave action, or ice pressure. However, the utmost care was exercised in preparing the rock foundation against leakage and sliding.

The mortar used was one of cement-lime (10 per cent of the volume of the cement being slaked lime) to four of sand. This mix will probably seem to many one containing an inadequate proportion of cement to prevent seepage, but the writer believes it justifiable under the conditions. Cement on the job cost about $17 U. S. currency per barrel, and the cost of other materials was in proportion. The dam now stands reservoir full and with but slight percolation, which is gradually lessening. From time to time corral sweepings are thrown into the water to silt up the voids in the mortar, reinforced, as it were, by the old "popcorn-popper" method.

Rock for the masonry was blasted out nearby and rolled to position on a "go-devil" running on a 24-in. Decauville track. All of it was handled by hand with the aid of crowbars. Boulders weighing 2½ tons were shoved into position by this method, but a cable-way with a chain-block was later installed and proved to be more economical of time and labor.

Unique Transportation—This cable was 1¼ in. in diameter and 800 ft. long and was brought from the mill-site on the shoulders of twenty men. Long cables brought in from the railroad to various mines in the mountains are frequently carried entirely by mule-back. A section of cable weighing about 250 lb. is rolled and packed on a mule at the head of the recua (mule train), then the cable is carried back about four paces and rolled further, etc., so that the cable finally arrives at its destination in one piece. No arriero (muleskinner) would dare pack a mule or burro without first binding his scarf or poncho over the beast's eyes. If asked why the animals are broken thus, he will probably merely say, with a shrug of his shoulders, it is the "costumbre."

FIG. 1. COUNTRY IN WHICH DAM IS LOCATED

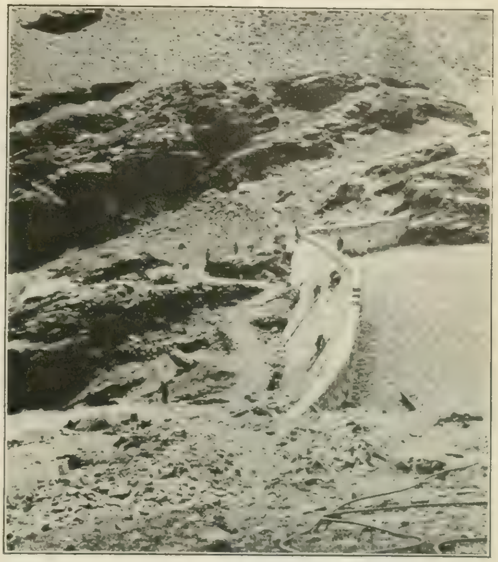


FIG. 2. MASONRY DAM AT ELEVATION OF 15,200 FT.

In building masonry work one wonders how the Incas and their predecessors, the long-extinct Chulpas, managed theirs. The writer has seen remains of their work—rocks weighing up to 80 or 100 tons placed without cementing material of any sort, with the joints so skillfully made that the blade of a penknife cannot be inserted. Furthermore, the blocks of stone are not square but may have as many as ten or twelve angles, all parts touching the adjacent stones with equal exactitude. The material of which this massive masonry is composed must have been transported a great distance for the surrounding country has not the same stone.

Labor—The labor used on the job was pure Aymara Indian and the Cholo, or mixed breed. These people, though not as efficient or as intelligent as skilled and unskilled labor in the States, are fairly steady and faithful, and are easily worth what they earn. They have the custom here, and also in Peru, of stopping work for fifteen minutes at ten in the morning and three in the afternoon to chew coca, or "acullicar." Each coca leaf is taken separately, pulled from its main stem with the teeth until the cheek is enormously distended. A bite of mild lye gives it more "kick." Then the laborer pulls out his native cigarette for a smoke. This is repeated thus for a couple of hours, the resulting liquid which is swallowed, giving renewed energy and strength.

The wages of these people are ridiculously low but they save up just enough after paying for their chuño, charque, and rice to have a glorious spree on 10 per cent alcohol when one of the numerous fiestas comes around. Chuño is a desiccated potato and charque is a mummified sheep, which, together, make great soup if you like it. The ordinary peon earns 65 cents to 75 cents per 10-hour day, a mason $1 to $1.20, a driller 90 cents to $1. etc., the average for the entire job being 90 cents per man day. Seventy per cent of the total cost of the work was for cement, lime, and other materials, and the entire cost per cubic meter was $11.85 or say $9.10 per cubic yard, including supervision. This compares favorably with concrete costs for similar work in the States. About ⅝ bbl. of cement per cubic yard of masonry was used, which was possible only because of the lean mortar, the use of large rocks, not dressed, and the care taken in placing them.

The "Bolivian Railroad"—Materials for the interior of the mountains are usually packed in small packages in order that they may be carried by llamas, sometimes called "the Bolivian Railroad." The llama will carry 100 lb. and no more, so that if he is loaded to exceed his capacity he will simply lie down on the trail until relieved. They travel about 20 km. per day in droves of twenty to two hundred. At about five in the afternoon their Indian drivers remove the packs and the llamas graze wherever they list. Often they stray to some pretty high peaks, so that the following day although their native keepers arise before the sun, it is usually ten o'clock before they are again on their way. After collecting their animals they are huddled close together with a long rope making a large ring so that they can not stray away while being packed. A couple of thicknesses of wool blankets are thrown over the woolly backs, then two packs aggregating 100 lb. are fastened on by another wool rope run under the llama's belly. All cement and lime for the job was sacked at the railroad and transported in this manner, taking five to seven days to cover the 100 km. The native Aymara or Quichua Indian makes an excellent llamero for he has great patience, and the speed of his mind and body synchronizes very well with the speed of the llama he drives.

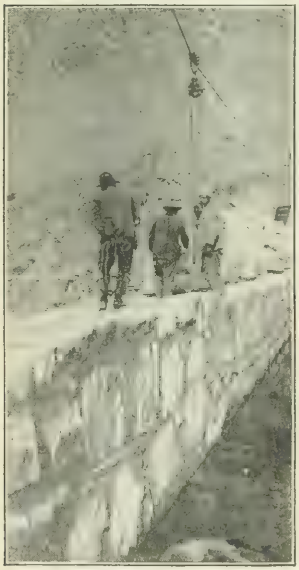


FIG. 3. SETTING ROUGH STONES IN THE DAM

A sketch of this sort would not be complete without telling something of the climate. From April to October is the dry season in which most of the days are beautifully bright and sunshiny, with very cold nights in which the temperature drops to 0 deg. F., and the piercing blasts from the glaciers and the rare atmosphere will cause one considerable discomfort if he be not warmly dressed. The rest of the year is a season in which fogs, sleet, rain, and hail are always in order. Intermittent sunshine will quickly give way to heavy overcast skies with a subsequent downpour of rain or hail, usually accompanied by a raw wind.

Handling a construction job in the Andes Mountains presents many difficulties, but they are part of the game which an American engineer working in foreign parts is obliged to play, and at the end he can look upon his work with pride as a good job well done.

Progress on the Chicago Plan

By Eugene S. Taylor
Office Manager, Chicago Plan Commission

The year 1922 marked the thirteenth year of activity on the part of the Chicago Plan Commission, and also the thirteenth major accomplishment on the "Plan of Chicago." Created in 1908 under the auspices of the Commercial Club, the "Plan" was recognized as the most comprehensive and most beneficial city plan that had been conceived up to that time. Today it still stands supreme and has furnished the inspiration for the modern development of nearly 200 American municipalities.

The various projects in the Plan of Chicago are intended primarily to make Chicago a better place in which to live and work. They have an equally beneficial result, however, in that they will increase the health, happiness, contentment and prosperity of our people.

Nearly every improvement in the Plan of Chicago has both a humanitarian and a commercial aspect. The humanitarian effect of the creation of 1,138 acres of parks, playgrounds, bathing beaches and boulevards along the lake front, and of the acquisition of 25,000 acres of country playgrounds or forest preserves encircling the city, is obvious. Their commercial benefits are not so plain, but they are just as real. The commercial advantages of the various street widenings and the railway terminal rehabilitation are self-evident. Their social benefits are not so apparent, until study reveals that the improvement of thoroughfares and of transportation facilities will make it easier for the dwellers in overcrowded districts to reach the lake front, the various parks and the forest preserves. At the same time these improvements add to the comfort of all our citizens, promoting their convenience in moving about the city, and adding to their health and well-being by increasing the amount of available light and air.

Projects now under way or in contemplation include nearly a score of widenings and improvements on important streets, the forest preserve, good roads, harbor facilities, park and lake front improvements, railway terminals, straightening the Chicago River, double-deck improvement and dock on South Water Street, a westside warehouse district and the zoning system. The completion of these projects and of other betterments proposed in the Plan of Chicago is essential if Chicago is to maintain its present leadership.

Fire Loss in New York State

In a recent bulletin issued by the National Board of Fire Underwriters, the fire loss in New York State during 1921 amounted to $48,391,992, a figure far exceeding the loss sustained in any other state in the Union during the same period. The largest single share of this loss was the item of "matches-smoking", which contributed $4,099,993. The total loss represents an increase of 33 per cent over the loss sustained in 1918.

Engineering Course Should Stress Scientific Training

Dean Ketchum Favors Four-Year College Course with Graduate Courses for Advanced Work—Teachers Are Vital Factor

Abstract of address delivered March 7, 1923 on his induction into office as dean of the College of Engineering of the University of Illinois.

By Milo S. Ketchum
Dean, College of Engineering, University of Illinois

TODAY the engineering profession demands that the student be trained intensively in engineering science so that he may be able to keep pace with the development of engineering and of scientific research. Industry demands that he be trained in the art of engineering and prepared also to enter the field of management and administration. In the time available it is practically impossible to give the student the intensive training of the professional engineer and at the same time the broad training to make him of immediate value to industry. Engineering educators are divided into two groups with respect to this question. One believes in a training in physics, chemistry, mathematics, language and economics, with intensive training in the fundamentals of engineering and in the application of science to engineering problems. The other believes in a broader course, including the humanities and business administration, to make the graduate of greater immediate value to industry and to the community. In such a course, the application of science to engineering is considered more from the viewpoint of the administrator and is intended to be a broadening influence rather than to make it possible for the student to solve engineering problems. The aim is more to qualify men to be leaders in industry than to train them for the profession of engineering.

Shall We Seek Breadth or Depth?—The usual four-year course does not give sufficient time to develop either of these satisfactorily. Additional time may be gained by increasing the course to five years or by adding a graduate course in engineering. Although it was possible formerly to accomplish both these objects in a four-year course, the development of engineering science and of business administration has made this impossible. The result of such an attempt will be to give the student a smattering of information, with little training that will prepare him either for engineering or for industry. We must, therefore, choose between a training that is narrow and deep, or one that is broad and shallow. Few can excel in more than one line, and those that can are marked men. The question is, shall we plan a course to give a broad training so that students will be able to do many things in a very indifferent fashion, or shall we limit our work to the training of men for the profession of scientific engineering, leaving to other departments the training of those who expect to enter business or administration immediately after college?

Education is a gradual development and is the summation of training in the home, in the elementary and secondary schools, in the university, in business, in professional life, and of the best effort of the individual. The successful man must not only have the training that will make it possible for him to appreciate art, literature, and his associations, but he must be able also to achieve, to do his share in carrying the world's burdens. College training should be intensive, should teach the student how he may best perform with his brain, and give him an appreciation of what it means to excel.

Five-Year Course Not a Solution—Engineering is a constructive profession which calls for intensive training and perspective, the lack of which cannot be remedied by increasing the length of the course. The proposed plan to spread the engineering course over five years, omitting the intensive engineering subjects, and adding certain so-called humanistic subjects and other subjects intended to prepare the graduate for administrative positions, does not solve the problem. If the profession is to advance and the demands of industry are to be met, the course must prepare the graduate with a training and a vision to be a leader in his profession. If he has this, and in addition, those essentials of industry, character, integrity, knowledge of men and administrative ability, which the successful must have whether they are college graduates or not, he will be a leader in his profession and will have opportunity to become an administrator or a leader of men.

Success as an engineer will be due largely to the intensive training while in college and success as an administrator will be due largely to success as an engineer and individual effort. This opinion is based on an experience of more than a quarter of a century as an engineering educator, a practising engineer, a contractor and as an administrator. The most successful men trained under my direction or who have come to my notice or have been in my employ, whether in engineering, business or administration, have almost without exception been those who have excelled in their technical studies, who have learned to think straight, who have come to appreciate what it means to accomplish and excel.

Research in Engineering—The engineer engaged in research should have a thorough theoretical training in the sciences, in mathematics, and in mechanics, should also have had a practical engineering experience and should have been trained in scientific methods of investigation. Engineering research and engineering experience co-operate in advancing the science and art of engineering. The engineering student should not only be given training in the underlying sciences, in mathematics, in mechanics, and in the fundamentals of engineering, and briefly in the art of engineering, but he should also be given an insight into the methods of the worker in engineering research and appreciate the necessity for engineering research. He should not only be trained to enter the profession of engineering, but should also be given a vision that will make it possible for him to become one of the leaders of engineering and of industry.

Summary—To sum up; the preliminary training of the engineering student should include intensive training in language, mathematics, history, civics, and science. The engineering course should be four years in length. The curriculum should include courses in science, mathematics, mechanics, the fundamentals of engineering science, and the practice of the art of engineering. Special emphasis should be placed on training in engineering science and some attention should be given to fundamental courses in economics, business law, and government. For men who wish to enter the higher branches of technical engineering, who wish to become engineering teachers, who are to engage in engineering research, a graduate course should be provided, the length of which should vary from one to three years to fit the needs of the graduate student. As an inspiration to the student and to the instructor and to assist in training teachers and graduate students, the college of engineering should engage in engineering research. The most satisfactory and efficient development of each will come from a combination of undergraduate work in engineering, graduate work in engineering, and engineering research.

Importance of the Teacher—The most important part of any institution of learning is the teacher. The engineering teacher should be a man who has had a liberal education as well as a thorough training in mathematics, mechanics, science and applied science, and in addition should have had engineering and business experience. Much of the training in a knowledge of business affairs, in a knowledge of men and in the application of economics to industrial problems and in ethics, must be given incidentally. After all, the greatest privilege given to the college student is that of coming in direct contact with men who have given their lives to literature, economics, science, mathematics or engineering, who live in their work and to whom the greatest joy is assisting students to unlock the storehouse of knowledge.

Some Obligations of Research on School and Industry

Research Needed to Impress Students with Lack of Finality in Engineering and to Urge Industry to Further Progress

Extracts from an address entitled "Importance of Research to the Progress of Industry" at the induction into office of Milo S. Ketchum as dean of the College of Engineering of the University of Illinois, March 7, 1923.

By E. J. Mehren
Editor, *Engineering News-Record*

THE pursuit of knowledge, the discovery of truth, has ever been one of the goals of university activity. The mere prospect of increasing our knowledge has been incentive enough for the aspiring spirits that the universities have gathered to their fostering arms. But if the mere pursuit of knowledge for its own sake offers sufficient incentive for scientific research in the halls of learning, the university nevertheless cannot be neglectful of the practical results; for the university has a responsibility for social, as well as for intellectual, leadership. Our social system today rests largely on an engineering and industrial foundation. Anything that will improve and develop that foundation is properly a subject of university responsibility.

To us, as engineers, there are more intimate considerations; considerations that have a profound influence upon the spirit that must animate the college. If research is a *sine qua non* of engineering and industrial progress, if, in turn, the college of engineering exists as a servant of engineering and industry, supplying it with the men who shall carry on in the future, it is the bounden duty of that college to cultivate the research spirit and to turn out its men imbued with that spirit, imbued with the belief that there is no finality in engineering development.

Fifty years ago the fundamental assets of industrial success in this country were daring and energy. We lived in a veritable gold mine. Resources were of unparalleled richness. Little skill was needed to wring success from such natural assets. That was the day of the adventurer in industry, of the promoter, of men of shrewdness rather than of broad or intensive knowledge.

Today, how different. The best of organizing brains, the greatest of financial resources, the most versatile of salesmanship are not sufficient of themselves to build industries. There must be knowledge, abundant knowledge of intricate industrial processes. The richest resources have been worked out. Profit must be wrung from poorer materials. Today, as never before, knowledge is power, and industrial knowledge, at the present stage of engineering development, is, more and more, a direct function of scientific research. Some industries are farther advanced than others. Success in many industrial operations can now be won only from the introduction of great refinements, from the development constantly of new materials and new products, from the discovery of processes which shall give value to the materials which were useless under cruder processes of recovery.

Researches of the recent past give us courage for the future. We could easily become discouraged by contemplating the rapid exhaustion of our richer resources. We could worry about the future of our children's children. Were we at the stage of scientific development of a hundred years ago and were witnessing the present rate of depletion of our richer resources, we might well be seriously disturbed. As it is, it behooves us as responsible members of a world civilization to use those resources to the utmost possible efficiency. Nevertheless, we can look with more complacency on the situation than our predecessors, for we have at hand an instrument that each year discloses as valuable treasures, materials and resources that formerly were valueless.

Obligation of the University—If then scientific research has come to occupy a place of such great importance in our daily lives, if the maintenance and further development of the material elements of our civilization are dependent upon new scientific discoveries, if the industries of today and those of the future rest upon the work of the research laboratory, it is manifestly the obligation of the engineering college, whose work it is to prepare men to carry on the work of applied science, to see that they are imbued with this spirit of research.

It is not to be expected that every student leaving the college of engineering should be adapted to research work. The processes of engineering are complex. They require men of many types, of varied inclinations, of widely different adaptabilities. But all who leave these engineering halls should be thoroughly imbued with the idea that there is no finality in engineering development. Some will engage in research work and develop new materials, new processes, new principles; some will engage in design, and, accepting principles already established, will work toward greater economy, greater efficiency within the range of those principles. Others will be responsible for the operation of the processes of production. All, however, even though they may be unable to engage in research work, and no matter what positions they may occupy, must be sympathetic with the spirit of research, must encourage it, must lend it their support, must help to place it in its proper place in the structure of American business.

Obligations on Industry—There is needed throughout the business organization of the land a better appreciation of the function of research. While some industries have gone far in introducing scientific inquiry into their businesses, while a very few of them are resting their whole operations on a research foundation, most of our industries are not beyond the stage of crude experimentation. If university men do not lead in advocacy of research, whence indeed shall come its friends? Our goal must be a "mutual deep appreciation," as one scientist has expressed it, between American industry and American science.

Nor can we be content with merely impressing upon the leaders of American industry the need for and the utility of such research as is associated with the solution of immediate difficulties in manufacture or the necessary improvement of a product. Our task, with our broader vision, should be to point out the necessity, if our industries are to continue to progress, to push inquiries of a fundamental nature, not necessarily connected with immediate prospective utility. Radical progress can be expected only from a thorough knowledge of the materials and processes with which we work. When their nature is thoroughly understood, then occur those radical advances which shoot a science or an industry into a new era and open radically new fields to scientific inquiry.

In advocating the necessity of fundamental research, we need to break down the distinction that some attempt to make between engineering and scientific research. Engineering research, it is held, is that directed at immediate results; scientific research relates to the fundamentals. The theory is that one is useful, the other is not. We have many instances to show, as Dr. Steinmetz has put it, that "there is no scientific investigation, however remote from industrial requirements, which might not possibly lead to industrially useful developments." Our task, as university men, is to promote the fundamental researches as well as those that have an obviously practical end.

We should find encouragement, too, in our efforts to secure the general adoption of research in industry because the American industrial leader so far senses the need for progress that he accepts crude experimentation as a necessary feature of industrial functioning. But he needs to be convinced that the bungling of the rule-of-thumb experimenter has passed, and that science furnishes a superior tool through the research mechanisms of mathematics, physics, chemistry and engineering.

Research and Instruction—It is not my function today to discuss the means by which this spirit of research can be impressed upon the students of engineering. Obviously, it requires something in addition to instruction in the established principles of engineering, mathematics and physics and in their applications. Nor is it sufficient for the student to learn that it is by an intensification of the methods that he sees about him in the laboratories that new knowledge is to be discovered. It is from the spirit of the institution, rather than from any direct teaching that appreciation of research is to be gained. Capable research men must be pushing their inquiries within the university walls where students can see and know them and absorb the spirit in which these leaders are working. Teaching by example is most powerful. Enthusiasm for painstaking scientific inquiry is the surest means of spreading the gospel of research.

Obviously, there are many problems to be considered in determining the relation of the university to industry with reference to research work. I do not propose to enter upon them today. The two obvious fundamentals are that industry has an obligation to give financial support to research work, and that the university has an obligation to further research work that shall result in engineering progress. There is needed a combination of industrial financial support with university vision and ability—a combination well realized in our own Engineering Experiment Station. Such a station will be a breeder of independent laboratories in industry, but if the university keeps its vision there will always be work ahead, particularly in the fundamentals, no matter how many industrial laboratories are established.

Insufficient Utilitarians—It would be unworthy of a university were its research, were its pursuit of knowledge inspired solely by the hope of useful result. Utilitarian ideals, if indeed they may be called ideals, are weak in power of inspiration compared with those that are intellectual and spiritual. The university is indeed a place of training for life—but for life in its larger and finer aspects. Moreover the university is a place of light and of leading. Its duty is to bring our knowledge to ever loftier heights and to breed not merely good workers and good citizens but creative leaders, those prophets who shall lead us to new promised lands. Such creative men, the finest flower of university effort, "arise spontaneously in an atmosphere in which creative men exist and, in general, nowhere else." This atmosphere is the sure strength of the university. It is that which distinguishes it from a mere place of instruction.

With this thirst for knowledge at the basis of university enthusiasm for research, utilitarian research will not only have a surer foundation but will be immeasurably strengthened by contact with the purer enthusiasm. Young men and young women will be led to new visions by acquaintance with the explorers of knowledge, adventurers into the unknown. Youth loves exploration and adventure — and research is exploration, research is adventure.

This, then, is the inspiring mission of the university—to stimulate the thirst for knowledge, to develop creative men and women, to send out with broad vision and sympathies the leaders in life's activities.

Present Extent of Railway Electrification

At the recent convention of the American Institute of Electrical Engineers in New York, W. P. Potter, engineer, railway engineering department of the General Electric Co., offered the following table, showing the present extent of railway electrification. This includes only steam railroads which have been electrified or are now in process of being electrified.

Country	[illegible]	[illegible]
United States	[illegible]	[illegible]
Switzerland	[illegible]	[illegible]
France	[illegible]	[illegible]
Italy	[illegible]	[illegible]
Germany	[illegible]	[illegible]
Sweden	[illegible]	[illegible]
Cuba	[illegible]	[illegible]
Austria	[illegible]	[illegible]
Africa	[illegible]	[illegible]
Chile	[illegible]	[illegible]
England	[illegible]	[illegible]
Spain	48	17
Canada	[illegible]	[illegible]
Japan	[illegible]	[illegible]
Norway	[illegible]	[illegible]
Mexico	[illegible]	[illegible]
Brazil	[illegible]	[illegible]
China	[illegible]	[illegible]
Java	25	5

Wood-Block Pavements Restored by Seal Coat

Buckled and Dried Out Pavements Put Into Good Condition by Applying a Bituminous Seal Coat Covered with Sand

By James A. McElroy
City Engineer, Bridgeport, Conn.

BRIDGEPORT, CONN., has about 150,000 sq.yd. of wood-block pavement, all less than 15 years old. On some streets it is in excellent condition after ten or more years of service. On others, especially on streets that have car tracks, it is in poor condition in spite of the fact that considerable money has been spent on it every year to keep it in condition.

The blocks were originally laid on a 6-in. concrete foundation with a 1-in. sand cushion. The trouble seems to be that after a few years the blocks lose most of the oil with which they were treated. Then a few days of wet weather following a warm dry spell, will cause the blocks to expand and buckle. When they are relaid some of the old blocks are broken and new blocks are required, the cost of which makes the repair work expensive.

A few years ago I suggested to one of the wood-block companies that they might devise some method of treating old blocks on the street. The cheapest scheme they could suggest was to take up the blocks and relay them with another type of cushion. They estimated the cost at $1 to $1.25 per square yard, exclusive of the cost of new blocks.

It was then decided to seal the old wood-block pavements by giving them a surface treatment of hot road oil. Tarvia B was tried on State St., which had buckled badly during the heavy rains of last June. After the blocks had been leveled, the material was applied with sprinkling cans at the rate of 0.4 gal. per square yard. It was allowed to stand for about an hour and then covered with sand, 1 cu.yd. of sand to 100 sq.yd. of pavement. Covering with sand immediately after the application was also tried but it could not be seen that it made any difference in the final result. It was found, however, that the Tarvia B was easier to apply if it was heated. After a few days under traffic the treated blocks had the appearance of a new pavement, and although considerable wet weather has been had since the work was done, the blocks have shown no signs of buckling. This treatment cost 10c. a square yard for 5,000 sq.yd.

On Fairfield Ave. and part of State St., Texaco special macadam binder was used. The material was heated to a temperature of 250 deg. F. and applied with a pressure distributor at the rate of 0.4 gal. per square yard. It was immediately covered with sand, 1 cu.yd. of sand to 100 sq.yd. At the end of a week the sand was well worked into the asphalt, forming a thin mat which effectually sealed the block and gave it the appearance of a sheet asphalt pavement. About 13,000 sq.yd. were treated with special macadam binder at a cost of 76c. per square yard.

Director of Public Works, George M. [illegible], is so well pleased with the results obtained that he expects to treat a number of our wood-block streets in this way next year, believing that if they are treated in time, a considerable saving in maintenance will be effected and the life of the pavement will be prolonged.

Erecting Office Building Over Complicated Track Layout

Difficulties Met in Constructing Building Independent of Railroad Structure Containing Two Track Levels

CONSTRUCTION difficulties perhaps unique in New York office-building work have been encountered in erecting the twenty-story Park-Lexington building now under construction at Park Ave. and 46th St. These difficulties were occasioned by the necessity of carrying foundations for the building to bedrock entirely independent of the steel in the New York Central R.R.'s double-deck track structure over which the building rises, and threading the supports through two track levels of different arrangement. The building covers the whole block on the eastern side of Park Ave. with a depth of 80 ft. on 46th and 47th Sts.

The principal difficulties in the construction work were encountered in cutting through the suburban and express levels of the track in order to get foundation steel and other materials through. Extremely limited space necessitated workmen operating much of the time from staging suspended from girder flanges, as it was impossible to install a plant which in any way obstructed or interfered with the operation of trains. Inasmuch as trains run frequently, particularly during rush hours, the difficulties which the contractor met are obvious. The express-train level tracks are about 22 ft. below the Park Ave. street surface. The suburban-level tracks are about 28 ft. below the express-level tracks, making the suburban level therefore about 50 ft. below the street surface. The principal difficulties in construction were met in the suburban level.

The steel supporting the express and suburban levels of tracks had been designed originally to carry twelve-story building loads in addition to the railroad structure. After the Grand Central Terminal development had been finished, however, it was found that any building supported on railroad steel was subjected to vibration caused by trains. In the Park-Lexington building, therefore, independent steel was used throughout the foundation in order to eliminate railroad train vibration in so far as possible. This required wind struts and bracing to be placed between the new columns below the street level. Nearly 1,600 tons of structural steel were used below the Park Ave. level in this substructure foundation and no part of this steel touches the railroad structure at any place.

The building has 43 steel columns in the substructure work. These rest on steel billets from 4 in. to 7 in. thick, which are supported on independent foundations of steel grillages and concrete, in turn resting upon bedrock. The excavation for the column grillages was in general about 6 ft. below the top of the suburban level rail and it was necessary in order to secure adequate foundation area to extend most of the foundation grillages under the suburban level railroad track.

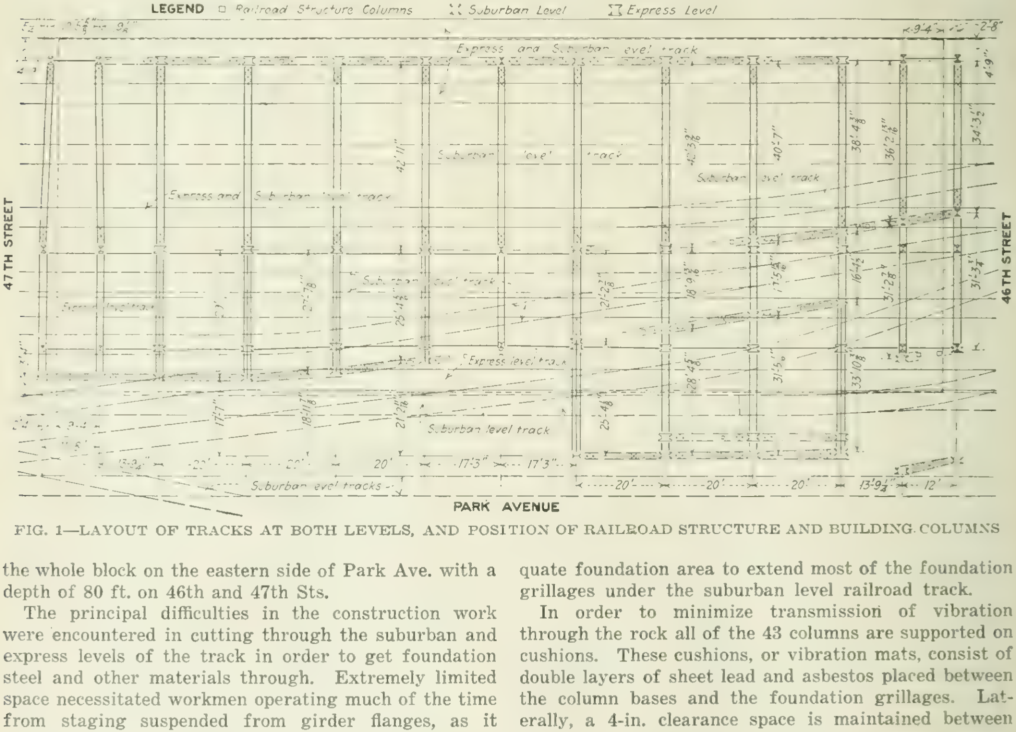


FIG. 1—LAYOUT OF TRACKS AT BOTH LEVELS, AND POSITION OF RAILROAD STRUCTURE AND BUILDING COLUMNS

In order to minimize transmission of vibration through the rock all of the 43 columns are supported on cushions. These cushions, or vibration mats, consist of double layers of sheet lead and asbestos placed between the column bases and the foundation grillages. Laterally, a 4-in. clearance space is maintained between the building columns and the railroad steel or the concrete protection walls. This space is closed by cork.

The steel street viaduct supporting the street surface around the building is separated from the building itself at the sidewalk line by a continuous expansion joint which is open 4 in. A similar clearance is maintained around all of the building columns where they pass through the railroad express level floor. All of the steel for the building substructure is to have a 2-in. concrete fireproof covering. The minimum 4-in. clearance is maintained between the fireproofing surface and any part of the railroad structure.

Actual construction methods in carrying out the work were necessarily governed by railroad traffic conditions. In order to provide space for the new substructure columns and foundations it was necessary to cut away large portions of the concrete and smaller portions of the steel of the original railroad structure. The concrete cutting was accomplished with pneumatic air drills which worked mostly at night. A small amount of the rock excavation for the new column footings was accomplished partly with the aid of light blasting. Compressed air for the drills was supplied from the 49th St. power house of the New York Central R.R. In carrying on this portion of the work it was necessary to protect carefully the third rail used for the transmission of electric locomotive power. In general, the third rails were kept alive and protected by boards.

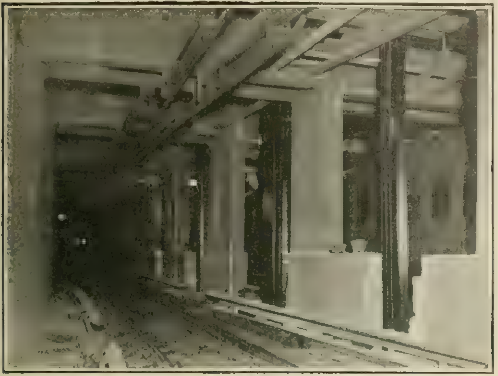


FIG. 2—NEW STEEL IN PLACE AT SUBURBAN LEVEL
Some idea of the restricted space in which workmen operated can be gained from this photograph. Concrete connecting walls first had to be cut away, then where railroad grillage steel interfered, it was burned away to give a 10-in. clearance between it and building column grillages. This steel was let down through holes cut in the concrete floor of the railroad structure.

Another difficulty was met when concrete was poured for footings. Inasmuch as the column footings could only be poured one or two at a time, as conditions permitted, hand mixing of material at each footing was the only satisfactory method that could be employed. Concrete materials were delivered from the street surface by means of long chutes.

One of the most difficult parts of the work was met when cutting through the 30-in. steel stringers of the old railroad structure at the express level floor was begun in order to provide room for the new steel. This cutting was accomplished with oxy-acetylene torches, workmen operating from staging attached to the flanges of the heavy girders just over the suburban-level tracks. This staging was used for each of the 35 stringers that were cut as well as for concrete cutting and fireproofing and the erection and riveting of the new steel.

In the express-level track area conditions were simpler as to working space. Three passenger platforms separate four parallel tracks. However, the work was hampered by the fact that the express-level tracks do not line up above the suburban-level tracks below so that many columns could not be carried up directly from their foundations to the street surface level. It was necessary to offset 21 columns on 15 girders placed just beneath the express-level deck. This condition was the one which made it necessary to cut through the 30-in. steel stringers of the express-level deck in order to let the building columns through. Unsupported ends of the cutoff stringers were carried by header beams to the next adjoining stringers.

An interesting feature of the steel construction in the substructure work is the employment of eleven large distributing girders placed at the Park Ave. level which are carried the entire width of the twenty-story building above. Some of these distributing girders are as deep as 7 ft. and weigh 33 tons. They constitute, in effect, an elevated foundation upon which the building rests.

With the railroad using for its trains the space in the building which ordinarily would have been occupied by boilers, mechanical and electrical equipment, the owners were confronted with the necessity of supplying heat, power and light from other sources. This difficulty was overcome by obtaining all heat and electric power from the central power station of the New York Central R.R. at Park Ave. and 49th Street.

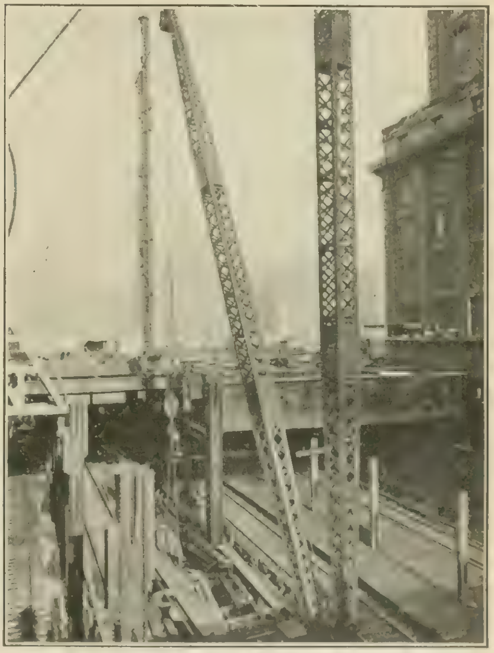


FIG. 3—ERECTING STEEL AT THE EXPRESS LEVEL
Construction was made easier at this level as steel could be handled from street to storage between tracks by derricks.

The Park-Lexington building is to be a twenty-story office building of the highest class. It will be connected by overhead bridges at the third, fourth, fifth, and sixth floor levels with the present Grand Central Palace, just east of it. These bridges, however, will be made structurally separate from both the Grand Central Palace and the Park-Lexington building by means of steel and sheet lead expansion joints.

Design of the substructure work was made by H. G. Balcom, consulting engineer, and the work carried on under the general supervision of W. J. Thornton, terminal engineer of the New York Central R.R. The Merchants and Manufacturers Exchange of New York City is the owner of the building. The construction work both for substructure and the building itself is being done by T. C. Desmond & Co., Inc., general contractors, with W. T. Spalding engineer in charge.

State Road Maintenance Through County Organizations

Advantages and Disadvantages—Patrol Organization—Mileage Costs for Five Years—Results Show Money Profit

By J. T. Donaghey
Maintenance Engineer, Wisconsin Highway Commission, Madison, Wis.

Paper presented at the annual convention of the American Builders Association, Chicago, Ill., Jan. 18, 1923.

Wisconsin has 78,000 miles of all classes of highways. At the time of taking over the maintenance in the spring of 1918, the records showed that 255 miles were concrete; 1,775 miles were stone macadam; 15,670 miles were gravel, most of which was ordinary town work; and 60,300 miles were earth. It was believed that a system containing not less than 10 per cent of the total road mileage of the state would be required to serve traffic reasonably well, and that eventually the public would demand that not less than 20 per cent of the total road mileage should be adequately maintained.

Maintenance Administration—A plan of administration was the first consideration. The question was: Should the state maintain the entire system with a state organization, the state paying the entire cost, or should the actual maintenance work be done by each county and the county be reimbursed by the state after the work was satisfactorily performed? There were many advocates of each plan. After analyzing the two the following conclusions were reached:

A—Under the state maintenance organization plan it appeared that:

1. The highway department would have closer control of the entire maintenance operations.
2. The work might be better and more economically done and in many instances done more promptly.
3. The costs of the work would be more accurately kept and unit costs of work could be shown on many specific parts of the work which would be of considerable value on other similar work in the state.

B—Offsetting these obvious merits appeared certain disadvantages which could be enumerated as follows:

1. It would require an appropriation sufficient to purchase approximately $2,000,000 worth of necessary maintenance equipment; this appropriation would have been very difficult, if not impossible, to obtain from the legislature at that time.
2. It would require an organization of experienced maintenance men that would be difficult to procure without employing the very men who were employed on road work by the several counties.
3. It would result, in many instances, in the operation of a state road-maintenance crew in close proximity to a county road crew, which would be undesirable, as the laws permit state employees to work but eight hours a day while county forces may work ten hours.
4. There would be no incentive other than the example of good maintenance shown by state work, to induce the local communities to maintain other roads not a part of the state trunk system.
5. Criticism of the work as a state organization would come from the other side of the road fence, which in many instances would not be constructive or helpful criticism.

C—If a plan of operating through the counties were adopted, it appeared that it would have these advantages:

1. The county organizations previously employed in each county to build roads could be utilized to maintain the state trunk system; that is, trained men familiar with conditions in the county would be put in charge of the maintenance work in each county.
2. The equipment owned by the counties would go a long way in providing the necessary tools and machinery for the maintenance work, removing the necessity of purchasing duplicate machinery.
3. The counties, represented by their local officials, would be actually doing the maintenance work, and the general public would not criticise them as freely as it would state officials doing such work. The highway commission's criticism of the counties' work probably would be much broader and more constructive than the counties' criticism of state work would be.
4. The fact that the local officials were actually in charge of the maintenance work would inspire them to want a larger mileage maintained locally, and through their efforts sentiment would be developed for the proper maintenance of additional roads in every community.

D—The possible defects of working through county organizations appeared to be:

1. The lack of co-operation between the county officials and the state highway department.
2. The possibility of work costing more than it should, due to lack of proper supervision.
3. The possibility that some of the work would be done in a more or less slip-shod manner.

After weighing both plans, the commission decided to operate through the counties as a unit, primarily because it believed that the *sentiment which would be created for the improvement of roads* other than those contained in the state trunk highway system would eventually more than offset the possible inefficiency and other unsatisfactory features of this plan.

Organizing For Patrol Maintenance—For convenience, the commission established nine divisions, containing approximately eight counties each. A resident engineer, called division engineer, is in charge of each, with the necessary assistants to plan and supervise the work. An assistant, known as division maintenance engineer, has charge of all maintenance, marking and signing. The latter visits each patrolman at least twice a month, reporting each visit by card to the main office. In 1922 there were 10,940 visits reported.

Each county is governed by a county board, consisting of a representative from each township and village and also one from each ward of every city. The county board elects a committee of three to represent it in all matters connected with road work, and also elects a county highway commissioner who has direct charge of all road construction and maintenance by the county. Each county highway commissioner has an assistant known as patrol-maintenance superintendent who is in charge of maintenance. He visits each patrolman at least twice each week.

The county-road committee really acts as a board of directors and as a buffer between the county highway commissioner and the county board on the one hand and the state highway department and the county board on the other.

Prior to the selection of the system authorized by the legislature, the division engineers made a condition survey of all competing roads showing the actual conditions existing on every mile. After the selection of the system another survey was made, at which time the distance was measured accurately and stakes set each mile locating future mile posts. The information on each mile shows by tenths of a mile the soil, drainage, type of surface and condition. This information was very helpful, later on, in planning the patrol system in each county.

The law provided that "each county must adequately maintain the portion of the system lying within the county, according to the specifications, directions and to the satisfaction of the highway commission."

The commission determined that a thorough patrol system must be installed at the very beginning which would cover every mile on the system, whether previously improved or not. The portion of the system lying in each county was divided into patrol sections by the county committee, acting jointly with the county highway commissioner and the division engineer. The patrolman for each section was selected in the same manner. The county committee advertises in the local press that on a certain day those seeking the jobs of patrolmen for the coming season must report at the county court house. The applicants "if new" are interviewed by the county committee and the division engineer, and the most promising candidates are given the positions. Applicants having served as patrolmen one or more seasons are given preference over new men and usually receive more salary.

Each patrolman enters into a written contract with the county and gives a bond in the amount of $500 for the faithful performance of the work and proper care of the tools and machinery entrusted to him. The contract is also subject to the approval of the division engineer.

On "team patrol sections" the patrolman must furnish a team and wagon, the county a light blade grader, road planer, plow, slip scraper and miscellaneous small tools. On "motor truck or tractor patrol sections" the county furnishes all the equipment.

The salaries paid on team patrol sections range from $140 to $165 per month for the 1922 season; those on motor truck and tractor patrols average about $110 per month. The season extends from about April 1 to Dec. 1, and from Dec. 1 to April 1 the patrolman agrees to work when requested at a fixed price per hour.

The "team patrol sections" average about 6⅜ miles each, and as a rule are confined to earth road sections and those gravel sections that carry light traffic. There are few tractor patrol sections. They average about 12 miles in length and are generally confined to earth roads but are sometimes preferable on heavy traffic gravel roads where heavy maintenance equipment is necessary. Motor truck patrol sections average about 18 miles, and are economical only on heavy traffic roads where heavy maintenance equipment is necessary and where new material must be hauled regularly, on surface treated stone or gravel, and for work on concrete surfacings. We find that on earth or gravel sections where traffic does not exceed an average of 200 vehicles per day the "team patrol" is cheap and satisfactory.

TABLE I—FIVE-YEAR MAINTENANCE RECORD WISCONSIN STATE ROAD SYSTEM

Year 1918	1918	1919	1920	1921	*1922
Actual miles maintained	4,998.9	4,998.9	7,234.0	7,260.4	7,458.59
No. patrol sections	561	561	791	911	940
Monthly salary team patrol	$130.00	$145.00	$165.00	$155.00	$150.00
Monthly salary motor patrol	90.00	110.00	125.00	115.00	100.00
Patrol maintenance cost per mile:					
Earth	135.21	154.01	187.24	196.21	186.40
Gravel	120.80	133.63	184.68	193.85	183.25
Stone and gravel surface treated	574.21	626.33	706.11	682.23	671.84
**Concrete	162.21	210.42	220.18	322.21	311.85
Cost patrol maintenance	573,042.16	767,302.12	1,220,535.00	1,326,927.24	1,355,900.00
Cost of betterments	396,449.65	488,529.68	756,474.38	1,028,976.04	952,850.00
Cost of marking and signing	7,888.22	17,776.16	28,820.61	20,462.14	41,250.00
Total expenditures	$977,430.93	$1,273,607.86	$2,005,829.89	$2,381,413.85	$2,350,000.00

The above total expenditures average $278 per mile per year.

* Final costs will vary somewhat from figures shown, as the season is not complete at this date (Dec. 15, 1922).

** Annual costs include all shoulder maintenance, which runs high on all surfacings less than 18 feet.

Costs on State Trunk Highways—The 1917 legislature provided for a 5,000-mile state trunk highway system, which the legislature of 1919 increased to 7,500 miles. Table I shows the actual miles maintained by patrol methods each year, the number of patrol sections, the salary paid patrolmen, the patrol maintenance cost of each type per mile, and the amount expended per mile out of maintenance funds for "betterments." "Betterments" consist of widening the road and providing drainage with heavy blade grader work, light resurfacing, new culverts, and the cost of marking and signing the system.

Counties Develop Maintenance—Several county boards as early as June, 1918, provided for patrol maintenance on important secondary roads. The growth of this sentiment is shown by Table II stating the miles of county trunk highways taken over for maintenance each year by the several county boards, the number of patrolmen employed, salary, cost of marking and signing, and total expenditures.

TABLE II—COUNTY TRUNK-LINE ROAD TAKEN OVER FOR MAINTENANCE YEARLY FOR FIVE YEARS

Year	1918	1919	1920	1921	1922
Miles maintained	2,021	5,590	7,743	8,980	9,885
Number of patrolmen	232	705	970	1,123	1,236
Average monthly salary of patrolmen	$125	$140	$160	$150	$145
Cost of maintenance	475,000.00	1,226,267	1,435,527	[illegible]	2,279,804
Cost of marking and signing		3,600	9,300	[illegible]	11,000
Total expenditures	$475,000.00	$1,229,867	$1,444,827	$1,875,715	$2,290,804

The above total expenditures average $214 per mile per year.

Table II bears out the original idea and proves that the plan of operating through the counties has resulted in local demands for more roads to be maintained each year by patrol methods and consequently a much greater mileage of patrolled roads. In addition to the 7,500-mile state trunk system, we now have a 9,880-mile county trunk system, making a total of 17,380 miles of well maintained roads. This gives more than 80 per cent of our population direct service, and brings patrolled roads within two miles of the remaining 20 per cent.

Results Obtained—The patrol maintenance plan adopted in 1918, improved upon from year to year, and extended to include additional county highways each year, has certainly served traffic better, and satisfied the public to a greater degree than the expenditure of the same amount of money each year in constructing a few lines of high type surfacing would have done. After five years of patrol maintenance we find that the following conditions prevail:

1. Every town, city or village in the state is on a well-maintained and marked highway.

2. Traffic is distributed over a large mileage, reducing congestion on many highways.

3. The average speed of traffic has been increased at least ten miles per hour, resulting in great time saving.

4. Night driving is safe and practical and our traffic census shows a marked increase each year in night traffic.

5. Prosperity immediately becomes noticeable. The farmers along such routes soon vie with each other in promoting neatness in their road fences, farm buildings and entrances. Farm names appear over the gateway and the mail boxes are given a fresh coat of paint. Letterheads even show the location of the farm by trunk highway route and mile number. Products of the farm are sold direct to the city dweller at a price satisfactory to both. In the villages and cities along the routes new inns or tea rooms, rest rooms and garages spring up to serve traffic.

6. Last, but not least, is the tourist, and our definition of a tourist is any person using our highways for pleasure, whether residents of Wisconsin or not. We realize that nature has provided Wisconsin with scenic features in abundance; nevertheless, the tourist today would not be with us if our highways did not make traveling by motor car a pleasure. As to the amount spent by tourists, from the most accurate data available we are confident that it now exceeds $100,000,000 annually. The little village of Kilbourn, located at the lower entrance to the "Dells of the Wisconsin," containing a population of but 1,200 people, furnished us accurate records kept by the banks, hotels and business houses for the 1922 season, showing that over one million dollars was left in that vicinity alone by tourists; also that a count taken by the business men's association one night registered more people camped in the village camping grounds than were living in Kilbourn. Many towns on patrolled highways provide free camping grounds.

Wisconsin is satisfied that during the five years of patrol maintenance, 1918-1922, tourists have left not less than $300,000,000. Figuring a net profit of but 20 per cent, which is very conservative, the profits from this source would be $60,000,000, or about seven times the total expended for patrol maintenance and marking and signing the state trunk system since April 1, 1918.

Concrete Structures for D., L. & W. R. R. New Grade Crossings

Different Standard Street Crossings and Elevated Station Structures Used in East Orange Grade Elevation—Old Masonry Arch Elevated by Concrete Superstructure

By M. Hirschthal
Concrete Engineer, Delaware, Lackawanna & Western R.R., Hoboken, N. J.

THE most effective "Careful Crossing Campaign" is that of grade crossing elimination, a fact recognized by the management of the Lackawanna R.R. as early as 1910 when this work was begun near its east terminal on the Montclair Branch and on the Morris & Essex Division a few years later. In turn the grade crossings were eliminated at Morristown, Chatham, Madison, Convent, South Orange, Morris Plains and Orange, so that with completion of the East Orange improvements, construction features of which were described in *Engineering News-Record,* Nov. 9, 1922, p. 778, there will have been eliminated all crossings at grade between Mount Tabor and Hoboken, removing all danger to vehicular traffic from that source in the thickly populated suburban district.

On the main line through East Orange, eleven grade crossings will be eliminated and three on the Montclair Branch, in addition to providing a new crossing at 16th St. on the main line and one at Rutledge Ave. on the branch. To accomplish this the bridge construction on the main line includes two viaducts in connection with each of the stations, six undercrossings, one pedestrian subway, the reconstruction of one overhead footbridge and the construction of a viaduct on top of the present Parkway Arch Bridge, in East Orange. On the branch four undercrossings have been constructed.

For 50-ft. streets, of which there are three on the main line and two on the branch, the type of bridge designed was one with a 2-ft. pier, having arched openings, located on the center line of the street with 24-ft. clear spans on either side and abutments on the street lines. A reinforced-concrete slab spans across the pier from abutment to abutment. For the 60-ft. street, that at Greenwood Ave., additional 2-ft. piers were placed at each of the curbs providing two roadway and two sidewalk spans.

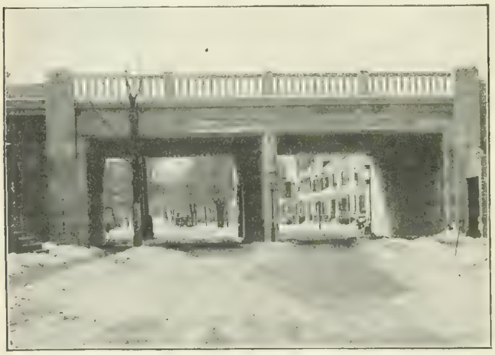


FIG. 1—TYPICAL 50-FT. STREET UNDERCROSSING

The remainder of the undercrossings are for larger streets and consist of circular columns surmounted by slabs of the cantilever flat-slab type having four-way reinforcement and depressed panels at the column capitals. Of this same type are the viaducts in connection with the Brick Church and East Orange stations, although at the latter it is in combination with other types.

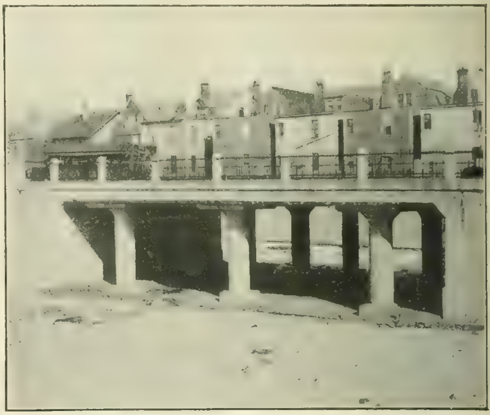


FIG. 2—FLAT SLAB TYPE UNDERCROSSING, SIXTEENTH ST., NEWARK

At Brick Church the viaduct is continuous from the east street line of Halsted St. to the west street line of Harrison St., a distance of 1,080 ft. Originally the plans called for bridges of seven spans each at Harrison and Halsted Sts., open construction at the station and retaining walls and fill between these points. The enhancement in the appearance of the construction and availability of the open space for future use finally overcame the obstacle of somewhat increased first cost so that the open construction was adopted throughout.

The first designs contemplated the use of the fascia column type for both the Brick Church and East Orange Viaducts but due to the conditions at the former which involved some very expensive property if this type were adopted, the cantilever type was designed to permit of the extension of the driveways under the viaduct, obviating the necessity of the purchase or reconstruction of a modern and expensive warehouse building. This revision materially changed the character of the Brick Church as compared with the East Orange viaduct, in its structural and architectural design and even in the station facilities.

Structurally the two cantilevers on the Brick Church structures displace one span of that at East Orange, resulting in a complete difference in the reinforcement of both columns and slab in the two structures. Architecturally, we have the continuous unbroken cantilever fascia at Brick Church surmounted by an iron railing in contrast with the pilasters at each bent of the East Orange viaduct, fascia arches sprung between them and an open concrete balustrade above.

The headhouse of a station connecting with a cantilever structure would of necessity be of a character different from that of one with fascia columns and here at Brick Church in addition, it was necessary to provide additional driveway space, hence a one way thoroughfare through the headhouse. All in all the final designs produced structures at each of the stations absolutely dissimilar in practically all features, except track and platform facilities. The comparative designs as governed by the varying conditions at Brick Church and East Orange, are the subject of an article to appear in an early issue.

Parkway Viaduct—The most unusual structure of any on this improvement is that at East Orange Parkway. Prior to the track elevation now in progress the tracks over the Parkway were supported on three segmental masonry arches, the center one of which is 40-ft. clear span, while the ones on either side have spans of 20 ft. with 10-ft. piers between. The track was carried on an earth fill retained by masonry spandrel walls. The width was sufficient to accommodate three tracks although only two were then in operation. The new line is elevated at this point about 11 ft. above the old, and there were three solutions presented to the problem of accomplishing this elevation. First, was the construction of solid walls at the two faces with fill between up to the subgrade of the new tracks. An analysis of the present arches and piers disclosed the fact that this condition would dangerously increase the stresses in the arch ring and the maximum foundation pressures to the point of making the structure unstable; therefore this scheme was eliminated from consideration.

There then remained the alternate schemes either of entirely demolishing the present structure and building one entirely new or of designing an open structure on top of the present one which would not result in any concentrations on the present arch rings and yet be of sufficiently light construction not to increase unduly the loads on the piers and abutments.

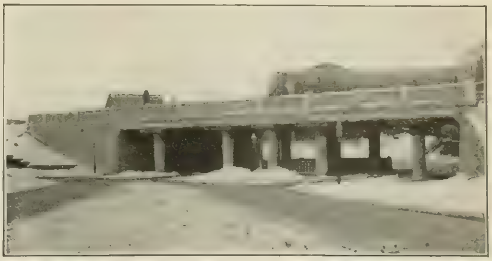
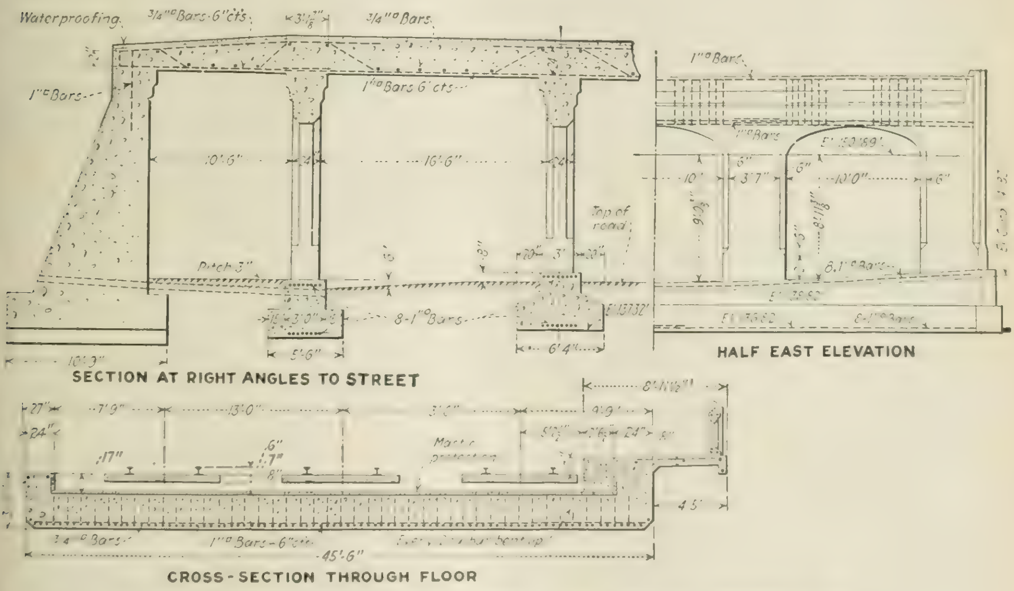


FIG. 3—FLAT SLAB TYPE, SPRINGFIELD AVE., MONTCLAIR

The first alternative was abandoned because of, first, excessive expense of the new construction, second, the difficulty and cost of removing the present construction and, third, lack of space for temporary train operation and new construction.



SECTION AT RIGHT ANGLES TO STREET

HALF EAST ELEVATION

CROSS-SECTION THROUGH FLOOR

FIG. 4—SECTIONS THROUGH 60-FT. STREET UNDERCROSSING, GREENWOOD AVE.

The question then resolved itself into what would be the type of open construction best adapted to the conditions involved. The present design is the result. For the main spans reinforced-concrete T-beams were designed 6 ft. 6 in. apart on centers, that is two beams per track; they are reinforced by three rows of steel, the bars in the top row being bent up to resist diagonal tension, for which purpose stirrups were also provided. These beams are supported by piers of the same thickness as that of the stem of the beams (2 ft. 6 in.), and of a width equal to the 10-ft. width of the arch pier below and are tied together by a 2-ft. thickness of cross wall at the outer ends of the piers. This wall acts also as a support for the two-way slab of the adjacent span which was made 22 ft. 11 in. clear longitudinally, so as to extend somewhat beyond the face of the abutment and resulted in panels sufficiently close to square to permit of their design as a two-way slab reducing its thickness, and hence the load on the present structure. For the same reason open spans were designed over the abutment, resulting in three two-way panels over each abutment. The slabs of these panels are supported by two longitudinal girders and the fascias, while transversely girders and columns were designed rather than solid walls, the fill being partly retained by the end girders, the remainder flowing through underneath them.

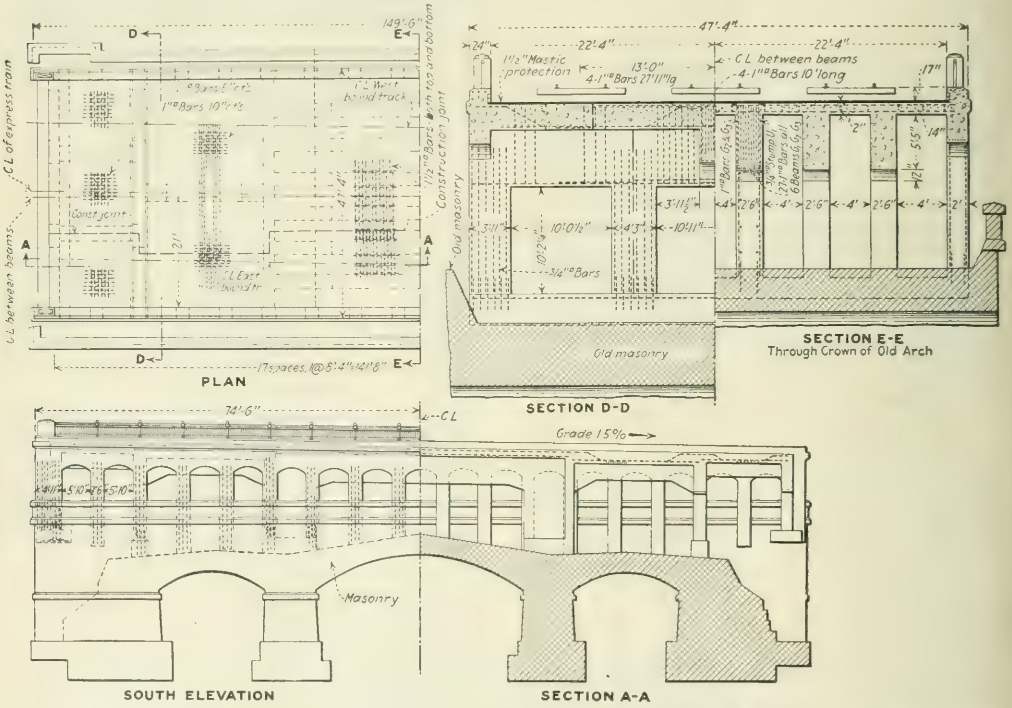


FIG. 5—DETAILS OF NEW CONCRETE TRACK ELEVATION OVER OLD MASONRY ARCH, AT PARKWAY, EAST ORANGE

All the piers are carried on continuous concrete footings on the old masonry, the earth fill being removed to permit their construction. For architectural effect, so as to produce a structure somewhat in keeping with the present construction the fascia girders were broken up into a series of arches extending from end to end of the structure, of such span and pier width as to be uniform and symmetrical throughout. In addition the piers above the line of the present parapet were scored as were also the arch rings with the effect illustrated in the view. The railing is a combination of structural steel and pipe railing. The result was the design of a structure which added but little additional load to that already carried by the existing structure with a pleasing effect and economical in cost. The F. M. Talbot Co. are the contractors who are constructing this bridge.

While the East Orange and Brick Church Viaducts were built completely clear of traffic, the Parkway Bridge because of lack of temporary track space had to be constructed so as to accommodate two tracks, it being planned to build the other section, after the two tracks are in operation on the new work. The construction joints are shown on the general plan.

The structures on both the main line and the Montclair Branch were designed under the direction of the writer, the Main St. portion under that of A. E. Deal, bridge engineer, and the stations under that of F. J. Nies, architect. O. H. Kellogg is the resident engineer in charge of construction, and M. H. Doughty is the division engineer, while both design and construction are under the supervision of G. J. Ray, chief engineer.

Design and Construction of Cahokia Station

In connection with the description of foundation work at the Cahokia power station, in our issue of Feb. 1, pp. 219-221, the designers give the further information that the reason for designing the station on a unit plan was that subsequent sections might take advantage of developments in the art. The site of the plant, it should also be said, is almost opposite the center of the city St. Louis. Work being done by subcontractors includes the foundation concrete work (exclusive of piles), which is being done by the Fruin-Colnon Co., of St. Louis; the levee work to El. + 40, which is being done by the Northern Dredge & Dock Co., of Minneapolis, and the foundation pile work, which is being done by the Raymond Concrete Pile Co., of New York. The general construction work, as well as engineering, design, and purchase of materials and equipment, is being done by McClellan & Junkersfeld, Inc.

American Railway Engineering Association Meeting

Increase in Committee Work and Large Attendance—Progress in Rails—Highway Bridge Specifications Presented—Passenger Station Design Under Study—Relation of Association to Standards Committee

AT THE twenty-fourth annual meeting of the American Railway Engineering Association, held at Chicago last week, the growth of committee work as the major activity of the association was apparent not only in the volume and broad scope of the reports presented but also in the reduced amount of open discussion. The meeting was unusually active, in spite of a somewhat lower attendance than that of last year's meeting, and plainly reflected the renewed activity in railway development. Because of the sparse discussion the following condensed review of the meeting is limited largely to an outline of the points of engineering interest in the committee reports.

Co-operation with Standards Committee—Close co-operation between the association and the American Engineering Standards Committee was recommended in the report of the committee on Standardization. At present the association is a member of the A.E.S.C. only indirectly, through the American Railway Association, although it has presented to the A.E.S.C. for adoption as American Standards two of its specifications, those for fixed and movable railway bridges. Discussion of the report dealt with the question of whether the association should become a member of the A.E.S.C.

A. W. Whitney, chairman of the latter body, and J. A. Capp, vice-chairman, addressed the meeting, giving reasons why the association should join. Mr. Whitney urged that the A.R.E.A. is not a sufficiently large interest to work by itself, out of contact with other interests. Mr. Capp argued that railroad men need the broadening effect of discussing their problems with other groups of men having related problems. On the other hand C. A. Morse (Rock Island Lines) expressed the view that the association has enough to do in getting the railways together in using the association's standards, and is little concerned with having these standards approved by outside interests. He held, also, that the problems of electric railways and of industrial trackage are distinct from those which are before the association. E. B. Katte (New York Central) said that the association's committee on electricity had recently been outvoted in a national standardizing body and a specification adopted that is less strict than the railway interest requires. To show that the work of the A.E.S.C. is too complex and too slow for the association's needs, he cited the delay of more than two years in formulating insulated wire specifications. The association would find itself in an unsatisfactory condition if it had not prepared its own specification. He favored continuing present representation on the A.E.S.C. by one member.

O. F. Dalstrom (Chicago & Northwestern) made the point that the association must be represented in the A.E.S.C. in order to defend its own interests and prevent the adoption of standards not acceptable to it. He instanced the fact that two railway bridge specifications are now in the field, and that it is essential for the association to submit its own specifications to the A.E.S.C. for adoption, as it has done. E. A. Frink (Seaboard Air Line) argued that standardization by a single industry, such as the railways, can never equal that done by a national body such as the A.E.S.C.

No action was taken by the meeting. However, R. H. Aishton, representing the executives as president of the American Railway Association, spoke at some length, expressing the opinion that the American Railway Engineering Association should decide how much representation of railway interests on the American Engineering Standards Committee is necessary, and that the A.R.A. would probably support their decision. Referring to the important fact brought out in the prior discussion, that the standards collected in the association's "Manual" are far from being in universal use by railways, he urged that the association make it its first object to bring about the use of its own standards.

Rail Failures and Quality—Statistics of rail failures, presented by the Rail committee as in previous years, continue to reveal a deterioration of quality of rail in the 1916 and 1917 rollings. The number of failures per 100 track-miles during five years' service ranged above 200 for the rails rolled about 1910, while subsequent improvement of quality brought the failures of 1914 rail down to 74. The latter figure increased to 105 for 1916 rail. Preliminary service indications for the rollings of 1918 and subsequent years indicate renewed improvement.

New methods of reporting rail failures led to some active discussion. A new form on which failure reports are to be entered by the section foremen was first adopted, then rejected, but finally, on a second reconsideration, was approved; changes in the form to suit the needs of the foremen are to be made.

Experience with the new non-segregating rail steel specification brought out a year ago for experimental use was reported, as reproduced in brief abstract. The rail so far rolled under the specification shows on the average a higher ductility than earlier rail, by one or two per cent. Whether the results in the track will also show greater toughness is not yet known, but the committee recommended that a much larger tonnage of orders under the new specification should be placed by the railways, in order to give fuller service data.

Work in hand by the committee includes the study of whether longer rails (39 ft length has been considered) are desirable, collection of data on rail wear, and study of canting the rails inward. Six railways have fixed on inclinations of 1:44 to 1:20 for canted rail, the latter figure being used by four of the six.

New specifications for heat-treated track bolts and for spring nutlocks were adopted.

Highway Crossings—Some sharp discussion developed in connection with a report on highway crossings by the committee on Signs, Fences and Crossings. The committee recommended certain grades of the roadway surface at the crossing, and suggested that diagonal crossings should be converted into square crossings by introducing reverse curves into the road alignment on either side of the railway line (see p. 543.). Criticism was directed against this proposed plan of road relocation on the ground of introducing too much curvature and making the crossing more dangerous to road traffic than before the change. Hunter McDonald (Nashville, Chattanooga & St. Louis Ry.) and others strongly upheld the demand that the crossing should preferably be built so as to compel road traffic to slow up. G. A. Mountain (Canadian Railway Commission) said that many crossings in Canada have been relocated substantially as the plan shows. It was proposed to change the plan so as to place all the curvature on one side of the railway line, but this, as well as a proposal to eliminate the relocation sketch, was defeated, and the committee's report with sketch was approved.

Reports on bituminous and concrete crossings as substitutes for plank crossings indicate that it is necessary to place the track in first-class shape before laying the crossing pavement, or defects may develop.

Iron and Steel Structures—Specifications for the erection of railway bridges and for the design of highway bridges were presented. The former, being in final form, were adopted for the association's "Manual," while the highway bridge specifications will be merely tentative for the coming year. A set of rules for classifying bridges and locomotives as to the capacity of structures was also presented, as a tentative draft. These rules define the manner in which Cooper's system of loading is to be applied as reference standard.

Like the 1920 railway bridge specifications of the association, the highway bridge specifications are limited to fixed bridges less than 300 ft. in span. They are based on the purpose of providing structures suitable for "any traffic reasonably to be expected on highways of the different classes" and of a character equal to that of railway bridges in unit stresses, details, materials and workmanship. Three classes of road traffic are contemplated, with governing loading as follows: Primary highways, three 20-ton trucks followed by a uniform load of 800 lb. per lin. ft. for each line of traffic and 80 lb. per square foot on sidewalks; secondary highways, three 15-ton trucks, 600 lb., and 60 lb., with the alternative of a single 20-ton truck; country roads, three 10-ton trucks, 600 lb. and 60 lb., with the alternative of a single 15-ton truck. Impact is to be added to live-load stresses, based on loaded length and number of lines of traffic, with a maximum of 80 per cent on floor and 67 per cent on trusses for plank deck, 40 per cent on floor and 33 per cent on trusses for paved deck, and 20 per cent on floor and 17 per cent on trusses for street railway cars. The basic unit stress for which the members are to be designed is 16,000 lb. per square inch in tension, and 12,500 maximum in column compression.

Some minor amendments to the 1920 railway bridge specification were proposed and adopted.

Revision of I. C. C. Accounts—Supplementing an elaborate detail report including among other items a sheet of symbols for architectural drawings, the committee on Records and Accounts brought up the subject of revision of the Interstate Commerce Commission's schedule of accounts for railways. These accounts are now so badly arranged, as several speakers emphasized, that it is impossible to determine, for instance, the cost of any one item of maintenance-of-way. Revision of the schedule by the commission is already in progress, but unless engineering representatives take part in the work the new schedule may be just as worthless for engineering and operating use as the old.

Further, as was brought out by E. H. Lee (Chicago & Western Indiana) the data established by the standard accounts determine the net return which railways will be permitted to receive, under the law, and if the accounts fail to show the true cost the return (in rates) may not be commensurate to the cost. It was therefore urged, especially by E. F. Wendt (consulting engineer), that immediate action be taken by the association, in connection with the American Railway Association, to bring the engineering requirements of an accounts schedule to the attention of the commission. Up to the present only the organization of the railway accounting officers has been consulted in the revision, but this organization is not adequate to represent the engineering department. The outcome of extended discussion of the difficulty was a vote in favor of prompt action by the two associations mentioned, for participation in the revision by a committee of engineers.

Track and Track Work—Apart from the subjects of rails and track stresses, noted already, an important matter was an outline of the requirements for substitute ties, submitted by the committee on Ties. Although there is no prospect of immediate use of substitutes for wood ties the committee considers that now is the time for the railways to make extensive tests of such substitutes and to make close observations of the results with a view to further development. Treatment of white oak ties and the adzing and boring of ties before treatment were recommendations of the committee on Wood Preservation, which suggested holes $\frac{1}{16}$-in. and $\frac{1}{8}$-in. smaller in diameter than the size of the spike for hardwood and soft-wood ties respectively.

A new cross-section for gravel ballast was presented by the committee on Ballast and this was adopted after brief discussion as to its increased width of roadbed: 25 ft. 8 in. for single track and 38 ft. 8 in. for double track, exclusive of ditches. Greater uniformity in methods of measuring the size of stone for ballast was also recommended. Chemical killing of weeds has given results which justify the practice, according to the committee on Roadway, even though certain grasses are not affected. Detailed specifications for contract work in tracklaying and maintenance were submitted by the committee on Track, which also presented plans for certain switch and frog construction. Both specifications and plans were adopted for the "Manual."

Practice in bending rails for curves varies so widely that the committee considers it a matter of opinion as to whether the results justify the expense. Curve guard rails are considered desirable only for protection on extremely sharp curves. The oiling of track parts to prevent corrosion is increasing; details were given of the methods employed on several roads. Various labor-saving machines and tools for use in track work were submitted by the committee on Rules and Organization in connection with the organization of labor forces. Modified specifications for concrete fence posts of round and square section, submitted by the committee on Signs, Fences and Crossings, were adopted. A U-shaped section of post was also considered favorably.

Costs, Records and Accounts—Deferred construction costs chargeable to tracklaying and surfacing are being studied by the committee on Roadway, which expects to show a definite relation between normal cost of track maintenance and the abnormal cost during the early period of operation of a new line. Records of cost of tamping ballast by hand and machine were submitted by the committee on Ballast. Graphic methods of reporting engineering data by charts and diagrams, to supplement tabulations which afford no prospective or mental picture, were discussed by the committee on Records and Accounts. Confusion in the distribution of items in accounts occurs frequently owing to different terms being applied to the same item. In order to effect greater uniformity of nomenclature among foremen in the field and accountants in the office the committee on Rules and Organization presented an explanation of the work orders known as "authority for expenditure" (A.F.E.) and "additions and betterments." In regard to the general contract form being drafted by a joint conference, the committee on Uniform General Contract Forms questioned whether such a form in itself or a form including an arbitration clause will be acceptable to the Association.

Passenger and Freight Station Design—A comprehensive study of the principles affecting the design of passenger stations for main-line traffic was a notable feature of the report of the committee on Yards and Terminals. Its purpose is to develop the proper relations between the amount of business handled and the size and arrangement of such facilities as tracks and platforms, waiting rooms, dining and toilet rooms, ticket offices, cab service and various facilities and concessions.

Study is being made also as to: (1) economic width and arrangement of freight-house platforms, and (2) the cost of various elements of freight handling in one-level and two-level freighthouses. Design of multiple-story freight stations with warehouse floors was discussed also by the committee on Buildings, which suggested the consideration of a type of freight terminal having tracks on two levels. Systems of numbering buildings for record purposes were reviewed. Except for a slight objection to the former committee's recommendation of long tracks and high platforms in large passenger stations both reports were accepted without discussion. Specifications for tile and other building material were also adopted, these being presented by the latter committee as part of a comprehensive set of building specifications.

Plans for single- and multiple-story pile and framed trestles with open and ballasted decks were submitted by the committees on Wooden Bridges and Trestles, as modifications of previous designs. All of these were adopted for the "Manual." The committee also discussed the question of shear in timber stringers and submitted a progress report on the recommendation of specific grades of timber for specific railway purposes. Culverts of corrugated metal were accorded an unfavorable opinion by the committee on Roadway.

Deterioration of concrete structures and developments in the art of making concrete were two subjects of the report of the committee on Masonry, the matter being submitted as information and without conclusions. In regard to the committee's suggestion that alkali may affect concrete either by seepage water or by direct contact with the ground, G. A. Mountain (Canadian Government Railway Commission) referred to troubles in northwest Canada which indicate direct ground contact as the cause.

Ashpits were the only subject of a brief report by the committee on Shops and Engine Terminals. The report covered capacity, track layouts and ash-handling methods, but made no recommendations. It was adopted as a substitute for matter already included in the "Manual.'

Relative merits of cast iron, steel, wood and other materials for pipe lines were discussed in the report of the committee on Water Service, with the conclusion that cast-iron is most satisfactory for underground water service under all conditions, wood-stave pipe is satisfactory where conditions are suitable and "genuine wrought iron" pipe for lines above ground. Standardization of methods of water analysis and the use of oil-engine pumps were also included, together with specifications for contract work on wells, pipe lines, tanks and machinery.

Economic Subjects—How to obtain and retain labor and how to organize labor for efficient and economical work are two important problems now facing the railroad engineer, according to the report of the committee on Economics of Labor. Similar views were presented in the address of the president. In discussion of this report, W. Beahan (New York Central R.R.) pointed out that colored labor is plentiful and may be introduced into sections where hitherto it has not been used. But this class of labor requires special handling by men who understand it and its peculiarities. Men of some kind are needed for railway work and it is up to the engineer to develop and make effective use of such labor as is available. This committee is considering methods of organizing forces for maintenance work and as a preliminary it submitted studies outlining in detail the methods of renewing rails and ties.

Three subjects relating to both engineering and transportation were dealt with at considerable length by the committee on Economics of Railway Operation: (1) Determining the effect of double-tracking on train operation; (2) calculating the cost of moving freight traffic, to show the cost of handling various commodities between certain points or to compare operating costs on different divisions or lines; (3) determining allowances for maintenance-of-way expenses due to increased use and increased investment.

Preservative treatment of piles and timbers was discussed by the committee on Wood Preservation, which advocated perforating or incising the surface of Douglas fir, since this practice gives better and more uniform penetration, aids seasoning and tends to prevent checking. Creosote, zinc-chloride and mixtures of these materials have been used successfully with Douglas fir. The report suggests a mixture of creosote and petroleum oil as permitting the injection of a larger volume of preservative without material increase in cost.

Information as to the elaborate current investigation of marine piling in waters infested by wood borers was supplemented by particulars of different methods of protecting the piles and by specifications for the preparation, treatment and handling of creosoted yellow pine piles. Returns received by the committee as to the life of creosoted timber in structures indicate 15 to 25 years in open-deck bridges, 15 to 30 years in ballasted-deck bridges and 15 to 40 years in docks and wharves.

Revised specifications for crossings of electric wires over railways, submitted by the committee on Electricity, were adopted. It was announced also that on account of the activity of various state public service commissions in regard to such specifications the Board of Direction in 1922 authorized the appointment of members in each state as local representatives of this committee. A brief statement on water power contained the recommendation of a report on the utilization of water power for electric operation of railways, with special reference to the St. Lawrence River development.

Developments in the Railway Engineering Field

Abstracts of Eight Committee Reports Presented to the American Railway Engineering Association at Its Annual Convention in Chicago, March 13-15

Metal and Concrete Ties

Committee on Ties

EXTENSIVE tests of substitute ties, as possible replacement for the usual wood ties, are desirable, notwithstanding the improbability of immediate general use. Only by such means and gradual development can a satisfactory substitute be produced. The larger railways should make extensive tests of one or more kinds of ties, the engineering departments following up the tests with a view to developing defects and determining improvements. It is believed that some substitute ties not suitable for high-speed main tracks may be found economical in side tracks, thereby conserving the timber supply for main-track use. Further, some ties, on account of high first cost, can be used economically only in heavy service tracks. Some of the fundamental considerations in the design of substitute ties are as follows:

The substitute tie must have sufficient strength to prevent failure and sufficient bearing surface to support the loads and provide against undue deflection in the rail. It should be designed to resist the forces tending to disturb gage, surface and line and to permit restoration. Rail fastenings must be of sufficient strength to maintain gage, and so designed as to permit a reasonable change of width or thickness of the base of rail, or variation of gage without change in the tie and without taking the tie from the track. The fastenings should be such as to offer as little obstruction to derailed wheels as possible. They should permit shimming, the change of defective rail, or the renewal of rails, and should be replaceable without disturbing the tie. If the design provides a separate support under each rail, united by a transverse member, this member must be sufficient to maintain gage and plane and to withstand a reasonable amount of damage incident to derailment. The tie should be of such shape that it will not only resist the tendency of track to get out of line, but also permit the track to be thrown back to line. Projections on the base that project into the ballast and make it necessary to lift the track out of surface before relining are therefore objectionable. Ties clamped in pairs which enclose such an amount of ballast that the ballast must be removed before the track is lined, add a material burden to the labor necessary for lining.

The tie should have sufficient length and breadth to provide a bearing surface per rail length of track at least equal to that obtained with wood ties for the same class of track, without reducing the space between the ties to such an extent as to make tamping difficult. It should have sufficient stiffness as a beam to develop the full bearing area on the roadbed.

Where electric insulation is to be provided, the design should permit of insulation without material change in the tie proper. The fastenings must be such that the insulation material will not be subjected to abrasion or to great stress other than compression. The annual cost per unit of length of track for renewals and track maintenance should compare favorably with that of wood ties. Economy in renewals depends upon first cost and durability. Economy in maintenance will depend upon how closely the requirements specified are met.

Experience indicates that some of the features productive of failure in substitute ties are as follows: (1) Lack of efficient protection against corrosion; (2) failure of rail fastenings; (3) failure of insulation; (4) loss of beam strength due to weakening tie in vicinity of rail to accommodate rail fastening features; (5) sharp interior angles or square holes from which cracks are developed; (6) lack of resistance to derailed wheels; (7) base of tie such as to render tamping difficult or impossible and maintenance of proper surface of track impracticable; (8) tie not holding track to line, and making lining of track impracticable; (9) lack of beam strength causing breakage on yielding roadbed; (10) lack of protection in concrete ties from abrasion by ballast; (11) lack of provision for expansion and contraction in combination ties of steel and concrete.

* * *

Ballast and Machine Tamping

Committee on Ballast

AN INVESTIGATION made by the committee on Ballast as to sizes of stone ballast, indicates that the Association's standard range of ¾ to 2½ in. is used extensively, but other sizes range in minimum from ¼ to 1½ in. and in maximum from 1½ to 3 in. Greater uniformity in measuring the size is needed, since some specfications mention a ring through which the stone is to pass in any position, while others specify the sizes of holes in screens. Cost data of track surfacing done by machine and by hand, as given in the report, are summarized in the accompanying table.

COST OF SURFACING TRACK BY MACHINE AND HAND TAMPING

Hand or Machine	Kind of Ballast	Cost Per Foot of Track, Cents	Cost Per Mile of Track, Dollars	Feet Per Man Per Hour
Pneumatic	Stone	6.7 to 8.56	420 to 559	4 to 6.7 and 15
Pneumatic	Gravel	..	502	5.6
Pneumatic	Sand	3.61		
Electric	Stone	....	367	4.9
Hand; picks	Stone	8.3 to 11	625 to 650	2.5
Hand; bars	Gravel	.	500	4.85
Hand; bars	Sand	4.2	. ....	.

* * *

Curve Rails and Guard Rails

Committee on Track

RETURNS from more than a hundred railroads indicate that the practice of precurving rails differs widely in the same section of country, even where the physical and operating conditions of roads are much the same. Therefore it seems to be a matter of opinion as to whether the results obtained in precurving rail justifies the expense. Further study is to be given to the ultimate economy of this practice and its effect on stresses in the rail.

The general use of guard rails for protecting curves is not recommended, but guard rails for protecting extremely sharp curves in special locations are desirable, especially on heavy grades where superelevation is a compromise between requirements of passenger and freight service, or where there is no superelevation. Their principal function is to prevent derailments.

Local conditions will govern as to whether the advantages of guard rails outweigh the disadvantages on added cost of track structure and maintenance. Allowable speeds should not be increased on curves because guard rails are installed.

* * *

Treating White-Oak Ties

Committee on Wood Preservation

IT IS recommended that all so-called "sap" ties of the species usually included under the term "white oaks" should be given a preservative treatment in order to obtain economy from their use. The so-called "heart" ties of the species usually included under the term "white oaks" can be treated efficiently so that they should withstand decay in a manner similar to other treated ties, if proper precautions are taken. A decision to treat such ties should be made only after a study on each particular line and in each particular locality has shown that treatment will result in economy.

Experience with New Rail Specifications

Committee on Rail

LAST year the rail committee presented a new rail specification for experimental use, and the rail manufacturers' association agreed to roll rail under it for trial purposes. The specification was framed with a view to obtaining quiet-setting, non-segregating steel; it provides for a minimum silicon content of 0.20 per cent in the finished steel. About 75,000 tons of such rail have been rolled, representing some 800 heats. The committee now reports that increased ductility of the rail-head metal resulted.

"The extent to which the steel is oxidized when poured into the ingot molds is probably the most important variable in general mill practice. Many believe that excessive segregation in the upper central part of the ingot, with consequent brittleness in the center of the rail head, can be largely restrained by such mill practice and specified analysis as will insure the quiet setting of the steel in the ingot molds.

"The association has undertaken to test this conclusion by authorizing circulation of the so-called 'Specifications for Experimental Lots of Dead-Setting Open-Hearth Carbon Steel Rails,' and has requested the railways to secure a substantial amount rolled to its provisions. So far only four such rollings have been made and as yet the quantity is too small to warrant general conclusions. The results of test appear to show an increased toughness in the rail head. The committee expresses keen interest in the showing and urges the Association membership to co-operate in securing a sufficient tonnage this year so that ample data may be available."

All the rail tested showed higher ductility than required under the association's 1915 specification, and all but one lot met the more severe requirement of the 1920 specification, which had been considered prohibitively high. Segregation appears to be reduced by one-half, and ductility increased several per cent, while on the other hand there is somewhat greater evidence of pipe lamination at the top of the upper rail, shown best by a nick-and-break test.

* * *

Care of Railway Work Equipment

Committee on Rules and Organization

THE ORGANIZATION for handling and care of the work equipment of a railroad should have at its head a supervisor of work equipment, reporting to the chief engineer or the chief engineer of maintenance according to the railroad's organization. He would have charge of all hoists, locomotive cranes, steam shovels, ditchers, spreaders, rail laying cranes, tie-tamping machines, motor cars, etc. The distribution of the machines for the season would be arranged by the supervisor of work equipment in conference with the chief engineer or whatever officer decides for the whole system the season's expenditures.

* * *

Corrugated Metal Culverts

Committee on Roadway

IT SEEMS to be the general opinion of railroad engineers who have used corrugated metal culverts that they are not satisfactory and that their use in general railway work should be discouraged. But it is hard to secure definite information as to failure of these pipes. To secure any reasonable service from these culverts the material must be high grade metal as nearly pure as possible and with rust-resisting properties. The galvanizing alone is not sufficient to protect the metal from rust. Reports also show the desirability of using sheets of proper gage and that a much heavier sheet must be used in the pipes of larger diameter. The best results seem to be secured when the top of pipe is placed not less than 3 ft. or more than 10 ft. below subgrade. Pipes should not be used in sizes with a diameter in excess of 48 in.

Some good results have been secured with the corrugated culverts under highway approaches at road crossings, where their cost is much less than cast-iron or concrete pipe, and in some cases less than vitrified bell-end pipe. Some satisfactory results are also reported where the pipes have been used in construction work, where cost of hauling cast-iron or concrete pipe to the job is excessive, the corrugated pipe being later renewed with the concrete or cast iron pipe after track is laid to the site.

* * *

Plan and Construction of Highway Crossings

Committee on Signs, Fences and Crossings

(Specifications approved as Recommended Practice)

1. A railroad grade crossing should be so constructed that it will not limit the traffic on a highway, in respect to the number of vehicles or load carried by the highway.

2. The grade of the surface of the highway should be level with the top of the near rail for a distance of 1 ft. outside thereof; should be 3 in. lower 10 ft. outside of the rail; and should be not more than 3 in. higher nor 9 in. lower than the top of the rail at points 30 ft. from it, measured at right angles thereto. The grade beyond these 30-ft. points should not exceed that which prevails in the section of the country, for highways of the class under consideration (Fig. 1).

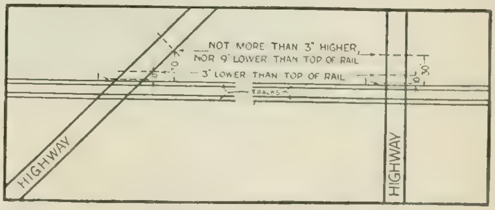

NOT MORE THAN 3" HIGHER, NOR 9" LOWER THAN TOP OF RAIL
3" LOWER THAN TOP OF RAIL
TRACKS
10'
30'
1'
HIGHWAY
HIGHWAY

FIG. 1—APPROACH GRADES FOR HIGHWAY CROSSINGS

3. When a highway crosses a railroad at an angle less than a right angle, consideration should be given to changing the alignment of the highway, so that the portion within the limits of the railroad right-of-way would be at right angles to the track (Fig. 2).

4. The width of embankments at the crown, and of cuts exclusive of ditches, should be not less than 20 ft.

5. Ample drainage for track and highway should be provided.

6. A crossing should be constructed with continuous surface between points not less than 8 in. outside of each rail. The surface should be not more than ½-in. below the top of the rail and should be beveled at each end. Flangeways 2½ in. wide should be provided on straight track and on curves of 8 degrees and under, and 3 in. wide on curves in excess of 8 degrees. They should be flared at the ends to 3½ in. There should be no rail joints within the crossing

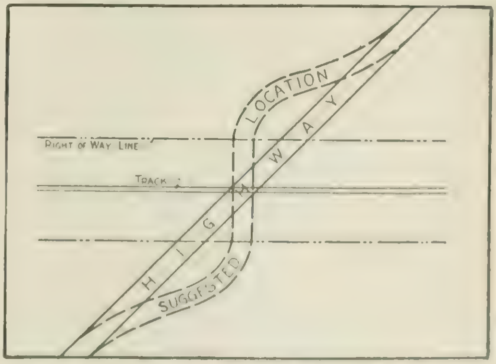


FIG. 2—RELOCATING A DIAGONAL HIGHWAY CROSSING

Stresses in Timber

Committee on Wooden Bridges and Trestles

IN COMPUTING the horizontal shear in timber stringers for railway trestles the opinion has been given by J. A. Newlin, of the Forest Products Laboratory, that it would be safe to ignore all wheel loads between the quarter-points of the span and its supports. The committee's study of existing trestles seems to confirm this view, that the inclusion of all wheel loads in figuring horizontal shear is too severe in estimating the stress put on the timber.

To find some means for expressing the phenomenon that as a load approached the point of support in a beam it might be increased without apparent greater probability of failure from horizontal shear, the problem of the unchecked beam was studied from the theoretical side and two solutions were advanced for verification. But Mr. Newlin expressed the opinion that the presence of checks and defects was of such great influence on the useful strength of the timber that formulas deduced upon the assumption of unchecked timber would be of little service. Useful results could be obtained only by making a series of tests for the purpose of determining an empirical formula to express the loss of strength due to the presence of checks of measurable length and position. A search of literature on timber mechanics has shown scant treatment of the problem of horizontal shear in wooden beams.

* * *

Combination Freighthouses and Warehouses

Committee on Buildings

MULTIPLE-LEVEL freighthouses and warehouses, such as are in successful operation in a number of cities, represent a development which has marked advantages, particularly in large cities where property values are high and adequate space for terminal expansion is not available. The increasing tendency toward separation of grades of railway tracks and city streets is a condition very favorable to the construction of a multiple-story freighthouse, with such additional floors for storage warehouse purposes as local conditions may demand.

Structures of this class may be divided into four distinct types: (1) All tracks and driveways on the lower level; (2) tracks on lower level and driveways on second level or both levels; (3) tracks on the second level and driveways on lower level only or on both levels; (4) tracks on both levels and driveways on the lower level or on both levels. Separation of track and street levels is not requird in the first, but is required for the second and third types. The fourth type is practically unknown in this country but the committee suggests that it should be given consideration in certain cases.

The principal considerations in the selection of the multiple-level plan for freighthouses are as follows: (1) relation of land values to freight revenue; (2) relation of building cost to freight revenue; (3) required operating capacity; (4) provision for future expansion; (5) value of storage space; (6) value of air right development; (7) relation of track and street grades and its effect on operating cost and capacity; (8) character of freight and its effect on cost of handling; (9) relative cost of handling freight in a long one-level house and in a shorter multiple-level house using mechanical means for handling freight between different levels. The mechanical means generally considered for handling freight from one level to another are: (1) Elevators, electric or hydraulic; (2) escalators; (3) gravity chutes; (4) conveyors of belt or endless chain type; (5) telfers. Only the elevator and escalator are in general use in freighthouses, on account of the diversity in size and weight of shipments. The elevator is more efficient and economical in operation than the escalator, as its use involves no reloading. It is cheaper in operation and is operated only when needed.

Photo-Recording Extensometer for Impact Tests

Instrument Developed at Bureau of Public Roads Gives High Multiplication Without Lag or Inertia Effects

AFTER two years of development a photo-recording extensometer of high sensitiveness and low lag or inertia has been developed in the laboratory of the Bureau of Public Roads, Washington. Preliminary tests of the instrument have proved entirely successful.

The primary use of the extensometer is expected to be in high-speed work such as impact experiments on bridges, for which service it was important to reduce mass effects to a point where they could not falsify the indication of the instrument. In test, alternations of motion up to a speed of 100 per second were found to have no influence on the results.

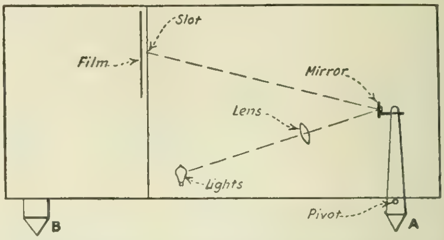


FIG. 1—MECHANICAL AND OPTICAL LEVER SYSTEM OF NEW EXTENSOMETER

A description of the instrument has just been prepared by Earl B. Smith, of the Bureau of Public Roads, who with A. T. Goldbeck did the principal work in developing the instrument.

For obtaining high magnification without the disturbing influence of the mechanical parts moving at high velocities and accelerations, the principle of the optical lever was applied, in connection with a single mechanical lever and a pivoting mirror. The arrangement is represented in diagram in Fig. 1, where *A* and *B* are the two gage points, *B* being fixed and *A* pivoted near its base and connected by a short link to a pivoting mirror. A beam of light from a lamp and lens is reflected by this mirror to a screen near the back of the case. A vertical slot in this screen allows a point of light to pass through to a moving film just back of the screen. Thus the indicating portion of the instrument

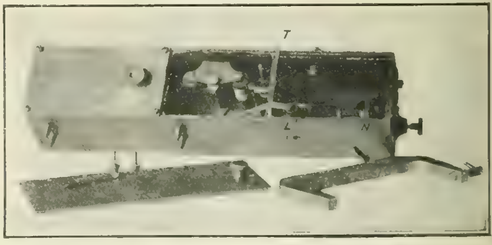


FIG. 2—INTERIOR OF EXTENSOMETER

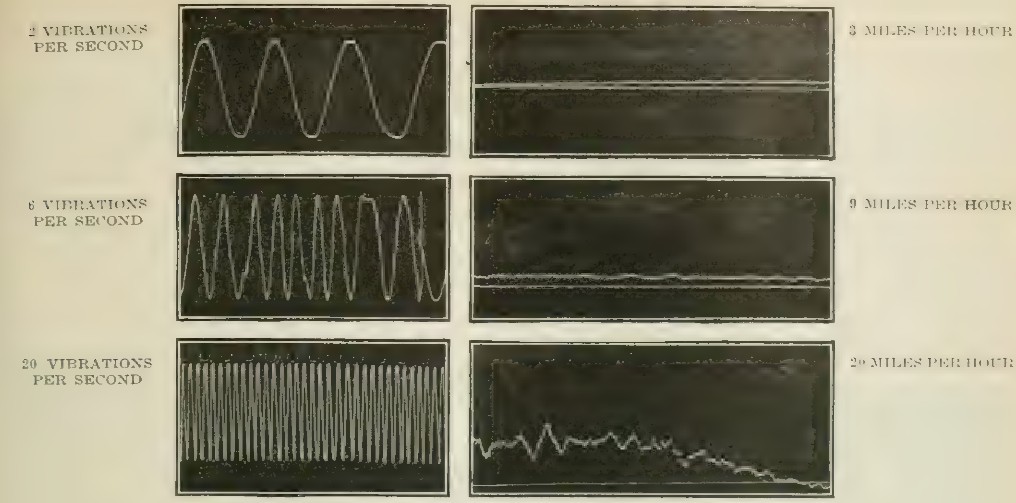


FIG. 4—SPECIMEN RECORDS TAKEN WITH INSTRUMENT

has only two moving parts, the pivoted gage point and the pivoted mirror, whose combined inertia effect is extremely small. Magnifications of 500 or more are obtainable, but generally magnifications of 200 are provided for.

Recording is accomplished by moving the film by means of a small electric motor in the back of the instrument case, which drives the film rolls by worm and spur gearing. A 12-volt storage battery will operate both the motor and the lamp. Fig. 2 shows a view of the interior of the instrument with cover removed, the movable gage point being at the right and the film rolls in the middle compartment. The clamp shown below the instrument at the right is used in fastening it to a member whose extension or stress is to be measured.

The instrument is attached to a bridge member as represented in Fig. 3. Here can be seen also the arrangement of the gage points. The fixed gage points really consist of three side by side, of which the two outer ones are about 1/16 in. longer than the middle one and are intended for use when the instrument is applied to a flat surface; on narrow plates or bars and on round members the middle gage point would be used.

Regular commercial "vest-pocket kodak" films, 1⅞ in. wide, fit the instrument as normally made. For special work spools may be provided to take motion-picture films, which will permit of taking long records.

In tests of the instrument the movable gage point was oscillated by an electric motor drive at speeds ranging from 2 to 100 vibrations per second. Three typical records are shown at the left in Fig. 4. The total movement of the gage point in this test was 0.003 in., and it was found that the amplitude of the curve on the film was the same for all speeds. In these records the magnification was 250. The irregularities in slow-speed curves are due to operating by hand.

In further trials of the instrument it was applied to the members of several highway bridges under truck traffic. The right-hand diagrams in Fig. 4 represent the extensions in the lower chord of a fixed panel through Pratt truss bridge, when a 3-ton truck was run over the bridge at speeds of 3, 9 and 20 miles per hour. The large impact effects are evident.

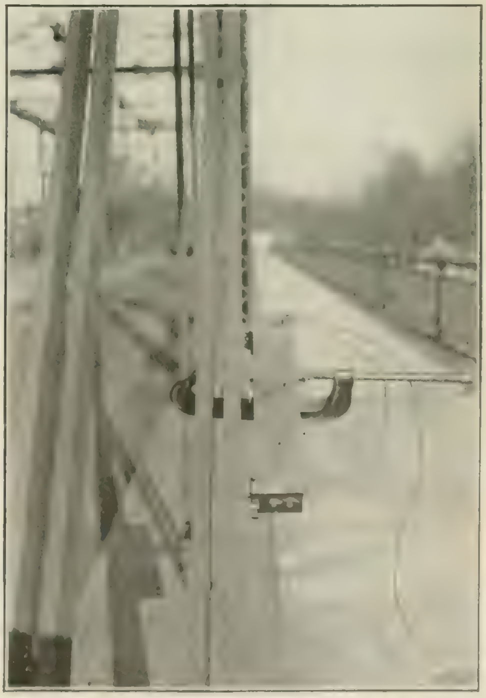


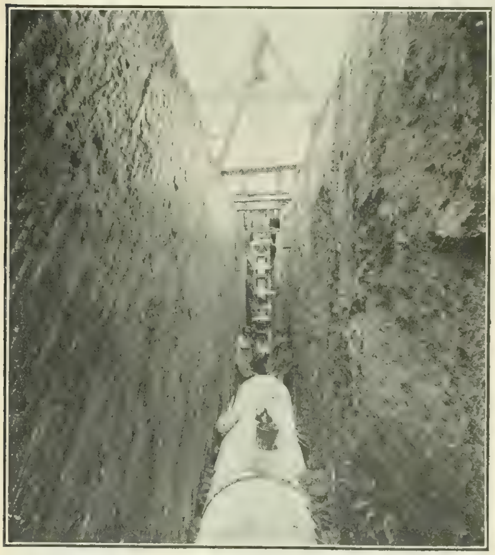
FIG. 3—INSTRUMENT MOUNTED ON BRIDGE DIAGONAL

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Good Soil Permits Rapid Pipe Laying in Deep Trench

REMARKABLE soil conditions account for the absence of bracing in the 16-ft. trench for a 36-in. reinforced-concrete sewer pipe being laid in Slocum St., near the Dixie Highway in Trenton, Mich. An occasional jack was used only as a precautionary measure for the protection of the workmen. No borings were made previous to construction but data collected after opening the trench showed a 3-ft. layer of top soil or flaky clay, and 8-ft. layer of yellow clay and then blue clay with no water in any of the material which was encountered.



LAYING 36-IN. CONCRETE PIPE IN 16-FT. TRENCH
Men standing on trench machine cut down the bank at the left which accounts for its ragged appearance compared with the right hand side. Progress of 100 ft. or more per day in cuts 14 to 15 ft. deep

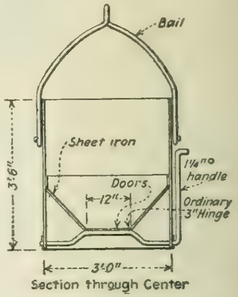
Normally the Pawling & Harnischfeger excavator used cuts a 27-in. trench but with side cutters is capable of making a 40-in. trench. Since the outside diameter of the pipe was greater than 40 in. spading of one bank was necessary. This work was accomplished by moving the machine ahead about 5 ft. and then men standing on the boom cut down the bank by hand. Further widening was unnecessary as pipe 4 ft. long was used which permitted the lower half of the joint to be filled with mortar from the inside and the upper half from the outside of the pipe. Even with the spading handicap, progress of 100 ft. or more per day was made in cuts 14 to 15 ft. deep, and a maximum of 80 ft. in a 17-ft. cut.

Hoad, Decker, Shoecraft & Drury, of Ann Arbor, were consulting engineers, for whom M. R. Dickie acted as resident engineer. The pipe was manufactured by the Independent Concrete Co.

Home-Made Concrete Bucket

By G. W. McAlpin.
Point Pleasant, W. Va.

A HOME-MADE controllable bottom-dump concrete bucket is shown in the accompanying sketch. It consists of an ordinary 3-ft. diam. dirt bucket from which the bottom has been cut and a new one, made of two doors and sloping sides installed. Doors are 6 in. x 24 in. of $\frac{3}{16}$-in. sheet iron, and hinged (with three hinges each) to the sloping sides, leaving an opening 12 in. x 24 in. They are kept at a sufficient distance from the bottom so as to swing wide open, and still not be damaged, when the bucket is set down. The sloping sides, also of sheet iron, are drawn in from the circumference of the old bucket to the 12 in. x 24 in. door opening so that the contents of the bucket will flow out easily.



CONCRETE BUCKET MADE OF 3-FT. DIRT BUCKET

A 1¼-in. diam. round iron handle bends and runs under the bottom of the bucket to form the latch, the operation of which is clearly shown in the sketch. By controlling the handle the doors may be opened to the desired width.

Advantages of Least-Squares Adjustment of Survey Observations

By Hugh C. Mitchell
U. S. Coast and Geodetic Survey, Washington, D. C.

ADVANTAGES of a least-squares adjustment of survey observations may be briefly considered with regard to triangulation and precise levels which form the basic control for many classes of detailed surveys. These advantages may be grouped in two general classes: The advantage of having the most probable results; and the advantage of having the final results.

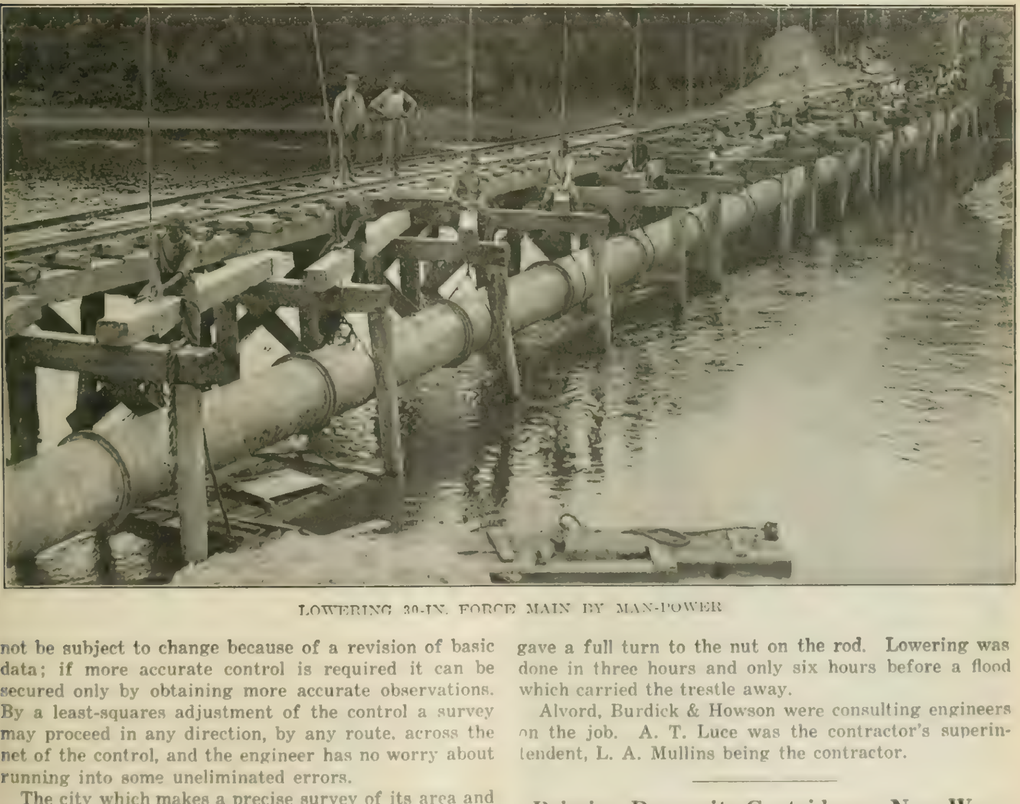
The least-squares adjustment of a triangulation gets out of that triangulation everything that is in it. It takes into consideration every condition imposed by the observations, so that each adjusted length and azimuth and therefore each position, is as good as the combined observations will afford. This means a great deal. Neglecting this, a survey may be made with a high degree of precision (of instruments and methods), and yet through injudicious computing, not necessarily inaccurate in its arithmetical operations, lose much of that accuracy which the observations were designed to secure. Thus a triangulation may be computed piecemeal and when separate parts are fitted together it may be found necessary to force a large discrepancy into some small link connecting two such pieces.

Having the final results from a triangulation has great economical value. Surveys based on such triangulation will then be final insofar as horizontal control is concerned, and results obtained for this control survey can be upset only by upsetting the observations themselves. There is no "cut and try" or "hit or miss" in the least-squares adjustment of a triangulation, a traverse, or a level net. Work based on such data will not be subject to change because of a revision of basic data; if more accurate control is required it can be secured only by obtaining more accurate observations. By a least-squares adjustment of the control a survey may proceed in any direction, by any route, across the net of the control, and the engineer has no worry about running into some uneliminated errors.

The city which makes a precise survey of its area and neglects to have a least-squares adjustment made of that survey is limiting its use—cutting down its efficiency to a very small percentage of its full value. It is much like the man who builds a large plant, then uses only a small portion of that plant and that for storage purposes. Another form of the same neglect of opportunity, for that is what it is, is where a city makes detailed and accurate maps of its area, and then, by refusing to publish them, selfishly limits their use to its own departments, and even to them makes their use difficult and uneconomical. The publication of such maps would put them not only in the hands of the city employees and of local private engineering concerns, but would give them also to the map using public.

Thirty-Inch Force Main Lowered Into Subaqueous Trench

IN ORDER to connect the pumping station of the Des Moines, Iowa, municipal water plant with the city, it was necessary that the 30-in. force main be carried across Raccoon River. A railroad trestle was first constructed and from this a locomotive crane excavated a trench in which the pipe was to be placed. Alongside the railroad trestle pile bents were put in at each joint in the force main. Pipe was then hung from these two-pile bents as indicated in the accompanying view, by means of long full-threaded 1-in. rods fitted with hook bolts. When the lowering was ready to be done a man was placed at each threaded rod and at a given signal gave a full turn to the nut on the rod. Lowering was done in three hours and only six hours before a flood which carried the trestle away.



LOWERING 30-IN. FORCE MAIN BY MAN-POWER

Alvord, Burdick & Howson were consulting engineers on the job. A. T. Luce was the contractor's superintendent, L. A. Mullins being the contractor.

Priming Dynamite Cartridges a New Way

ONE of the drawbacks in the use of explosives in cold weather, says a recent issue of the du Pont magazine, especially with the cap and fuse method of priming, is the difficulty of tying the fuse securely to the dynamite cartridge so that it cannot pull out. Misfires and burned up charges often result from careless priming, both among farmers and miners. The fuse with the cap attached must be securely fastened to the dynamite cartridge so that the side spit of the fuse cannot ignite the dynamite. A new kink in priming consists of the standard method of priming in the side of the cartridge near the top, though fastening the fuse with a tarred string. A piece of tarred string

15 in. long and about as thick as the twine used by hardware dealers for tying up about a 5-lb. package of nails, does away with tying knots.

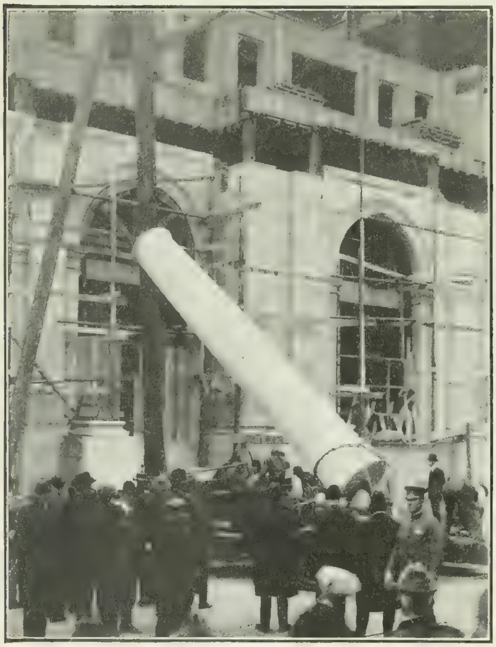
After the cap with fuse attached is inserted in the dynamite cartridge, two or three turns are taken with the tarred string about the fuse about an inch from the cap, and then two turns are taken around the dynamite cartridge and the fuse. The priming is then finished with as many more turns around the fuse as will use up the string. This makes a tight firm operation which, if properly carried out, will hold the cap securely in place.

From Job and Office

Hints that Cut Cost and Time

Platform on Rollers Used in Setting Heavy Granite Columns

In delivering and setting up 23-ton granite columns for the Anglo & London Paris National Bank Building in San Francisco, the contractors used a low-bed trailer on which each column was loaded with the column footing resting on bags of sand carried by a platform on rollers. As the top of the column was raised the platform rolled forward on the trailer bed and the sand cushion prevented any chipping or snipping of the finished column base. When the column swung free in the air the shears carrying the tackle were drawn back toward the building by block and tackle until the column hung over the base and could be lowered to the place and plumbed. Some of the columns were set within a period of thirty minutes after arriving on the job.



GRANITE COLUMN BEING RAISED FROM TRAILER.
Note sand bags at base of column on rolling platform which has moved forward from rear of trailer.

Six such columns were set. A pair of shear legs were used for the first two, but for the remaining four the space available at the footing did not permit of the use of shear legs nor was it convenient to use a derrick with tackle dropped from the top of the structure. Accordingly a 55-ft. gin pole 18 in. square was substituted for the shear legs first used. This is said to have been fully as safe and satisfactory in operation as the shears.

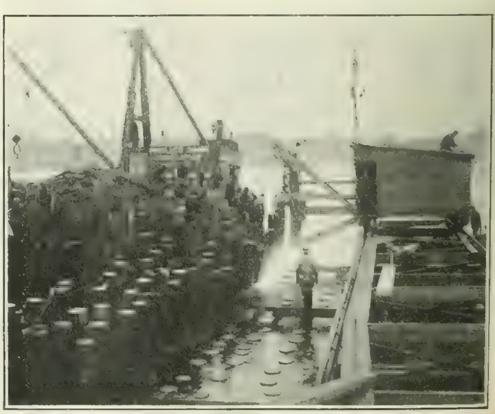
The tackle consisted of a two-part derrick fall and a lifting fall with four parts, making six parts in all, through which a ⅝-in. cable was reaved.

The columns were supplied and set in place by the McGilvray-Raymond Granite Co. of San Francisco under the personal supervision of Harry McGilvray, superintendent of construction.

Wide Area Covered by Pile Cut-Off Saw

In the construction of the Hudson Ave. generating station for the Brooklyn Edison Co. extremely heavy loads to be imposed upon foundations required the driving of pile foundation supports very close together, the spacing in some sections being on 3-ft. centers. With them so close together there was presented to the contractor a problem of wholesale cutting of piles to grade. The cut-off saw herein described and pictured was developed by the Frederick Snare Corporation, contractors, and it worked so efficiently that more time was required to clean up after the cutting had been done than was used in the actual cut-off operations.

As indicated in the accompanying photograph, the machine has a motion in both lateral and longitudinal directions. Lateral motion of the saw is provided by mounting the carriage on crane rails with an 11½-ft. span. These rails are clipped to stringers resting on heavy steel I-beams. The frame is braced laterally with timbers and by light angles diagonally. This crane rail frame is mounted upon 16-in. wheels (there being four sets of wheels spaced at about 25-ft. centers) running on 40-lb. railroad rails set on heavy planking



PILE CUT-OFF SAW, OPERATING IN TWO DIRECTIONS

From Job and Office

For Contractor and Engineer

which rests upon piles that have been cut off and blocked.

The 40-in. circular saw is mounted in an A-frame and driven from the saw carriage by belt. Power for the saw is supplied by a 40-hp. motor. In order to move the saw carriage laterally an endless cable passes through snatch blocks at either end of the track and then over a reversible steam-driven cable drum on the saw carriage.

The whole structure moves forward by being wedged from behind. As rail sections are vacated they are taken up and placed in front so that but two short rail lengths are in use at a time.

This rig has been found extremely effective and operates as well on land as over water. When dismantled its parts can be easily handled by a 20-ton locomotive crane.

G. L. Knight is designing engineer for the Brooklyn Edison Co., and Robert K. Munroe is the resident engineer.

Compressed Air Reheated to Drive Water Trench Excavating Equipment

RATHER an ingenious method is being used in furnishing air power to excavating machinery in Cleveland where the city is laying several miles of water intake mains from Kirtland Pumping Station to the new Baldwin Reservoir and purification plant. Because it was felt work should progress rapidly as possible with as little obstruction to street traffic and with every precaution being taken to avoid defacing residences and buildings along the route. Use of steam shovel equipment producing, large volumes of soft-coal smoke was impossible. Instead, compressed air was employed for all machinery. As the work is done both day and night it was also necessary to avoid noisy exhaust of steam engines as much as possible.

An air compressor plant with two angle compound units was established at a central point. They have a rated capacity of 784 cu.ft. per minute each at 250 r.p.m. and supply an abundance of air at 125 lb. pressure. Each compressor is driven by short belt connection from a 220-volt three-phase slip-ring motor of 150 hp.

From the compressor house a 6-in. main leads about 4,000 ft. north and a 4-in. main for about 3,600 ft. in the other direction along the trench. These mains are equipped with numerous tees to which the various machines can be connected.

The unique feature of the machinery operation lay in the fact that in order to have compressed air of sufficient pressure to drive equipment efficiently it was reheated. Two-inch hose connected the shovel to the main. This hose is led through one of the openings in the side of the sectional track and connected with the hollow swivel pin on which the shovel revolves. Thence it runs into the boiler and there reheated by means of a light wood fire which is maintained in the boiler for that purpose.

STEAM SHOVEL REFITTED FOR COMPRESSED AIR

The work has been under the close personal supervision of A. B. Roberts, Director of Utilities, City of Cleveland; A. V. Ruggles, Commissioner of Water; and G. W. Bowers and F. R. Sullivan, assistant engineers in direct charge of the work. The contractor is Peter F. Connolly, Boston, Mass.

Material from which this article was prepared was supplied by the Sullivan Machinery Co., whose air compressor plant was used.

Signboard Gives Bridge Erection Progress

By William A. Schuerman

C. C. C. & St. L. Ry. Co., Cincinnati, Ohio

KEEPING the public informed as to progress of construction which has a general appeal is well illustrated by a signboard erected at the site of construction of the Belle Isle bridge at Detroit. The board is placed in a conspicuous position on the approach to the bridge and all who cross over to Belle Isle on the wood bridge must pass by the sign.

PROGRESS CHART ON BELLE ISLE BRIDGE WORK

The accompanying view shows the sign as it appeared in December, 1922. All the important facts are indicated, the chart can be easily interpreted and it is always kept up to date. Boards similar to this one might well be erected to indicate progress on all important construction jobs.

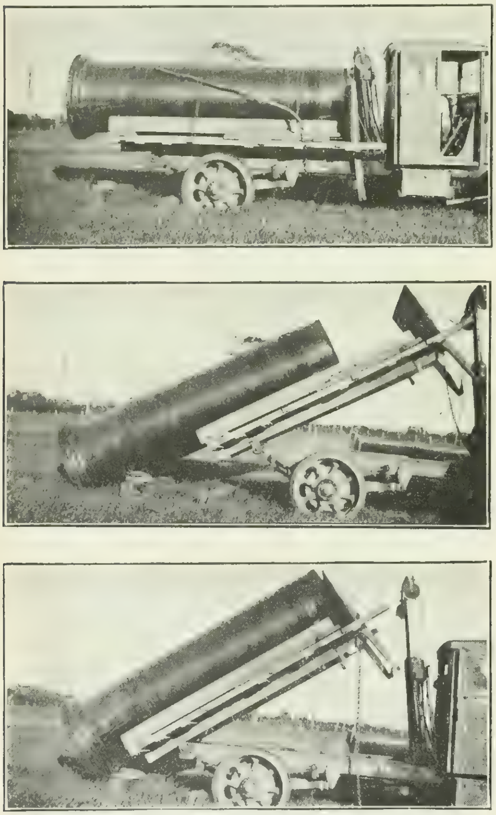
From Job and Office

Hints that Cut Cost and Time

Handling 36-In. Cast-Iron Water Pipe

IN HANDLING 2,200 tons of 36-in. Class D water pipe for replacement at the feed main for the City of Schenectady, the following method was used:

At the railroad siding, pipe was loaded from cars to a motor truck by means of a standard railroad yard crane and a pair of pipe hooks. The rigging on the truck was a pneumatic dump body with sides removed and three 2-in. planks bolted crossways on the truck platform, one at each end and one in the middle. To these planks were bolted two 8x8-in. timbers spaced far enough on either side of the center of the truck so that when the 36-in. pipe was lowered between them it was kept from rocking.



UNLOADING 36-IN. PIPE FROM MOTOR TRUCK

With the pipe in place on the truck, a binder chain was thrown over the pipe from the one side of the frame to the other and made tight with an elm binder. In loading pipe on the truck, the bell end was always placed toward the back so that it hung over the truck end.

With the truck backed into position at delivery points the hoist was operated until the pipe would slide. When the bell touched the ground, the truck body was chained so that there would be no back lash as the pipe left the back of the platform. A 10x10-in. timber was placed behind the truck so that as the pipe dropped the timber would catch the pipe about 3 ft. from the spigot end. By the time the pipe left the end of the platform, there was only a drop of a few inches to the timber.

With a 3½-mile haul each way, one truck driver with three helpers unloaded as high as 15 sections a day by this method and not a single pipe was damaged in handling the entire 2,200 tons. The contractor who handled the pipe was Ellis C. Edgar, of Scotia, New York.

Tightening Tension Bars of a Bridge by Heating and Upsetting

By Wm. J. Titus

Bridge Engineer, Indiana State Highway Commission, Indianapolis

DURING 1921 the Muscatatuck River was deepened and widened for several miles of its length in Jackson Co., Indiana, and it was necessary for the state highway commission to lengthen its bridge over this stream near the Millport Knobs, and to make extensive repairs on it, including the tightening of the diagonal truss members. For the latter operation an ingenious method was used, the bars being heated to forging temperature and upset by sledging, without removal from place.

The bridge was built in 1884, with two pin-connected steel truss spans, a 158 ft. 4 in. double-intersection through truss with parallel chords, and a 69 ft. 4 in. south approach span, which is a pony Pratt truss. In the 1921 improvement the river was widened 60 ft. on the north side, so that it was necessary to remove the old limestone abutment and replace it with a concrete pier with much deeper foundations resting on 35-ft. wood piles. A new 70-ft. pony Pratt truss was then added at the north end of the present structure, together with a new concrete abutment resting on long piles. The superstructure of the old bridge was in a fair state of preservation, but it would have been very difficult and expensive to dismantle and re-erect it in order to permit the dredge boat in the river to pass. A new main truss span would have been quite expensive, so that an agreement was arranged with the dredging contractor whereby the dredge boat was partially dismantled in order to move it beneath the old steel span. The state was thus enabled to place the old bridge in excellent condition at a total cost of $17,000.

During the long life of the bridge, several loop-bar truss diagonals of the main span had become loose, and there was a great amount of noise and rattle under moving loads. It was thought advisable to correct this feature at the time the bridge was repaired. But a difficult problem was presented: The old loop-bars were not provided with turnbuckles, and these could not be installed without two welds in each bar. It was not possible to substitute new eyebar members without supporting the old truss upon falsework.

At first it was planned to replace the diagonal members one at a time with new bars with turnbuckles and a yoke at each end, which could be inserted in the box-section top chords and around the panel-point pins without the necessity of removing the pins. This

From Job and Office

For Contractor and Engineer

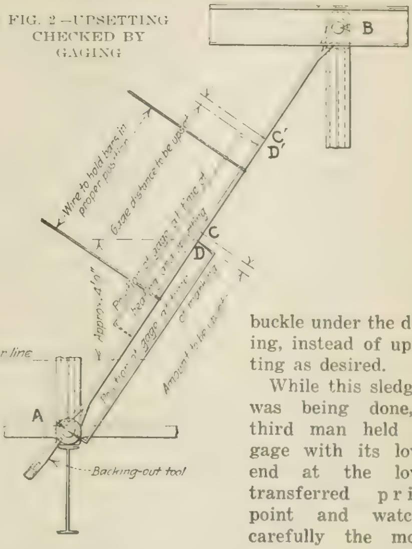
method of repair was clumsy and at best unsatisfactory. After further study there was finally worked out a very simple and ingenious method of shortening the members, by heating and upsetting them.

The first thing done was to determine how much the loose loop-bars should be shortened. A gage was made of ½-in. round reinforcing steel, about 4 ft. long, with the ends turned at right angles about 2 in. long and sharpened to form prick points. The loop-bar diagonals were then in turn wedged up tight against the lower panel-point pin *A*, Fig. 2, and a prick mark *D* made at gage length from the center of the pin, by striking the end of the gage with a light hammer. The wedge at the lower end of the loop-bar was then removed, and the bar was wedged down tight against the upper panel-point pin *B*. One point of the gage was again placed at the center of the lower pin *A*, and another prick point was made at the upper end of the gage, at *C*. Care had to be taken that all sag in the loop bar was removed, in order that the distance between the two prick marks *C* and *D* should indicate the exact amount which the bar must be shortened in order to carry its share of the stress in the panel. The distance between prick points *C* and *D* varied from $\frac{1}{16}$ in. in some cases to as much as 1 in. in others. The diagonal bars averaged about 1x1½ in. in section.

These gage marks were too far down on the diagonal members for convenience in measuring while the bar was being shortened. The two prick points were therefore transferred nearer to the middle of the bar (*C′* and *D′*), and a third point was established at gage length below *D′*.

The loop-bar was anchored to its neighboring bar to prevent sagging, and was then heated to a bright cherry red by the use of a one-man forge placed on a movable platform. The heat was applied within the gage distance, a metal shield being used to prevent the heating of the neighboring diagonal, which was of course carrying all of the shear in the panel. To have allowed this neighboring diagonal to heat would have permitted its elongation under load and the serious distortion if not failure of the truss. When the diagonal bar had been heated to the proper temperature, the forge was removed and the member was quickly upset by driving with a sledge at the lower end, the upper end being wedged down tight against the upper pin. The driving was done against a heavy backing-out rivet punch, with one end placed against the lower loop of the diagonal. It was necessary to use care that the member did not buckle under the driving, instead of upsetting as desired.

FIG. 2—UPSETTING CHECKED BY GAGING


B
Wire to hold bars in proper position
Gage distance to be upset
C′
D′
Position of gage at time of heating and upsetting
C
D
Approx. 4 in.
Position of gage at time of marking
Amount to be upset
Floor line
A
Backing-out tool

While this sledging was being done, a third man held the gage with its lower end at the lower transferred prick point and watched carefully the movement of the upper end of the gage toward the upper prick point *C′*. In order to make the proper allowance for shrinkage during the cooling of the metal, it was necessary to stop the driving when the upper gage point was approximately $\frac{1}{16}$ in. from the upper prick point. Sometimes the member would get too cool before the necessary amount of upsetting had been completed, and it would be necessary to reheat it.

Upon completion of the upsetting to the proper point, the bar was allowed to cool, the wedges at the upper end were removed, and the bar was tested to determine its tightness and tension, as compared to the other diagonal member in the same panel. If the member had been shortened too much, the other member would be loose, and the distribution of stress in the entire truss would be disturbed. It was therefore necessary in one or two cases to reheat a diagonal member and allow it to elongate from the stress existing in it. By careful work on the part of the men, it was possible to so adjust the length of the diagonal members throughout the bridge that the unit stresses existing in them were believed to be very nearly uniform.

Ten diagonal members were tightened in this manner, at a total cost of $97.86 for labor, exclusive of supervision, making a unit cost of approximately $10 for each bar. This method was simple and expedient, and the cost was several hundred dollars less than it would have been by the use of any other method which was considered. The results were very gratifying, as all the rattle of loose diagonal members was eliminated and the strength of the truss was practically doubled. The entire structure has since been carefully cleaned with wire brushes and given three coats of paint.

The work was done by the Oregonia Bridge Co., in connection with their contract for lengthening the old bridge and adding the new pier and abutment. The method of tightening the loop-bar diagonal members was worked out largely by R. T. Spencer of that firm who was in direct charge of the work for his company. The work was done under the supervision of W. R. Britton, field bridge engineer for the Indiana Highway Commission.

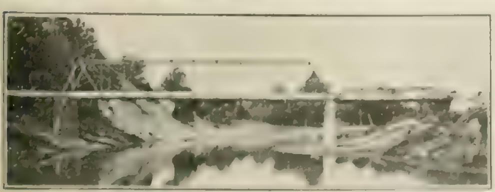


FIG. 1—LOOSE LOOP-ROD DIAGONALS OF [illegible]-FT. SPAN TIGHTENED BY HEATING AND UPSETTING

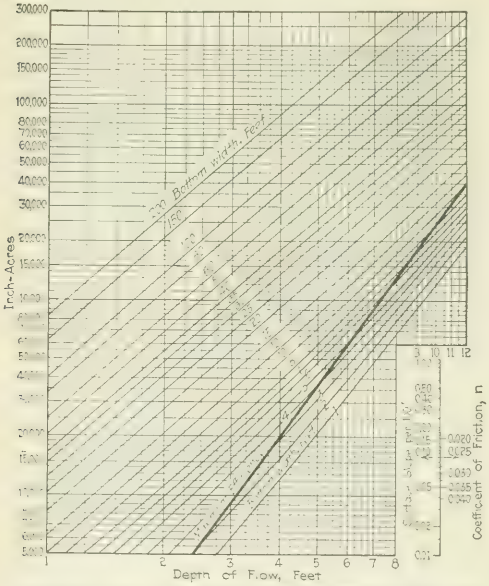
Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Diagram Giving Capacity of Trapezoidal Channels of 1 to 1 Slope in Inch-Acres per 24 Hours

Sir—Herewith is a diagram which I have calculated and plotted and have used during my drainage practice. It was part of a paper on "Design of Open Ditches" that was read before the Association of Ontario Land Surveyors Feb. 21.

The diagram has been prepared to give immediate comparison between the cross-section of the ditch and the area of the watershed. An ordinary provision is 1 in. of runoff in 24 hours, and the diagram shows on the scale of ordinates the inch-acres capacity per 24 hours of trapezoidal channels with side slopes of 1 to 1. Values are calculated and plotted with $n = 0.025$ and $s = 0.10$ per 100 ft. For these values of n and s the capacities of the ditch with different bottom widths and different depths of flow are read directly on the diagram. The velocity, and therefore the inch-acres capacity, varies as the square root of the surface slope of the water, and when the slope is greater or less than 0.10 per hundred the capacity may be increased or diminished by a ratio representing this square root; an auxiliary scale is drawn for this purpose showing a range of surface slopes from 0.01 to 1 ft. per hundred, and by applying a pair of dividers to this scale and transferring to the logarithmic scale of inch-acres the capacity is indicated at once. Also the velocity varies inversely with the coefficient of friction, and the inverse ratio of any desired coefficient of friction to the coefficient 0.025 is also indicated on the auxiliary diagram and can be transferred with dividers to the scale of inch-acres. Allowance for any surface slope and for any coefficient of friction may be made in one operation with a pair of dividers and the required capacity immediately determined. The following are illustrative examples:



CAPACITY OF TRAPEZOIDAL DRAINAGE CHANNELS IN INCH-ACRES PER TWENTY-FOUR HOURS

Sides slopes, 1 to 1. $n = 0.025$. $s = 0.1$ per cent with corrections for other values

n	s	Depth Ft.	Bottom Width, Ft.	Capacity Per 24 Hr In.-Acres
0.025	0.10	6	10	10,000
0.025	0.05	6	10	7,000
0.020	0.10	6	10	12,500
0.020	0.15	6	10	15,000
0.035	0.05	6	10	5,000
0.040	0.15	6	10	7,500

The line on the diagram marked "maximum efficiency" indicates those sections for which a given sectional area provides the maximum carrying capacity.

The diagram was originally calculated by Kutter's formula, but has been recently checked by Manning's formula with the result that there is no noticeable difference.

George A. McCubbin.
Surveyor and Civil Engineer.

Chatham, Ont., Feb. 17, 1923.

The Motor Truck Transportation Problem

Sir:—I note with interest the article in *Engineering News-Record*, March 1, 1923, p. 378, on "Solving the Motor Truck Overload Problem." There appears in the same issue an article on the traffic situation in large cities; a problem that is indeed growing to alarming proportions. Both subjects have a particular bearing one on the other and both on the community.

The tremendous battle for existence fought by our municipal carriers and great railways is a subject for serious consideration and of vastly more importance than whether a truck should run empty or carry twenty tons. The primary question as I see it is whether or not motor truck transportation is economically sound. Your article brings out prominently the proper co-ordination of the roadbeds and loading on railroads and should have shown that this well preserved balance was made possible by the financial earnings of the carrier itself and was due in no way to support from the state. The question then arises, does the heavy motor truck, that is really a menace to our railroads, pay its proportionate share of damage done to our roads, and is it capable of so doing without making the cost of this type of transportation prohibitive? Someone has said that competition is the life of trade and in so far as this applies to the survival of the fittest it is well said, but for the public deliberately to finance one side of the competitive issue and utterly disregard the other is an unsound policy. If the community financed the upkeep of the railroad roadbeds and yards, would they not be justified in expecting a corresponding reduction in freight rates? Yet on the other hand the public goes on building and maintaining roadbeds for another type of carrier that has not yet by any means proved itself as economically sound as the railroad, thus fostering a condition of railroad breakdown similar to that Canada is facing.

If the motor truck could by its own strength eliminate the railroad either as a short or long carrier we are naturally justified in giving it moral support and it would not need financial aid. Your article suggests that some manufacturers need heavily loaded and fast trucks. This being true they can well afford to pay for it. To your suggestion that communities might be kept employed repairing roads, I should reply that I have no desire personally to move my money from one pocket to the other, nor can I see the advantage.

If the motor truck can carry its own burdens, it is a commercial success and a decided advantage to society, but in my opinion as a carrier of freight, it is a miserable economic failure particularly as applied to a distance carrier.

I could go on indefinitely citing damage unpaid for by this class of transportation such as public protection, and traffic congestion, but will conclude with the sincere wish that some enterprising and able writer will soon put the motor truck before your readers in its proper light.

Camden, N. J. **William H. Aspden.**
March 7, 1923.

Another Method for Deriving Cost Curves

Sir—In reading the article on "Cost Curves for Building Estimates" in your issue of Feb. 15, it seemed to the writer that the matter could be much simplified by using the well-known and easy method of substituting the known values in the stated equations from which the constants can be readily established. Thus, using the calculated examples (A) and (C), as is done by the author, we obtain the two equations:

$$\text{Building (A) } 284.89 = 1{,}267\,a + K$$
$$\text{Building (C) } 533.07 = 4{,}928\,a + K$$

Solving these equations we obtain: $a = 0.0678$ and $K = 199.00$; and the equation of unit costs becomes

$$x = 0.0678 + 199/y.$$

The calculated examples are taken too close together to give an accurate curve if it is to be much extended, but all of the examples should be used in establishing the constants of the equation. This can easily be done by using the method of least squares for cases in which the number of unknown quantities is less than the number of equations. The procedure is perhaps too well known to be given space here, but the results give $a = 0.0679$ and $K = 198.21$. These vary but slightly from those given above because the range of values is very small. F. W. DALRYMPLE.

Washington, D. C., Feb. 27, 1923.

Earth Pressure Formulas and Their Inconsistencies

Sir—In *Engineering News-Record* of Feb. 8, p. 270, M. Hirschthal states that the standard formulas for the lateral pressure of earth are inconsistent, since for the case of a vertical wall and horizontal fill the pressure is given as $\frac{1}{2}wh^2\tan^2\frac{1}{2}(90° - \phi)$ while the weight of the corresponding "wedge of pressure" is $\frac{1}{2}wh^2\tan\frac{1}{2}(90° - \phi)$ or a ratio of $\tan\frac{1}{2}(90° - \phi)$ to 1, while in the case of a vertical wall and fill at the angle of repose the total pressure is $\frac{1}{2}wh^2\cos\phi$, which is also the weight of the wedge.

There are two errors in the above argument. The first is the assumption that the plane of rupture bisects the angle between the vertical wall and the plane of repose in both cases; this is only true for the special case of a horizontal fill. The second is the use of the formula $\frac{1}{2}wh^2\cos\phi$, which is derived by the Rankine theory without any reference to a wedge and acts obliquely.

To make this perfectly clear, the following formulas for the lateral pressure against a vertical wall are tabulated:

I. According to the Coulomb theory; the pressure assumed to act normally to the wall, i.e. horizontally.

II. According to the general wedge theory; the pressure always inclined to the normal at an angle ϕ', where $\tan\phi'$ is the coefficient of friction between wall and fill.

III. According to the modified wedge theory; ϕ' assumed equal to ϕ.

IV. According to the Rankine theory; pressure always parallel to the surface of the fill. Since no wedge is assumed we cannot have any values for the weight of the wedge or the wedge angle.

In all these theories we assume that the angle of natural slope is equal to the angle of internal friction. To save space only the results for the cases of horizontal and maximum sloped fills are given. The symbols in the formulas are:

W, weight of the wedge;
P, total pressure;
H, horizontal component;
ϕ, angle of natural slope;
ϕ', angle of friction between wall and fill;
θ, angle between vertical wall and plane of rupture.

The values of the table were computed by drawing the equilibrium triangle of the three forces acting on the wedge and obtaining the relation between H and W in terms of the angles. Simplification gives the ratio H/W as above. The value for θ is found by substituting the value for H from the first row of the table. The detail is omitted because of its length; note however that if we set ϕ for ϕ' in Theory II, there result the values under III; and with zero for ϕ', the values under I. A value for the ratio H/W of zero, since H is not zero, can only mean that the wedge is infinite, in other words, the plane of rupture coincides with the plane of slope. The inconsistency does exist in these formulas, but not as Mr. Hirschthal pointed out.

To see the relative values more clearly, assume the case of $h = 20$ ft., $w = 100$ lb. per cu.ft., $\phi = 34$ deg., $\phi' = 25$ deg. Then the following values result:

	Horizontal Fill				Fill At Natural Slope			
	I	II	III	IV	I	II	III	IV
H......	5,650	4,620	4,300	5,650	13,800	13,800	13,800	13,80
P.......	5,650	5,100	5,200	5,650	13,800	15,200	16,700	16,70
$\frac{H}{W}$	0.532	0.360	0.442	.....	0.000	0.000	0.000	
θ ...	28° 00′	32° 40′	32° 10′	. ..	56°	56°	56°	.

The above is in no way intended to prove or disprove any theory; that can only be done by experimental data.

Brooklyn, Feb. 11, 1923. JACOB FELD.

HORIZONTAL FILL

	I	II	III	IV
H	$\frac{1}{2}wh^2\tan^2\frac{1}{2}(90° - \phi)$	$\frac{1}{2}\frac{wh^2\cos^2\phi}{(n+1)^2}$ where $n = \sqrt{\frac{\sin(\phi+\phi')\sin\phi}{\cos\phi'}}$	$\frac{1}{2}\frac{wh^2\cos^2\phi}{(1+\sqrt{2}\sin\phi)^2}$	same as I
P	H	$\frac{H}{\cos\phi'}$	$\frac{H}{\cos\phi}$	H
$\frac{H}{W}$	$\cot(\theta+\phi)$ or $\tan\frac{1}{2}(90° - \phi)$	$\frac{\cos(\phi+\theta)\cos\phi'}{\sin(\phi+\phi'+\theta)}$	$\cot(\phi+\theta)$	....
θ	$\frac{1}{2}(90° - \phi)$	$\tan\theta = \sqrt{\tan(\phi+\phi')[\tan(\phi+\phi')+\cot\phi]}$ $-\tan(\phi+\phi')$	$\tan\theta = \frac{\sqrt{2}\cos\phi}{\cos 2\phi} - \tan 2\phi$	....

FILL AT NATURAL SLOPE

	I	II	III	IV
H	$\frac{1}{2}wh^2\cos^2\phi$	same as I	same as I	same as I
P	H	$\frac{H}{\cos\phi'}$	$\frac{H}{\cos\phi}$	$\frac{H}{\cos\phi}$
$\frac{H}{W}$	$\cot(\phi+\theta) = 0$	$\frac{\cos\phi'\cos(\phi+\theta)}{\sin(\phi+\phi'+\theta)}$	$\cot(\phi+\theta) = 0$	....
θ	$90° - \phi$	$\tan\theta = \frac{\cos\phi\sin(\phi+\phi')}{\cos\phi' - \cos(\phi+\phi')\cos\phi}$	$90° - \phi$	....

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Amendment of the New York City zoning regulations which reduced from 150 to 75 ft. the permissive height of buildings on Fifth Ave. was sustained on March 13 by a Justice of the State Supreme Court.

By a bill recently introduced in the New York State Assembly the state is authorized to issue $5,000,000 for its share in the elimination of certain grade crossings by the Long Island Railway Co.

The Interstate Commerce Commission will hold a meeting in Denver Colorado, April 16, to discuss the consolidation of certain Western railroads. The Colorado Society of Engineers has appointed V. A. Kauffman to be present as an observer for the engineering society.

Senator O'Brien has introduced into the New York State Legislature an amendment to the engineering licensing law to exempt from examination and payment of fees persons employed as civil engineers in any department of the state.

No communication from Henry Ford has been received by the Federal Power Commission at this writing since the authorizing of a preliminary permit in his favor for the High Dam on the Mississippi. Despite the rather exacting conditions in the permit, it is anticipated, however, that he will accept it.

Application has been made to the Interstate Commerce Commission by the Great Northern R.R. for permission to issue $60,000,000 in 5 per cent gold mortgage bonds, of which the railroad proposes to sell $20,000,000 immediately. Approximately $55,000,000 of the issue is said to represent expenditures made by the railroad between 1911 and 1921 on betterments.

Harbor and port construction work calling for an appropriation of 57,050,000 yen ($27,945,975) is contemplated in the program to be introduced into the present session of the Japanese Diet. The principal ports that will benefit by the bill, if it is approved, are Yokohama, Kobe, Nagasaki, Moji, Tsuruga and Shimonoseki. According to a recent issue of *Commerce Reports* Kobe is to receive the greatest part of the appropriation, or about $14,500,000.

The Asia Development Co., one of the new American firms to operate in the Orient, has signed a contract with the provincial government of Shantung for closing the break in the Yellow River in Li-Chinhsien Shantung. Work involves the repair of the 3-mile break in the dikes and the retention of the river in its old course. The contract is said to involve $1,500,000. Paul P. Whitham, a Seattle engineer who served for several years as special agent and trade commissioner for the Bureau of Foreign and Domestic Commerce is president of the company.

Hoover Proposes Interstate Treaty for Superpower Plan

Washington Correspondence

The next step toward the realization of the superpower plan in the Northeast, George Otis Smith announced on Mar. 10, will be a conference between members of the superpower advisory board with representatives of the eleven state commissions having jurisdiction over public utility matters. Commerce Secretary Hoover believes the most workable scheme to insure the co-ordination of these regulating bodies would be the drafting of an interstate treaty along the lines of the Colorado River Compact.

An early effort will be made to have a legal study undertaken of the existing state statutes or regulations which would interfere with or hamper the carrying into effect of the superpower project.

Albany Engineers Endorse Plan to Merge State Agencies

In a resolution passed recently by the Albany Society of Engineers, endorsement was given of the proposed Senate resolution which would amend the state constitution providing for the creation of nineteen civil departments. At the same time the resolution of the engineers contains a recommendation that the words "engineering and" be inserted so that the proposed new department may read "engineering and public works." The resolution is based upon the view that because of the relation of engineering to all public works specific recognition should be given, and because the successful and proper planning, prosecution and ultimate effectiveness and utilization of all public works are dependent upon proper engineering design, supervision of construction and operation.

D. W. Davis Made Assistant Secretary of Interior

D. W. Davis, formerly Governor of Idaho, has been appointed a special Assistant Secretary of the Interior. He was added to Secretary Work's staff because of his knowledge of irrigation and reclamation matters.

Mr. Davis served as Governor of Idaho for two terms, from January 6, 1919 to January 1, 1923. His home is at American Falls. He was a member of the Idaho State Senate in 1912 and in 1914. While Governor of Idaho he formed the Western States Reclamation Association. He has been president of that organization since its founding in 1919.

Mr. Davis was born in Wales in 1873. He came to America in his infancy. During his boyhood he worked as a coal miner in Iowa. While still a youth he moved to Idaho. He has had wide experience in all of the questions affecting the public lands.

Action on Demolition of High Bridge Postponed

Numerous Protests Hold Up Board of Estimate Plan to Tear Down Structure

Protests by engineers, architects and others against the tentative decision to tear down High Bridge (*Engineering News-Record*, March 15, p. 508) made on March 16 before the Board of Estimate and Apportionment, New York City, were followed by the adoption of a resolution requesting the Department of Plant and Structures to "re-examine, investigate and report with all convenient speed" in the matter of removing piers and some of the present short arches and building a longer arch to carry the Old Croton Aqueduct across the Harlem River. The preamble to the resolution stated that the Department of Water Supply had reported on Jan. 30 and Feb. 27 of this year that surveys of the present structure and borings in the bed of the Harlem River have shown that it would be feasible to remove these piers and substitute a single arch for them and the arches that would be destroyed.

MANY PROTEST

Among those who requested that the bridge be spared because of its engineering, architectural, and historic interest were Charles M. Leavitt, President of the American Institute of Consulting Engineers; E. S. Jarrett, Daniel E. Moran, Lincoln Bush, and Ralph Modjeski, representing the New York Section of the American Society of Civil Engineers; Nelson P. Lewis, former Chief Engineer of the Board of Estimate, representing the Russell Sage Foundation; Mr. Barber and Arnold W. Brunner, representing the American Institute of Architects.

During the discussion, High Bridge was spoken of as a worthy memorial to John B. Jervis, engineer for the Croton water supply. Donn Barber, of the American Institute of Architects, declared that it would be criminal to tear down that historic structure, which he declared is "one of the finest examples of early American engineering and architecture."

BUILT IN 1836

The general plan for the Croton supply, as proposed by Major D. B. Douglas, was approved by the City Council on March 11, 1835, and later on by a popular vote of 17,330 to 5,963. Major Douglas was made chief engineer, located the aqueduct and made plans for it.

These plans were modified in some details and the aqueduct was constructed under the direction of John B. Jervis, who succeeded Major Douglas as chief engineer in October, 1836. Water was passed through the aqueduct on June 27, 1842.

The population of New York City was then in the neighborhood of 375,000.

A. R. E. A. Annual Meeting Is Well Attended

Standardization and Labor Economics are Emphasized—Numerous Matters in 24 Reports Accepted

That labor economics is the coming great problem of the railway engineer as well as of industry in general was the opinion expressed in the presidential address of J. L. Campbell (El Paso & Southwestern Ry.) at the opening meeting of the 24th annual convention of the American Railway Engineering Association, held in Chicago, March 13-15. Mr. Campbell dwelt upon the difficulties of this problem as compared with physical problems. He believes that its solution lies in equal assimilation and practice of the principles of the Christian religion by both employers and employees. Development of standardization and especially the need of a wider use of adopted standards of design and practice were also dealt with by Mr. Campbell, who pointed out that there is a division of opinion in the Association as to whether it should continue its affiliation with the American Engineering Standards Committee, the adverse reasoning being that the railways constitute so large and distinctive an industry that they should make their own standards without entangling alliances. This matter came up later in the discussion of the report of committee on Standardization, which is composed of the chairmen of the several committees and which recommended close co-operation with the A. E. S. C. It was in part also the subject of a brief address by R. H. Aishton, president of the American Railway Association.

COMMITTEE REPORTS

Reports of the twenty-four committees had been printed in advance and aggregated nearly 1,100 pages. Every report was presented and acted upon, so that obviously there were few extended discussions, most of the matter being accepted formally by resolution. With the new edition of the "Manual" issued only recently there were comparatively few additions proposed, but all of these were adopted. The great bulk of the material in the reports was submitted as information and was accepted without dispute and with very little comment. In fact the action of the convention was mainly in stamping the work of the committees with the formal approval of the Association. The registration at the 1923 meeting totaled 665 members and 168 guests, as compared with 707 and 178 in 1922.

A memorial hour was set aside during one session for brief addresses paying tribute to the professional ability and high personal character of the late A. S. Baldwin (Illinois Central R.R.), C. E. Lindsay (New York Central R.R.) and William McNab (Grand Trunk Ry.) At the annual dinner the principal addresses were by Hon. F. B. Carvel, chief commissioner of the Board of Railway Commissioners of Canada; Floyd W. Parsons (formerly editor of *Coal Age*), and Judge Harry V. Osborne, president of the New Jersey Board of Public Utility Commissioners.

An increase of fifty in membership was shown by the report of the secretary. With ninety-six new members and the loss of forty-six members by death and resignation, the net membership on March 1, 1923, was 2,010, as compared with 1,960 in 1922.

Financial conditions were reported as being satisfactory, the receipts for 1922-1923 having been $45,280 or $3,283 in excess of expenditures, while the present cash assets amount to $45,025. The revised edition of the "Manual of Recommended Practice" was issued during the year. An amendment to the constitution which provides more flexibility in setting the date of the annual meeting was adopted by a ballot vote of 696 to 57 during 1922.

Excursions arranged for the day after the convention included inspection of the concrete investigation work of the Structural Materials Research Laboratory at Lewis Institute, fire tests of concrete at the Underwriters Laboratories and a visit to the Hawthorne works of the Western Electric Co. There was also a trip to the Forest Products Laboratory at the University of Wisconsin, Madison, Wis.

Officers elected for the year 1923-24 are as follows: President, Edward H. Lee, president and chief engineer, Chicago & Western Indiana R.R.; vice presidents, George J. Ray, chief engineer, Delaware, Lackawanna & Western R.R., and J. M. R. Fairbairn, chief engineer, Canadian Pacific Ry., the former holding over from 1922. The treasurer is G. H. Bremner, and the secretary E. H. Fritch, both being re-elected.

M., K. & T. Ry. Places Large Order for Water Softeners

As part of a move for providing better water for its locomotives a contract for twenty-four water softening plants has been placed by the Missouri, Kansas & Texas Ry. with the Graver Corporation, East Chicago, Ind. This order includes fourteen plants with a capacity of 5,000 gal. per hour, the others ranging from 8,000 to 30,000-gal. capacity. Two of the larger plants will have storage tanks of 100,000-gal. capacity. For proportioning the chemicals the weir type of device will be used, as the closer accuracy of the new submerged-orifice method of the Graver concern is not required for large water-softening plants.

New England Extension of Grand Trunk Certain

Only the failure of the Rhode Island General Assembly to grant a two-year extension of the charter permitting construction stands in the way now of completing the Southern New England extension from Palmer, Mass., to tidewater at Providence, of the Grand Trunk Ry. This announcement has been made by John S. Murdock, of Providence, vice-president of the Southern New England. As a result of such assurance, the floor leader in the Rhode Island House has introduced an act renewing the road's charter for two years. The extension is designed to link the Central Vermont, a subsidiary of the Grand Trunk, with deep water at Providence. The right-of-way is already largely graded. The road will run through one of the busiest industrial sections of the country. Work has been held in abeyance since 1912, original construction having been started in 1910.

Edward H. Lee Elected Head of Railroad Engineers

New President of A. R. E. A. Has Been Prominent in Development of Chicago Terminal Facilities

Edward H. Lee, elected president of the American Railway Engineering Association, is vice-president and chief engineer of the Chicago & Western Indiana R.R. Co. and the Belt Railway Co. of Chicago. These two lines form one of the most important passenger and freight terminal systems of Chicago and Mr. Lee has been prominent in the development of the city's railway terminal facilities.

Mr. Lee was born at Dayton, Ohio and was educated at the old Ohio University and the University of Wooster.

After working for several years on different railroads, some of which are now parts of the Baltimore & Ohio R.R. and Norfolk & Western R.R. he went to the Union Pacific R.R. and then to the Elgin, Joliet & Eastern Ry., of which he was office engineer and then chief engineer. Following this he had two or three years experience as partner in a contracting firm. In 1897 he returned to the railway field as chief engineer of the two companies mentioned above. Later he was made vice-president and during the war time period of government control of the railways he was president of both corporations, but resumed the combined position of vice-president and chief engineer when the railways were returned to their owners.

The design and construction of extensive track elevation work on lines of busy traffic was carried out under his direction, as well as the reconstruction of the great freight classification and transfer yard at Clearing, where the cars move by gravity and the yard switches are controlled from an elevated tower by electro-pneumatic apparatus. On the track elevation work Mr. Lee was a pioneer in the extensive use of machinery, including the use of unloader plows and spreaders in placing the great amount of sand filling, and the use of locomotive cranes for handling track material, raising temporary bridges and throwing track. He has advocated particularly the use of double-deck freight houses to economize high-value land areas, and the recent project for the reconstruction of the Dearborn Station of the Chicago & Western Indiana R.R. on a greatly enlarged scale was prepared under him.

Reservoir for Pennsylvania R.R. at Enola Yard

A 3,000,000-gal. reservoir formed by an earth embankment and lined with concrete is to be built by the Pennsylvania R.R. at the Enola yard on the low-grade freight line, just west of Harrisburg, Pa.. Water will be pumped from the Susquehanna River to the re[illegible] a [illegible] to the shops and yards. This increase in the water supply is part of a general plan to improve the facilities at Enola in order to insure more rapid handling of trains in fast freight service.

Additions to Water-Power Plants Are Authorized

California Developments Include Pit River, Caribou Extensions—Holtwood Station To Be Completed

Caribou Extension—Plans for the immediate installation of a third unit of 22,000-kw. capacity in the Caribou plant on the North Fork of the Feather River in California have been announced by J. B. Black, general manager of the Great Western Power Co. The addition to the generating capacity of the company will entail the expenditure of approximately $1,500,000. Surveying parties are already in the field and preliminary engineering work under way. Bids for hydraulic and electrical equipment will be called for within the next fifteen to thirty days. The installation will include penstock, turbine, generator, exciter, transformers and other electrical equipment. Tunnels and transmission lines are already completed. Increased load demands constitute the reason for the enlargement of the plant.

At the present rate of growth the added power will be required within a year and it is expected that the installation will be completed within that time. The present Caribou plant was placed in operation in the summer of 1901. The equipment includes two 30,000 horsepower double overhung impulse wheels operating under a head of 1,080 ft. and two 11,000-v. 22,223 kva. generators. The ultimate capacity of the plant is six such units.

Skagit River Development—Bids for the construction of 100 miles of 165,000-v. transmission line and telephone line from the Gorge Creek plant of the Skagit River development to the city of Seattle will be called for April 13 according to C. F. Uhden, chief engineer of the project. Specifications will be completed by Mar. 30 and will be on file in the office of the chief engineer, 1400 Alaska Building, Seattle. The line will bring power from the Gorge Creek plant, the first unit of Seattle's municipal development program on the Skagit River, to a substation outside the city. The plant, which will have an initial capacity of 34,500 kw., will be completed late in 1923. It is planned to have the transmission line ready for operation at the same time.

Holtwood Station—Completion of the Holtwood (McCall Ferry) power station, on the Susquehanna River, of the Pennsylvania Water & Power Co., delayed almost ten years by the war, is finally to be brought about. A contract has been given the I. P. Morris department of the William Cramp & Sons' Ship & Engine Building Co. for the remaining hydraulic machinery needed, principally consisting of two 20,000 hp. Francis turbines of the I. P. Morris design.

The addition of this equipment will bring the station up from 110,000 to 150,000 hp. capacity, for which it was originally planned. The present hydraulic equipment consists of eight turbines, all of I. P. Morris design and construction, but the two new wheels will not only be much larger and more powerful than any of the older ones, but the delay has enabled the Cramp company to embody in them a number of the latest improvements, evolved since the original installation was made, in design of draft tubes, etc., which will result in increased efficiency of the station as a whole.

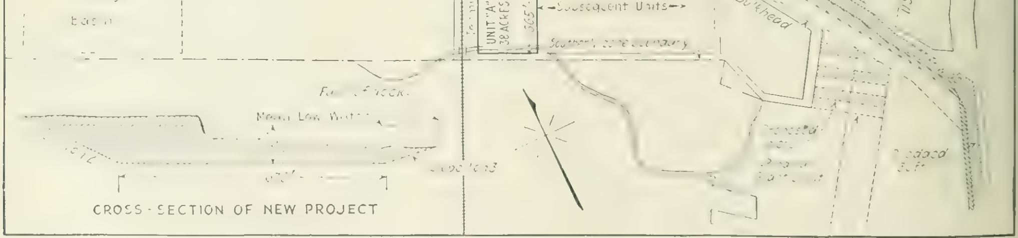
The Holtwood station operates on an average effective head of 54 ft., the concrete dam being 55 ft. in height and half a mile long. The present battery of generators is of the three-phase, 25-cycle type, with 11,000 voltage at the generator terminals. This is stepped up by transformers to 70,000 volts in the long-distance transmission lines.

The two new turbines are by no means the largest which the Cramp company now has on hand. Work is now approaching completion on the two 70,000 hp. Francis turbines for Niagara Falls in the Cramp I. P. Morris shops. These will be, when installed, the most powerful hydraulic turbines ever constructed.

Pit Number 3—Construction of Pit Number 3, the second of a chain of power houses which will ultimately develop over 600,000 hp. from the waters of the Pit River in Northern California, will start within the next thirty days according to an announcement made by John A. Britton, vice-president and general manager of the Pacific Gas and Electric Co. The plant will have a capacity of three 27,000 kva. units and will be completed by the fall of 1925. The development will involve a cost of about $17,000,000.

Pit Number 3 will be located about twelve miles below Pit Number 1 power house. Installation will involve the construction of a diversion dam 125 ft. high at a point two and one half miles below Pecks Bridge on the highway between Burney and Bartle. From this point a tunnel approximately 22,000 ft. in length, having a capacity of 3,000 sec-ft., will carry the water to a point above the site of the power house. The plant will operate under a static head of 313 ft.

City of Newark Extends Port Terminal Development



Under contracts recently awarded, the Department of Streets and Public Improvements of the City of Newark is extending the Port Newark terminal development. The channel from the government project in Newark Bay as far as the western pierhead line of the bay has been dredged to 30 ft. by the federal government. From this line to the crossing of the Central R. R. of New Jersey the work is in the hands of the Port Newark administration. The first dredging that was done in this section provided for a width of 400 ft. and a depth of 21 ft. Later the northerly half of this channel was deepened to 30 ft. and 7,000 ft. of marginal dock was built.

The present project is to widen the channel to 670 ft. beginning at its west end, alongside the Central R. R. of New Jersey, and extending for 1,200 ft. eastward; and to deepen it to be 30 ft. for the full width. This will involve about 525,000 cu.yd. of dredging which is being carried on by the Atlantic, Gulf & Pacific Co. of New York. A contract for 1,000 ft. of dock-wall has been awarded to Allen Spooner & Sons, Inc.

The initial step in the development will be the construction of an extension of the Pit River R.R. The line will branch off at Cayton Valley and will follow the river in a southwesterly direction, a distance of five miles to the dam site. The road will then extend five miles further to the site of the power house. A gravity road will lower the material to the construction camp at the dam site before work on the permanent dam is started. A temporary diversion dam and tunnel will be constructed. The driving of the four-mile turn will start immediately. The installation will also require the construction of eight miles or more of double circuit 220-kv. transmission line from power house number three to the main transmission system.

Another Hearing on Carquinez Strait Bridge Held

A public hearing was held in San Francisco March 6 before Major U. S. Grant, III, Engineer Corps, U. S. A., to receive the application of the Rodeo-Vallejo Ferry Co. for permission to build a bridge, in accordance with the franchise recently secured from Contra Costa County, and to hear any objections or protests.

The Rodeo-Vallejo Ferry Co. has secured the approval of the California State Engineer and holds a franchise from the supervisors of Contra Costa County to build a bridge across Carquinez Strait from Valona to Morrow Cove, provided construction is begun before June 5, 1923 and completed within three years. A previous hearing before army engineers was held on this project and was reported in *Engineering News-Record* Nov. 30, 1922, p. 949. The March 6 hearing was made necessary by changes in plans made to conform to restrictions imposed by the franchise, and because of the desire of the Rodeo-Vallejo Ferry Co. to submit to the War Department two alternative plans, one for a cantilever and the other for a suspension bridge, either of which would meet the requirements of the franchise as granted by Contra Costa County.

The cantilever bridge would require a pier centrally located in the Strait but would leave a clear channel on either side of the central pier 1,070 ft. wide. Two other piers would be within the pier head lines and each would be reached by a 500-ft. approach anchor-span. The suspension design calls for a 1,950-ft. center span with two approach spans of 975 ft. each.

The applicant asks that approval be granted for either type of bridge, thus making it possible to call for competitive bids on both types. However, if the War Department can give approval on only one type, preference was expressed for the cantilever structure because of its lower cost. Admiral J. S. McKean, Commandant of Mare Island Navy Yard, stated that neither type of bridge would be a menace to navigation and that while the center pier might be considered an obstruction, the disadvantage of having a central pier was more than offset by getting the two shore piers inside the pier head lines.

Charles Derleth, Jr., is chief engineer of the Rodeo-Vallejo Ferry Co. and Wm. H. Burr of New York City is consulting engineer.

Eugene Young A.G.C. Secretary

Eugene Young, formerly secretary of the Minneapolis Builders Exchange, has been appointed secretary of the Associated General Contractors of America. He takes the place of G. W. Buchholz, who recently resigned to enter the contracting field. In the selection of Mr. Young, the Association has obtained a man well qualified to assume the duties of such an office. His success in organization work, and in dealing with labor problems in Minnesota is well known in construction circles; and as a monument to his executive ability he left the Builders Exchange a membership of 380, a modern 12-story office building, and a surplus in its treasury.

Engineering Employment Still on the Up-Grade

Engineering services continue to be in demand in most sections of the country, but particularly in the Middle West. The outlook for technical employment is active and favorable, reports the employment department of the American Association of Engineers which outlines the situation as follows:

The past six months have been exceptionally good for the office engineer and the expert engineer. This demand is expected to continue for some time. The number of plans being prepared indicates an up-tone of strength and a large demand for construction engineers and estimators, provided construction does not reach its limit in labor supply and material.

Engineering activities are starting to show signs of life in the northwest section where weather conditions have caused a general pause. Building, municipal construction and road work are starting, with manufacturing coming along strong. In California engineering work continues good. The southwest section has been poor for the civil engineer but excellent for the miner. The mountain states show an early spring start with a number of oil, mining and general engineering projects under way. The central states have on hand a large volume of construction work, much of which is being rushed to completion and much new work being started. The coal mining region indicates continued activity with a fair demand for technical services from that section. Engineering work is not as active in the eastern states, particularly in New York and Massachusetts, and business is not as optimistic, although the supply and demand for engineers about balances. The following table shows the trend of employment for the whole country:

	[illegible] 1923	[illegible]	[illegible] 1922
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

The average salary of positions filled was $[illegible] a month.

New York Railroad Club Discusses National Transportation

At a meeting of the New York Railroad Club held in that city on March 16, J. Rowland Bibbins, consulting engineer and formerly manager of the department of transportation of the Chamber of Commerce of the United States, presented a paper on "Our National Transportation System." Mr. Bibbins outlined the development of the several transportation agencies and emphasized the need for a better integration of the railroads, highways and waterways in the interest of more efficient transportation service to industry. As a beginning he urged the intensive study of the several metropolitan areas of congestion.

The paper was discussed by Capt. S. B. Moore, consulting engineer; Col. Willard Chevalier, *Engineering News-Record;* D. L. Turner, consulting engineer, New York Transit Commission; Col. H. D. Emerson, consulting engineer; Col. Charles Hine, consulting engineer; J. C. Lincoln, traffic manager, New York Merchant's Association; W. E. Symons, mechanical engineer; J. Shirley Eaton, consulting engineer and J. S. Marvin of the Nation Automobile Chamber of Commerce.

Railway Revenues Increased During 1922

According to a recent bulletin issued by the Bureau of Railway Economics, the total operating revenues of Class 1 railways and large switching and terminal companies in the United States, in 1922 amounted to $5,617,252,656. This compares with $5,573,153,133 in 1921, representing an increase of 0.8 per cent. The total operating expenses amounted to $4,455,650,216 for 1922. This is a decrease over 1921 of 3.2 per cent. The net railway operating income amounted to $776,665,960, or an increase over 1921 of 26 per cent.

Engineering Foundation Elects Officers at Annual Meeting

At the annual meeting of the board of Engineering Foundation Charles F. Rand, treasurer and past president of the American Institute of Mining and Metallurgical Engineers, was reelected chairman, and Edward Dean Adams of New York, fellow of the American Society of Civil Engineers, was chosen first vice-chairman. Frank B. Jewett, president of the American Institute of Electrical Engineers, was elected second vice-president, and Alfred D. Flinn was re-elected director. Joseph Struthers is treasurer and Henry A. Lardner, assistant treasurer. Dr. W. F. M. Goss, president of the Railway Car Manufacturers Association, was elected to the foundation board to succeed George M. Basford, and Col. Arthur S. Dwight was chosen to succeed Edwin Ludlow. Other members of the board for the coming year are George B. Pegram, Bancroft Gherardi, Silas H. Woodard, Prof. Arthur L. Walker, John H. Barr, H. Hobart Porter, Dr. David S. Jacobus, Prof. Herbert M. Boylston, E. Wilbur Rice, Jr., Elmer A. Sperry, and J. Vipond Davies, president of the United Engineering Society. The executive committee consists of Messrs. Rand, Adams, Pegram, Jewett and Porter.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Spring Meeting, New Orleans, La., April 18-20.

NATIONAL FIRE PROTECTION ASSOCIATION; Boston; Annual Meeting, Chicago, May 8-10.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Detroit, Mich., May 21-25.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

The Rochester Engineering Society will be host to the New York Section of the American Water Works Association at its last meeting of the year, in Rochester, Apr. 7. The address of the principal speaker, Alvin H. Dewey, manager of the Rochester & Ontario Water Co., will be followed by an inspection of buildings and equipment of the Rochester repair department and yards. The speaker at the banquet in the evening will be Dr. Samuel W. Stratton, president of Massachusetts Institute of Technology.

Personal Notes

William R. Casey, formerly civil engineer with A. E. Stephens Co., Springfield, Mass., has become associated with McClintock & Craig, engineers and architects, of that city.

C. I. Rhodes, chief hydraulic engineer for the California State Railroad Commission, has resigned to enter private practice as consulting engineer in association with **C. H. Loveland**, of San Francisco. Mr. Rhodes has been with the commission for five years, for the past two years holding the position of chief of the hydraulic division.

F. W. Epps, for the past five years bridge engineer of the Kansas Highway Commission, has resigned and entered consulting bridge and road engineering with **H. S. McFadden**, under the firm name of the Kansas Engineering Co. This firm has been doing road work in Kansas for the past four years. Mr. Epps is secretary of the Kansas Section of the American Society of Civil Engineers, a member of the executive committee of the Kansas Engineering Society, and president of the Topeka Engineers Club.

Alfred H. Terry, formerly city engineer of Bridgeport, Conn., and also engineer during the war for the United States Housing Corp., was elected president of the Connecticut Society of Civil Engineers at the annual meeting held recently at Hartford.

Edward Burr, who recently retired from the Corps of Engineers with the rank of colonel and who served with rank of brigadier-general during the World War in France, has been retained as one of the consultants on the staff of the chief engineer of the Board of Estimate and Apportionment, New York City, in connection with the Narrows Tunnel project. General Burr retired Feb. 23, being at that time U. S. District Engineer in charge of the First District, New York City, a station which he had held since his return from France. During his term of service in New York City, he was in charge of river and harbor improvements, including all federal matters in New York Harbor east of the Jersey state line. These improvements aggregated a total estimated cost exceeding $50,000,000 and included operations for moving all classes of material from harbor mud to ledge rock. Previous to the World War, General Burr was senior assistant to the Chief of Engineers and was acting chief of engineers for periods totaling ten months.

Isadore Walzer, former county assistant engineer of Nassau County, New York, for the state highway commission, has resigned to accept a position as secretary and treasurer of the newly-organized Heling Construction Corp., engineers and contractors of Lindenhurst, L. I.

Lawrence W. Cox has resigned as assistant city engineer of Dubuque, Iowa, to become city manager of Maywood.

L. D. Parks, until recently county engineer of Comanche and Erath Counties, has been appointed county engineer of Eastland County, at Eastland, Texas, succeeding W. R. Eccles, resigned. Mr. Parks is a graduate of Texas A & M College. He was assistant sewer engineer of the City of Houston prior to the war, during which he served as an officer in the air service.

L. O. Forsgard has resigned as city engineer of Palestine, Texas, to become city engineer of Nacogdoches. Mr. Forsgard is a graduate of Texas A & M College and was formerly assistant engineer with the City of Houston.

Reeds & Thorpe, engineers of Hartford, Conn., have dissolved partnership, Mr. Reeds retiring. **George H. Thorpe** will continue the business under his own name.

Alvin G. Andrew was elected as borough engineer for Tyrone at a meeting of the council, succeeding the late **R. A. Zentmyer**. Mr. Andrew was formerly associated with the Pennsylvania R.R. Co. as assistant supervisor of the Tyrone division.

Donald des Granges, formerly with Cram & Ferguson, Boston architects, has joined the organization of Stone & Webster, Inc., of Boston, as engineer in the structural division. During the war Mr. des Granges was engaged in architectural work in France on the development of the port of St. Nazaire and other A. E. F. operations.

Walker B. Lounsberry, of Binghamton, N. Y., has been appointed as assistant city engineer of that city by W. Earl Weller, the city engineer.

Arthur Richards, Columbus, Ohio, has been chosen city engineer of Chillicothe. He is a graduate of Ohio State University, department of civil engineering, and following his graduation was employed by the city of Columbus for several years. He then went to the Panama Canal where he was employed for six years on construction work. Since 1918 he has been bridge engineer of Franklin County, Ohio. Mr. Richards succeeds **Henry M. Redd**, who resigned recently.

Fred Grumm has been appointed office engineer in the headquarters office of the California State Highway Commission at Sacramento. Mr. Grumm goes to Sacramento from the Fresno office where he has been located recently as assistant division engineer.

R. W. Hebard, member of the firm of R. W. Hebard & Co., Inc., engineers and contractors of New York, has been elected a director of the International Railways of Central America. The International Railways comprise the existing railway mileage in the Republics of Guatemala and Salvador.

C. V. Waddington, engineer for the Kansas Gas and Electric Co., Wichita, Kansas, has been appointed secretary and treasurer of the Kansas Engineering Society to fill the vacancy made by the resignation of **C. P. Buck** of Topeka.

F. B. Goedike, has been appointed engineer for York Township, including a large suburban area of Toronto. Mr. Goedike is a graduate of Queen's University, Kingston, and has had an extensive experience in railroad, harbor and waterworks construction.

Arthur V. Moninger, formerly chief engineer with Donaldson and Meier, architects, Detroit, Mich., has joined the staff of the Federal Bond and Mortgage Co., of Detroit, as construction manager. Mr. Moninger has spent considerable time in contractors' organizations and in his new position will have supervision over the construction of a large variety of building projects.

Obituary

John Farrell, for 70 years a contractor in Montreal, died Mar. 16, aged 96. He constructed the two original gas works in Montreal and remained active in business until a few years ago.

David Dexter Clarke, former chief engineer of the Water Bureau of Portland, Ore., died recently, aged 79 years. Mr. Clarke, who was born in South Hadley Falls, Mass., went to Portland in 1864 and took up immediately the practice of civil engineering. Several years later he was engaged in government surveying work in Washington State, but returned to Portland and became assistant to the chief engineer of the Portland Water Bureau. In 1917 he retired from active service, though he maintained almost daily touch with water bureau officials until a month before his death.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Railway Appliances Shown at Chicago Exhibit

Development of Small Tools Indicated—Train-Control Systems Displayed at Coliseum Last Week

(*Engineering News-Record Staff Report*)

RAILWAY work is promising so wide a field for the near future that the annual National Railway Appliances Exhibition, held at Chicago in connection with the convention of the American Railway Engineering Association, March 13-15, was of more practical interest than it has been for the past few years. Although the exhibits were fewer in number than in some previous years they lacked little in comprehensiveness, the reduction being mainly in the number of individual exhibits of different classes rather than in the classes themselves. There were more than 160 exhibits at the Coliseum, but some firms which usually exhibit were content this year to have representatives in attendance at the convention at the Congress Hotel. Novel or special features in the products on display were rare, the exhibits, with few exceptions, being standard or well established materials, devices and appliances.

TRACK AND TRACK APPLIANCES

Rails, frogs and switches were notably limited and only well-known rail joints were included, the usual experimental joints being absent. Switchstands were numerous and there were some special frog guardrails, including ordinary and manganese steel rails, cast-steel guards of the American Chain Co. and a "girder" guard, consisting of a heavy bar supported in chairs, of the Positive Rail Anchor Co. Bumping posts were also in evidence. Such smaller appliances as spikes, bolts, washers, tie-plates and rail anchors were fairly numerous.

TRACK MACHINERY AND TOOLS

There were only a few of the machines for heavy work, such as steam shovels, ditchers, spreader cars, locomotive cranes and weed-killing (chemical) cars. They were represented mainly by models and drawings. A notable exception was a Koehring concrete mixer mounted on flanged wheels and intended for miscellaneous scattered or isolated railway jobs requiring amounts of concrete too small for regular work-train service. Ballast-tamping machines were displayed, both electric and pneumatic tampers requiring traveling power or compressor outfits.

Smaller tools and mechanical appliances were in much greater number and it appears that it is in this class of appliances that greater development may be expected. They included small portable hoists for laying rails, a tie-spacing device, the Owen tie-puller for renewing ties, ballast cleaners, track-lining jacks of the Rail Joint Co. and the Idol Co., a Q. & C. snow melter for use at switches, an Ingersoll-Rand rail drill, and the Rawls and Woolery mowers attached to motor cars. The number and variety of motor cars for section and bridge gangs was very large. Hand tools for track work were numerous, including the Wood Co.'s shovels of molybdenum steel.

ENGINE TERMINALS AND SHOPS

Exhibits in the engine terminal and shop class were much less numerous than usual, particularly in regard to railway buildings. Models represented an Ogle reversible-hoist coaling station and a new design of Roberts & Schaefer ash-pit with mechanically operated car receiving the ashes and traveling up an inclined track to discharge into an ash car. Several water columns and oil columns were exhibited; also an oil-engine centrifugal pump, windmill pumps and water-softening plants. Wood and steel elevated tanks were represented and the Chicago Bridge & Iron Works showed a self-supporting steel dome roof on tanks. For enginehouse work there were smokejacks and ventilators and a Nichols electric tractor for turntables. Prominent among building materials were the zinc shingles and corrugated sheeting of the Illinois Zinc Co.; other exhibits in this line included wood-block flooring and asbestos and asphalt shingles.

Three or four makes of steel fence-posts were shown. Highway crossing signals were numerous, with both flashing and revolving lights. A crossing with Headley bituminous macadam paving was shown as an improvement upon ordinary planking, and there were two unusual, but little used, types of cattle guards, one of these being composed of rollers.

BRIDGES AND STRUCTURES

Practically the only bridge exhibits were the Raymond cast-in-place piles and the Massey precast concrete piles and slab spans for bridge and trestle decks. Others of the few exhibits included concrete cribbing for retaining walls, culverts of corrugated iron pipe, concrete pipe and cast-iron sections.

In the miscellaneous class may be listed the Clark dump-car, several torch welding and cutting devices, leadized pipe, chemical toilets, two or three weed-killers and different makes of industrial motor trucks for shop and factory use. Signals were less numerous than usual and most of them used lights instead of semaphores. On the other hand, there were four or five automatic train-control systems.

NEW OFFICERS ELECTED

At the annual meeting of the Nation Railway Appliances Association officers were elected as follows: President, L. W. Shugg, General Electric Co., Schenectady, N. Y.; vice-president, A. J. Filkins, Paul Dickinson Co., Chicago; secretary, C. W. Kelly, Kelly-Derby Co., Chicago.

Should Equipment Makers Feature Record Runs?

Figures for Unusual Performances Are Subject to Misconstruction by Engineers and Contractors

By K. H. TALBOT
Koehring Co., Milwaukee, Wis.

> *There has long existed a considerable diversity of opinion among manufacturers of construction equipment and materials as to the advisability of attempting to capitalize record performances. While temporary advantages may be secured by featuring unusual runs, it is open to question whether this practice, in the end, benefits either the maker or the user of construction machinery.*
>
> *The Koehring Co., of Milwaukee, manufacturers of concrete mixers, locomotive cranes and rotary graders, has established a definite policy on this subject which is set forth in the following statement.—Editor.*

AS TO the desirability of presenting record runs in advertisements and in articles for publication, the Koehring Co. has always felt that it is a mistake to use any language in its advertising that gives a wrong impression to any one, whether or not he be familiar with the machine advertised. The policy of this organization, therefore, is to use nothing in its advertising that, however construed, would be detrimental to the construction industry. Figures on record runs made with machines over short periods of time are misleading as to the amount of work that can be completed in a year.

To the uninitiated, and even to the engineer and road official who are not conversant with the actual quantity of concrete that can be laid with a contractor's organization, the publishing of such information leads to conclusions as to the quantity that can be placed *per year*. The tendency is to feel that there must be a considerable discrepancy between the effectiveness of the contractors' organization on work in their own vicinity and that in some other part of the country.

With machines of the size that are now being generally adopted the receiving, handling and transportation of the material requires organization. A highway represents the labor and equipment required to handle this part of the work as well as the labor and material required to mix and place the concrete. Conditions may arise where economy dictates the desirability of carrying a heavy payroll expense to drive the machine at its utmost capacity throughout the whole construction season, and there may be conditions, over which the contractor has no control, that reduce the amount of material that can be economically delivered to the machine.

It is not possible for the manufacturer of construction equipment to know the conditions surrounding the individual contractor who, we should he furnish information that may be used as a means of arriving at an average figure for work, based on maximum runs over short periods. This last statement is in line with the policy adopted by this company four years ago, namely, to offer to contractors all information possible to assist in obtaining the utmost from the equipment manufactured by us. We have always differentiated between the service that should be given by a manufacturer of equipment and the service that should be given by a consulting engineer. In other words, a manufacturing company may offer to a contractor a suggestion based on past experience but it cannot take the responsibility of furnishing figures on which an estimate of cost can be based.

[*In next week's issue other manufacturers will discuss their policies on featuring record runs or performances.* —EDITOR.]

Hoover Commends Progress in Lumber Standardization

W. A. Durgin, chief, Division of Simplified Practice, U. S. Department of Commerce, who was delegated to represent Secretary Hoover at the annual convention of the Southern Pine Association and the National Lumber Manufacturers' Association at New Orleans, at the end of his own speech on lumber standardization March 20, read a message from Mr. Hoover, from which the following is quoted:

"The better part of a year has passed since the representatives of your interests and all other lumber interests met with us in the Department of Commerce to initiate plans for coordinated voluntary action for national simplification and standardization of sizes and qualities of lumber and the development of suitable machinery within the trade to secure their observance. During these ten months a substantial organization, heading up in your Central Lumber Committee and the consulting committee of technical experts, has been developed, and I am informed that progress has been made toward adjusting the viewpoints of various sections of the country and formulating standards which shall have nationwide acceptance.

"Most of the earlier obstacles appear to be safely past. With the exception of one group which persists in misrepresenting the motives and objects of our common undertaking, I think all lumber interests are agreed on the fundamental importance of these plans, not only in themselves and for their immediate benefit to lumber producers and distributors, but because of the convincing demonstration they will carry of the intent of you lumbermen to place your business on a plane of highest business ethics and widest national service.

"The far-reaching economies in transportation and construction, the elimination of waste of our forest resources, the better protection to the consumer, the better understanding of the quality of American business men, are all great objects to be attained.

"I have stated repeatedly that my only thought in these undertakings is to make the Department of Commerce of value in cooperation for measures which must be carried out through the machinery of the trade itself, as a matter of self-government in the trade. I am uttterly opposed to any attempt to extend the arm of government, but I am equally convinced that these questions, so vital to the stability of our national industrial fabric, can gain great weight through proper Government support to the efforts of the trades."

Motor Industry Registers Third Largest Month

February motor-vehicle production was the third largest month on record, according to shipping reports made March 7 to the directors' meeting of the National Automobile Chamber of Commerce in New York City. The output of 270,995 cars and trucks is regarded by the industry as indicative of a big year, as February is usually a light period. The production figure for the past month is 125 per cent greater than the second month in 1921. The previous high mark for February was 180,000 in 1920.

The production figures for the three record months are: 289,011 in June, 1922; 272,538 in August, 1922; and 270,995 in February, 1923.

Contractors' Graveyards

Discussion by Alfred Carlson, Seattle, Wash., at the convention of the Associated General Contractors at Los Angeles, Jan. 30-Feb. 3.

A. P. Greensfelder's report for the Committee on Methods might be enlarged with regard to equipment waste. Going through the country you see the carelessness that many farmers show in the care of their equipment. On every farm I passed here or elsewhere, and over the country, the machinery stands outside. When the farmer finishes his work, he dumps his machinery on the nearest acre lot that he doesn't want to use—puts it there with no shed, and there it stands and rusts.

That practice is true, also, of contractors. Go through your cities and villages to the contractors' equipment yards and see how their equipment looks. I call them the contractor's graveyards. There stand concrete mixers that had been used and left full of concrete. They look as if they have been immersed in concrete and left there to stand, representing a loss of thousands of dollars.

You never find a contractor's warehouse; you can't find a single thing. I think one of the greatest losses is that due to carelessness of the contractor and his crew. When they are through with a job, they slam the equipment on the truck and get it back into the yard and it is there in a heap and nobody cares for it. When you want a ten-cent tool, you take a dollar of time to find it.

It is left to the superintendent or purchasing agent to order equipment and he orders equipment you can't use.

Discuss Uniform Motor Parts

Wider adoption of standards in automobile and motor truck construction, with particular regard to uniform sizes for certain parts, were discussed March 9 at a meeting of representatives of various interested associations called by the Division of Simplified Practice of the U. S. Department of Commerce. A central committee was created to carry out a program of standardization. The first subjects to be considered will be spark plugs, roller bearings, storage batteries and tires.

Business Notes

TRUSCON STEEL CO., Youngstown, Ohio, announces that F. H. Maloney was appointed Feb. 15 general agent for its railroad department, covering the southwest territory, with headquarters at St. Louis.

GIBB INSTRUMENT CO., Bay City, Mich., manufacturer of electric welding equipment, has opened a sales office in the General Motors Building, Detroit, in charge of F. M. Luchs, formerly chief engineer for the company.

EASTERN FOUNDRY CO., Boyertown, Pa., has recently been organized for the manufacture of cast-iron soil pipe, fittings and plumbing specialties. For its personnel the new organization has drawn largely upon the Sanitary Co. of America, the controlling interest in which has been disposed of by E. M. Rhoads who heads the new organization with the title of president and treasurer. The other officers of the Eastern Foundry Co., all former members of the Sanitary Co., are B. W. Frederick, vice-president; Grant P. Bechtel, secretary; Daniel G. Burkert, purchasing agent; and Harry R. Trout, general superintendent.

A. E. ENSTELL, formerly with the Equipment Corporation of America, has established a business of his own at 1628 Market St., Philadelphia, for the purchase, sale or rental of new and used contractors equipment.

MORRISON & RISMAN CO., INC., Buffalo, N. Y., manufacturers and jobbers in railway track equipment, has been incorporated, with a capital of $500,000 fully paid in. The officers of the company are: S. Morrison, president; S. Risman, vice-president; R. L. Morrison, treasurer; and S. H. Risman, secretary. The company maintains general offices in Buffalo, N. Y., district sales office in Philadelphia, and has works and warehouses in East Buffalo, N. Y., and Lebanon, Pa.

DODGE SALES & ENGINEERING CO., Mishawaka, Ind., which for the past eight years has been operating as the selling subsidiary of the Dodge Manufacturing Co. and the Dodge Steel Pulley Corp., has been consolidated with the parent company, the Dodge Manufacturing Corp., organized last July. The distribution of Dodge products, including power transmission appliances and heavy oil engines, will be conducted by the sales department of the Dodge corporation, with Duncan J. Campbell, general sales manager in charge, and John A. Beynon, assistant general sales manager. Activities of the advertising department, under the direction of William W. French, include a complete program of dealer co-operation.

DETROIT STEEL PRODUCTS CO. has opened a branch office, in charge of C. W. Moon, at 22 North 5th St., Reading, Pa., to better serve the architects and engineers in central Pennsylvania. Mr. Moon has been connected with the company for seven years as sales engineer.

Equipment and Materials

Portable Compressor Designed for Road Building and Other Uses

For breaking pavements with air-operated drills and for other uses, such as erection of structural steel and work incidental to trenching and pipe-laying,

the Buhl Co., Chicago, has developed a portable compressor weighing 2,700 lb. and having a capacity of 80 cu. ft. of free air per minute. It is mounted on a four-wheel steel-channel frame, is driven by a 16-hp. gasoline engine, and has overall dimensions as follows: Width, 66 in., length, 105 in., and height, 70 in.

The air receiver, mounted on the front of the truck, is a cylinder 24 in. in diameter and 42 in. high. Cooling of the gas engine and compressor water is accomplished by a radiator and a belt-driven fan. One of the features of this outfit emphasized by its manufacturers is the use of mechanical four-speed oilers which pump fresh oil to all main and connecting-rod bearings and to cylinders. The governor is of the positive gear-driven, built-in type, and the compressor unloader is positive in its operation.

Variable Weight Grab Bucket for Rehandling and Excavating

Designed for both rehandling and excavation, the new Universal grab bucket (Type W) designed by the Mead-Morrison Manufacturing Co.,

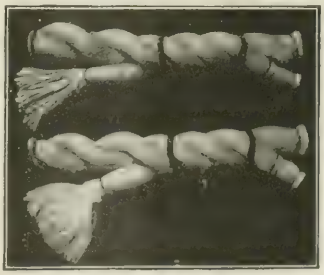
Boston, in sizes ranging from ½ to 2 cu. yd. has a variety of uses. To secure the maximum bite at closing the hinge-shaft and the pivot point of the yokes and links are off center. This feature, the manufacturers claim, increases the closing leverage, so that the bucket does not lift but stays where it drops and digs down.

For different services the bucket is equipped with removable counterweights on the lever arm, while the purchase at the sheaves may be changed at will to either 2, 3, 4 or 5-part arrangement, according to the job at hand. Experience shows that the bucket rehandles best with two or three-purchase reeving and no weight, while excavating takes four or five-purchase reeving with two-thirds of the weights in place.

Another feature of the design allows the shell to be renewed in the field. The usual arrangement of hinges and stiffener is modified so that they are connected to form a framework to which the shells are bolted and may be disconnected without disconnecting any other part of the grab. For excavating in hard pack material removable cast-steel teeth may be bolted to the cutting edges.

Make Stronger Rope By Replacing Inner Yarns with Fibre Core

By a new form of Manila rope structure, increased strength and durability are secured in the larger sizes—above 1 in. diameter. The new rope, a product of the Whitlock Cordage Co., New York City, differs from other types in that the inside yarns have been replaced by a core of unspun hemp, protected by a sheath of outside yarns. This new-process rope has been given the name Fibore. It is the invention of Herbert V. Whitlock and is covered by basic patents.



CORE OF UNSPUN HEMP (BELOW) REPLACES TWISTED YARNS (TOP)

In the ordinary type of rope (excepting the smaller sizes) the strands are made up of layers of yarns twisted around one another. When rope of this sort is subjected to tensional stress the yarns do not pull as a unit, but rupture successively, layer by layer, beginning with the inner yarns. These center yarns, forming a helix of the same pitch but of smaller diameter than the outer yarns, have a shorter length and are therefore first stressed to this limit of strength.

With the Fibore rope, however, the forces act differently, all of the straight inside fibres composing the core being subjected to a uniform pull. This type of rope structure, it is claimed, adds from 10 to [illegible] per cent to the strength of the rope and increases durability, inasmuch as all friction occurs between fibres essentially parallel to each other and not between yarn rubbed against yarn. Other advantages mentioned by the manufacturer are easier handling due to great flexibility, less permanent stretch and greater elasticity. Splicing is accomplished in practically the same way as when using ordinary rope. In making "tapered" splices, or long transmission splices, division of the fibre core is made in the same manner as when separating the usual center yarns.

Publications from the Construction Industry

Cement Prices and Profits—CEMENT INFORMATION SERVICE, New York City, has published a 15-page pamphlet entitled "Concerning Cement." The material is an answer, from the cement manufacturer's point of view, to charges which, according to the foreword, are unfounded and have affected the relations between the cement industry and the public. The subject matter includes prices, profits, competition, production, and construction cost.

Leaning Wheel Graders—J. D. ADAMS & Co., Indianapolis, in a 56-page illustrated booklet sets forth the application of its leaning-wheel graders to road construction. A back-sloper attachment may be employed on the graders for cutting ditches. The leaning-wheel feature balances the weight of the machine against the side load of earth on the blade, the angle of inclination of the wheels being adjustable. The booklet describes in detail the construction and adjustment of these graders, which are made in a number of sizes, the largest being the Road King No. 12, with a 12-ft. blade for tractors of 25 drawbar horse-power or more. The illustrations are well selected and show the application of the graders and back-sloper attachment to a wide variety of work. Other types of equipment, including scarifier attachment, road maintainers or drags, scrapers, plows, and wheeled scrapers are described.

River Bank Protection — Woods Bros. Construction Co., Lincoln, Neb., has published a 32-p. illustrated booklet on the practical application, by means of standard current retards, of the principle of sedimentation to the replacement, protection and conservation of river banks subjected to erosion, wash or cutting. The methods described involve the use of the Bignell pile as a permanent submerged anchorage for the retards. These piles are reinforced-concrete columns 14 in. square and 20 ft. long with a 4-in. pipe running through the center to which, at intervals, are connected small pipe jets with upturned ends. Water at from 150 to 200 lb. per square inch pressure is forced through the central pipe openings and the side jets to sink the pile. The retards consist of mats of trees larger than 8 in. in diameter at the butt that are anchored by cables to the piles. The booklet describes the process of construction in detail, while sketches and photographs illustrate the sequence of operations. There is also a section describing the action caused by the completed retards. This system of river bank protection, it is claimed, has been responsible for saving large areas of valuable farm land.

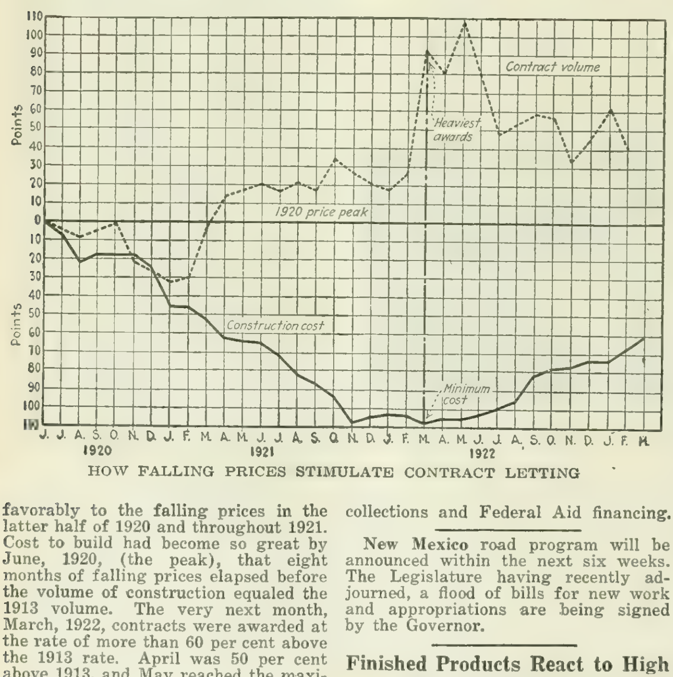
Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Reasonable Prices Will Make 1923 a Banner Year

Falling Prices of 1921 Produced Heavy Construction of 1922—Cost Is Higher Than 1921 Average

Decline from the record prices of 1920 began in November of that year, and proceeded steadily until December, 1921. The cost curve then remained fairly flat for the next six months, the long upward swing (which still continues) starting with June, 1922. The rise is 43 points.



HOW FALLING PRICES STIMULATE CONTRACT LETTING

Construction volume reacted very favorably to the falling prices in the latter half of 1920 and throughout 1921. Cost to build had become so great by June, 1920, (the peak), that eight months of falling prices elapsed before the volume of construction equaled the 1913 volume. The very next month, March, 1922, contracts were awarded at the rate of more than 60 per cent above the 1913 rate. April was 50 per cent above 1913, and May reached the maximum of 79 per cent.

With this prospective record demand, began the cost rise which now is viewed with gravity by far-seeing men in the industry.

The *E. N.-R* Cost Index averaged 201.78 for 1921, when the Volume Index was only 88. The Cost Index is now 205.25. True, contract volume holds above the pre-war rate, and March promises to be a record month. Somewhere, however, there is a breaking-point, where the volume curve will bend downward and remain low for a long while despite possible thirteenth-hour efforts to stimulate business.

At present, demand is good, and 1923 may boom along despite the increasing cost pressure. With reasonable cost a banner year is certain.

State Road Programs

Illinois will enter the 1923 construction season with approximately 800 miles of pavement under contract. The state expects to let contracts for at least 200 miles of additional pavement, and plans are also under way to complete at least 1,000 miles of standard 18-ft. pavement during the season of 1923. Ample funds have been, or will be appropriated by the State Legislature now in session, to take care of this program; the funds coming from the $60,000,000 Bond Issue passed in 1918, also from current motor vehicle fee collections and Federal Aid financing.

New Mexico road program will be announced within the next six weeks. The Legislature having recently adjourned, a flood of bills for new work and appropriations are being signed by the Governor.

Finished Products React to High Raw Materials Prices

The National Industrial Conference Board in its weekly survey of industrial and trade conditions throughout the country issues the following:

Conditions in industry and trade are generally accepted as sound and business is active. A reflection of this improvement is evidenced by the fact that in some commodity lines the problem is not one of closing new contracts, but rather of meeting all demands and making prompt deliveries.

Prices of many raw materials, like steel, pig iron, copper, cotton and silk have been on the increase. Finished commodities are now beginning to react to these higher prices in the commodity market. Many steel mills report a shortage of common labor, which causes considerable concern in view of the spring exodus of those who favor outdoor employment. This gives weight to reports that a wage advance will be made in this industry before long.

Delay Federal Construction, Hoover Advises President

Industry Now Taxed to Full Capacity by Private Demands—Government Should Not Compete

In connection with the foregoing estimate of the situation, Secretary of Commerce Hoover's advice to the President to hold government construction in abeyance, at least for several months, on the ground that private work will tax the full capacity of the construction industry, is apropos. Mr. Hoover's letter, in part, is as follows:

"1. The year 1922 was a year of very large employment and activity in the construction trades and at the end of the year stocks of construction materials were very much reduced. Since the beginning of the present year there has been even more activity than in the same period last year and the contracts let in the past few months are of larger volume than any hitherto entered into in a similar period. Advance orders for construction materials are upon a very large scale.

"2. Labor in the construction trades and in the manufacture of material is not only at full employment but there is actually a shortage in many directions.

"3. Transportation facilities available for the building materials are fully loaded and almost constant car shortages are complained of with consequent interruption in production.

"My conclusion from all this is that, at least for the next several months, the trades will be fully occupied in private construction, all of which is generally needed by the country.

"For the Government to enter into competition at the present moment will give no additional employment to labor and no additional production of materials but must in the broad sense in the end displace that much private construction. The governments, nationally and locally, are in a much better position to hold construction work in abeyance than are private concerns, and are in better position to speed up in times of less demand as we did in the last depression as the result of the Unemployment Conference. We can by this means contribute something to a more even flow of employment not only directly in construction work but in the material trades.

"I would recommend, therefore, that you direct the different divisions of the Government to initiate no new work that is not eminently necessary to carry on the immediate functions of the Government and that there should be a slowing down of work in progress so much as comports with real economy in construction, until after there is a relaxation in private demands."

Recent Unit Bids On Large Contracts

Reservoir—Wellsville, Ohio

Bids were opened by Dept. Pub. Serv., Feb. 14, for constructing earthen reservoir, (A) A. W. Hinaman, Canton, Pa.; (B) Allison-Harris Co., West Liverpool; (C) Ambursen Constr. Co., Grand Central Terminal, New York City. The unit bids were as follows:

	A	B	C
Reservoir and dam complete of concrete construction (lump sum)	....	....	$134,800
26 acres clearing reservoir and dam site	50.00	80.00	100.00
12,965 cu.yd. earth excavation at dam site	.70	.90	2.00
161 cu.yd. rock excavation at dam site	2.00	2.00	6.00
60,000 cu.yd. earth excavation at Borrow Pit	.70	.70	......
2 acres seeding embankment	25.00	260.00	......
100 sq.yd. sodding embankment	.25	.33	......
6,285 sq.yd. rip-rapping (dry)	2.00	2.75	......
1,195 cu.yd. rip-rapping (grouted)	2.50	3.25	......
100 cu.yd. clay puddle	1.00	3.00	......
355 cu.yd. rubble masonry	15.00	10.00	......
1,270 cu.yd. concrete (1-3-6)	20.00	17.00	22.00
10 cu.yd. concrete (1-2-4)	21.00	20.00	24.00
26,446 lb. steel reinforcement	.06	.05	.06
.54 squares triangle mesh reinforcement	2.25	10.00	......
1 gate house, complete, (lump sum)	5,980.00	6,635.00	......
1 gate house operating equipment (lump sum)	100.00	......	2,500.00
.37 ton cast iron screens	......	......	......
2.32 ton special c.i. lugged pipe	......	......	......
22 ton 3-spans foot bridge	......	......	......
1,000 cu.yd. road grading	1.00	.50	.75
500 cu.yd. crushed stone	4.00	2.50	6.00
Possible extras:			
Common labor, 200 hrs	.50	.55	.65
Skilled labor, 100 hrs	1.00	1.10	1.00
Team labor, 100 hrs	1.00	1.00	1.25
Extended totals	$114,083	$117,214	$141,505

Filtration Plant—Baltimore, Md.

Bids were opened by Bd. Awards, March 7, for addition to Montibello filtration plant, (A) Carozza-Rowe Contg. Co., 624 North Gilmore St.; (B) Consolidated Eng. Co., Calvert Bldg.; (C) Sanford & Brooks, Commerce and Water Sts. The unit bids were as follows:

	A	B	C
Clearing and grubbing (lump sum)	$15,000.00	$1,450.00	$2,000.00
365,000 cu.yd. excavation	.65	.74	.90
74,000 cu.yd. rolled embankment	.15	.14	.295
270 cu.yd. class A concrete	50.00	46.30	41.50
30,800 cu.yd. class B concrete	18.30	19.50	20.10
14,600 cu.yd. class C concrete	12.05	11.50	1.160
3,760,000 lb. steel reinforcement	.05	.0525	.052
50,000 lb. expansion plates	.045	.15	.08
15,000 lb. miscellaneous steel work	.06	.18	.16
30,000 lb. iron castings	.06	.10	.13
5,800 ft. pipe railings	1.50	1 90	1.70
165 ton laying B&S pipe	25 00	18 00	54.50
110 ton laying B&S specials	25.00	20.50	63.00
350 ton laying flanged specials and valves	35.00	27.60	44.00
190 ton setting sluice gates	35 00	25 00	52.00
6 hatchways	150 00	165.00	200.00
4,000 duct. ft. fibre conduit	10	.26	.26
600 ft. t.c. drains	.50	.55	.50
1,620 ft sheet metal piping	.50	1 40	1.40
Crys. vat. foundations (lump sum)	2,000.00	1,000.00	800.00
Tar roofing (lump sum)	700 00	400.00	350.00
Extended totals	$1,248,955	$1,310,194	$1,414,816

Paving—Salina, Kan.

Following are lowest three bids opened by city, March 7, for paving, curbing and guttering various streets, (A) M. R. Ammerman, 248 North Market St., Wichita, (awarded contract for brick pavement, alternate No. 2); (B) Cook & Ransome, Ottawa; (C) Tibbets & Pleasant, Tulsa, Okla. The unit bids were as follows:

	A	B	C
24,000 cu.yd. excavation and grading	$0.70	$0.70	$0.75
5,000 cu.yd. concrete curbing alternate No. 1	.40	.75	.67
5,000 cu.yd. concrete curbing, alternate No. 2	.40	.65	.52
35,000 cu.yd. combined curb and gutter, alternate No. 1	.80	.90	.92
35,000 cu.yd. combined curb and gutter, alternate No. 2	.80	.80	.77
80,000 cu.yd. brick paving, alternate No. 1	....	3.29	3.28
80,000 cu.yd. brick paving, alternate No. 2	3.18	3.19	3.22
80,000 cu.yd. asphaltic concrete pavement, alternate No. 1	....	......	2.98
80,000 cu.yd. asphaltic concrete pavement, alternate No. 2	2.30	....	3.90
80,000 cu.yd. reinforced concrete pavement, alternate No. 1	2.28	2.60	....
Concrete header at end of pavement	.40	.50	....
Cubic yards extra concrete	10.00	20.00	....
Sq.ft. new concrete walks 4-in.	15.00	.18	....
Sq.ft. concrete walk taken up and relaid	.14	.10	....
Sq.ft. brick walk taken up and relaid	.10	.10	....
Sq.yd. old brick pavement relaid with asphalt filler	.10	.10	....
Cu.yd. extra broken stone or gravel	3.25	5.00	....
Cu.yd. extra sand	3.00	2.25	....
Extended totals brick, paving	$301,200	$303,250	$305,150
Extended totals asphaltic concrete paving	$231,200		$279,550
Extended totals reinforced concrete paving	$229,200	$256,050	

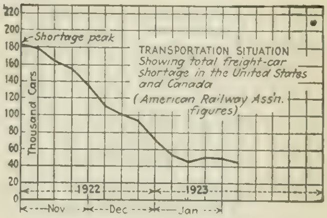
All totals on Alternate No. 2.

Gain in Car Loadings Due to Coal and Merchandise

All Seasonal Records Broken—Heaviest Since Dec. 9—Increase in Demand —Fewer Bad Order Cars

With freight loadings totaling 917,896 cars for the week ending March 3, freight traffic continues to break all previous records for this season of the year, according to the American Railway Association.

The total for the week was an increase of 124,781 cars over the corresponding week last year, and 206,529 cars in excess of the corresponding period in 1921. It also exceeds by a considerable margin the same weeks in 1918, 1919 and 1920.



CAR SHORTAGE SINCE PEAK

The increase of 87,673 cars over the week ending Feb. 24 was largely due to heavier shipments of coal and merchandise and miscellaneous freight, which includes manufactured products.

Loadings for the week of March 3 were the heaviest of any week since Dec. 9, 1922, and indicate a stimulation in business unprecedented for this time of the year.

NUMBER OF CARS LOADED WITH REVENUE FREIGHT

Week Ended	1923	1922	1921
Mar. 3	917,896	793,115	711,367
Feb. 24	830,223	728,925	659,642
Feb. 17	817,778	773,275	692,007
Feb. 10	853,289	777,791	687,867
Feb. 3	365,675	747,895	699,718
Jan. 27	871,164	740,386	701,605
Jan. 20	865,578	731,109	708,658

Demand for freight cars in excess of the current supply amounted to 80,633 cars, Feb. 28, an increase of 3,783 since Feb. 23.

Fewer freight cars were in need of repairs on Feb. 15 than at any time during the last two years. On that date, 206,585 or 9.1 per cent of cars on all lines were in bad order. This represents a decrease since Feb. 1 of 2,886.

Locomotives in need of repairs, Feb. 15, totaled 15,581, an increase, due to bad weather conditions, of 169 over the total of Feb. 1. This represented 24.1 per cent of locomotives on all lines.

New freight cars of all descriptions on order Feb. 15, totaled 97,932, an increase of 29,600 over the number on order Jan. 1, 1923.

Last Week's Contracts About the Same as Year Ago

Last week's Construction News section was the heaviest on record. Its nineteen pages carried 856 tips to construction men. The principal increase was in proposed work which had not yet reached the contract-awarded stage.

The value of contracts for the week of March 15 was $37,226,000, against $38,000,000 for the same week last year and $23,000,000 for the corresponding period in 1921. The average weekly value for March, 1920, was $37,000,000 the same as last week.

Of the $37,226,000 awarded during the week, $17,138,000 was for public improvements and $20,088,000 for private projects. Building awards, above a minimum value of $150,000 and amounting to [illegible] for the week, were divided as follows: $16,237,000 for private and $1,980,000 for public buildings. Canadian lettings reached a total value of $4,630,000 as against $4,805,000 for the Southern and $4,823,000 for the Western sections of the United States.

Structural Steel Sales Increase

A further increase in sales of fabricated structural steel is reported for February by the Department of Commerce through the Bureau of the Census. Sales amounted to 80 per cent of shop capacity as against 76 per cent for January. Total sales reported for February by 151 firms, with a shop capacity of 219,955 tons per month, amounted to 176,787 tons, the highest since last May.

Tonnage booked each month by 164 identical firms, with a capacity of 223,355 tons per month, is shown in the accompanying table, pro-rated to a capacity of 250,000 tons per month, together with the per cent of shop capacity represented by these bookings.

FABRICATED STRUCTURAL STEEL SALES

	Actual Tonnage Booked	Per Cent of Capacity	Estimated Total Booking
1922			
April	197,796	89	222,500
May	181,503	81	202,500
June	162,876	73	182,500
July	153,903	69	172,500
August	152,253	68	170,000
September	143,566	64	160,000
October	128,315	58	145,000
November	108,593	49	122,500
December	130,082	58	145,000
1923			
January	168,336*	76	190,000
February	176,787**	80	200,000

*Reported by 161 firms with a capacity of 222,605 tons. **Reported by 151 firms with a capacity of 219,955 tons.

Building tips in Construction News last week totaled 270, and 55 were for buildings to cost $500,000 and over. These latter aggregated $50,000,000, in the following stages: 38 proposed building jobs, to cost $38,000,000; 9 bids-desired, $6,150,000; 2 bids-received, over $2,000,000; 6 contracts awarded, $4,000,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of March 1; the next, on April 5.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.44	$3.95	$4.50	$3.20	$3.45	$3.95	$3.45	+$4.00	$3.75
Structural rivets, 100 lb	4.00	4.60	5.25	3.75	4.00	5.15	4.75	+4.50	5.50
Reinforcing bars, ¾ in. up, 100 lb	3.34	3.85	3.15	3.10	3.35	+3.97½	3.30	+4.00	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	51%	53%	45%	59½%	55-5%	38%	38.2@46.5%	45%	32.76
Cast-iron pipe, 6 in. and over, ton	+57.20	52.50	57.00	+55.20	60.50	65.00	57.00	58.00	55.00
Concreting Material:									
Cement without bags, bbl	2.70@2.80	2.90	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd	1.00	1.24	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd	1.75	2.00	2.50	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	63.00	38.00	53.00	60.50	44.75	51.00	39.00	+30.00	95.00
Lime, finishing, hydrated, ton	16.80@17.10	23.00	22.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	3.00@3.25	1.95	2.50	1.50	1.25	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	13.00	+11.60	11.00	17@19	12.00	15.50	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.0859	.115	....	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1314	.0859	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal	+1.04	—1.05	1.16	1.12	+1.16	1.25	1.09	.86	1.17
Common Labor:									
Common labor, union, hour	.60	.35	.30@.50	......	....	.50@.55	.56¼	....	......
Common labor, non-union, hour	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.50	.30@.70	.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine casing. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.77). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Consequent to recent advances in coke, iron and steel scrap and pig-iron prices, structural shapes are now quoted at a minimum of $2.35 per 100 lb., Pittsburgh mill, with $2.50 applying on specified deliveries. Plates are also at a minimum of $2.35, with offers of $2.50@$2.60 to secure deliveries in thirty to sixty days. Bar mills are completely sold up for the next quarter. A minimum of $2.35, however, is quoted on large tonnages, with small lots for quick shipment not under $2.50 per 100 lb.

Reinforcing bars quoted in Denver warehouses at $3.97½ as against $3.62½ per 100 lb.; in Seattle, $4, advanced from $3.80. Seattle also reports advances of 20c. on steel shapes and 25c. per 100 lb. on structural rivets.

Bessemer pig iron up 23c., basic, 50c. and No. 2 foundry, $1.50 per ton at Pittsburgh. Following pig-iron rise, cast-iron pipe, 6-in., advanced to $57.20, from $56.50 per ton, in New York; Chicago quotes $55.20, compared with $54.20 per ton, one week ago.

Lime, brick and concreting materials, generally, show marked price stability in the current market. Brick, however, advanced 60c. per M in Dallas.

Lumber mills, particularly yellow pine, are sold up for some weeks ahead; price levels remaining fairly firm. Seattle, however, reports a rise in Douglas fir, to $30, as compared with $29 per M ft. b.m., last week. The inadequate car supply in the Southeastern lumber districts is reported to be growing in seriousness.

Raw linseed oil, in 5 bbl. lots, advanced to $1.04, f.o.b. New York, as against $1.02; in Minneapolis, $1.16, compared with $1.13 per gal. Atlanta reports a decrease to $1.05, from $1.07 per gal., one week ago.

A Consolidation of Engineering News and Engineering Record
McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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Educating the Highway Amateur

SEARCH for the universally supreme type of road is persistent. Last week at Harrisburg, Pa., at the conference of highway officials called by Governor Pinchot, evidence of the quest appeared repeatedly in the questions raised for answer. It is difficult for the heads of government not trained as engineers to avoid the notion that there is somewhere to be found a universally best road and that it will be disclosed if road officials will go into conference and talk enough about the subject. At the Harrisburg conference it proved easy as usual to raise a dispute between partisans of different types of roads and as usual this dispute arrived nowhere. The useful effort of the conference was the determination with which the engineer delegates drove home the truth that the selection of road type and its design are widely different problems in different sections of the country and that knowledge of traffic and its probable trend is essential to intelligent selection and design. There is no universally best road surface any more than there is a best type of bridge or a best size of shoes. If this fact can be established in the minds of public officials it will pay to hold many conferences like that called by the Governor of Pennsylvania even though they develop no thought with which the road expert is not familiar.

To Safeguard Municipal Bonds

IN 1922 the American people invested a billion and a quarter dollars in municipal and state bonds. This is a tremendous business and one closely related to that common bugbear of all of us, taxes. And yet it is a business controlled for the most part by inexpert men, the results of whose mismanagement are concealed in the maze of governmental accounting. The common assumption is that a city or a state cannot go bankrupt, that the issuance of obligations is so safeguarded by laws that there will always be ample security for all legal debt. The facts are that the rising cost of government and the multiplication of governmental units overlapping the same community assets have made repudiation a growing possibility. A few such possibilities, not specified by location, are indicated in a report just issued by the Institute of Public Service, of New York City. Gaylord C. Cummin, an engineer of long experience in municipal finance, has been looking into the books of some of our cities and counties and he finds some alarming facts. Many municipal issues are not legally valid, many can never be paid off under present practices, some bad faith has been revealed and mismanagement and confusion of accounts is general. Much of this abuse is unintentional; it is due to the ignorance of the office holder appointed or elected to a job which requires experience and financial knowledge. Only a little of it is due to corruption. But as long as the public will buy the condition will continue. It is proposed, therefore, to organize a so-called Municipal Bond Service, for the benefit of the buyer, a service which by publicity will try to educate both the buyer and the seller of governmental bonds to the dangers in unwise financing. So far the idea is embryonic, but the facts are authentic and the future is threatening. The proposal for reform is most commendable.

Why Not a Smaller Cement Sack

NO LITTLE part of the current high price of cement is due to the expense of the cloth sack. The material from which these sacks are made has been constantly rising in price until now each new sack costs the cement manufacturer approximately twice as much as he charges for it. Part of this is paid by the customer, a part is absorbed by the re-use of such bags as are returned and rebated for but a great deal is lost because of the loss of bags after one use and because of the cost of renovation. Obviously, a paper bag strong enough to stand transportation and thrown away after one use would mean a saving to both maker and user. Paper strong enough for the purpose is available but the main factor against its use is the apparent fact that the user demands his cement in quarter-barrel, that is 1 cu.ft., sizes and paper sacks of that size will not stand the necessary wear and tear. Fifty-pound, or approximately $\frac{1}{2}$ cu.ft., paper sacks on the contrary seem to stand up under any normal service but the cement companies are reluctant to attempt them because of the impression among engineers and contractors that the present standard sack is so convenient as a unit of measure. Is this a fact? Is there inherently more difficulty in measuring with the more easily handled and cheaper $\frac{1}{2}$ cu.ft. paper sack than with the standard 1 cu.ft. cloth sack? The cement manufacturers would like to know.

A First Step Which Should Count

SLOWLY but surely the idea is taking hold that transportation today is a unit problem, not to be separated into its hitherto antagonistic highway, waterway and railway elements. The unprejudiced student, not hampered by allegiance to any one of the three services, has long recognized the necessity for some better co-ordination, some superior means which would assign to each its economic field and would interlace the three to the greater good of each and of the people who pay the bills. History and practice and prejudice all have worked against any such co-ordination, but now the drive of economic events is forcing even the proponents of each to admit its necessity. Given a necessity and enough people who recognize that necessity, a consequent solution is only a matter of time. That is why the coming meeting of the Chamber of Commerce of the United States, at which the co-ordination of transportation is the major subject, is a hopeful sign. Such conferences as this can effect little direct action, but by bringing together the best minds in many complementary fields there can result a statement of the problem which is the first requirement for its solution. The railways today are more willing than ever before to admit the place of the motor truck in the short haul and distribution field; the motor truck interests are just about ready to concede their inability to make money in the long hauls; the sane waterway advocates may doubtless be persuaded to throw overboard the lunatic fringe who see in the canal and river the cure of all our economic ills. When all of them sit around the same table some useful compromise should emerge.

Floor Load Data

OPPORTUNITY is given by the floor load measurements in the Equitable Building, reported in this issue, to bring together much-needed data on the floor loads which occur in different classes of building occupancies. There are few figures on record concerning such loads. Building laws prescribe loads for design, which loads vary picturesquely from city to city; and for the rest, a very rough sort of guessing is depended upon by designers. There is a fair justification for this process of guessing, since floors must be made strong enough to carry not only the particular loads of this or that tenant but any load that may chance to occur in the varied conditions of a long period, under changing occupancy. Occasional heavy concentrated loads are as likely to endanger a floor as excessive distributed loading. The necessary basis for all sound judgment of proper design loading is a large and comprehensive collection of data on actually existing floor loads. The Equitable Building weighings constitute an excellent beginning toward such a compilation. If engineers, architects, and industrial men in different fields will contribute each a little item of data from his own observation, a collection of load figures may be obtained that will have commanding importance in fixing a sound and economical basis for building design. These contributions will be of additional value if they include observations on load concentrations that may be expected in normal use, though the fundamental importance will lie in the figures on actual loads of regular occurrence, and on their grouping. How important the latter will be is plainly enough indicated in the sample sketches accompanying the Equitable data, which show very clearly that in most cases the larger part of the loading comes upon one or two of the floor members and that the required floor strength is quite different from that indicated by the average square foot figures. When such data are obtained from many different kinds of buildings—not merely office buildings—we will be a step nearer the ideal of efficiency and economy in building design.

Publicity for Public Works

FIFTY thousand dollars for a publicity campaign of engineering facts! That is what the Sanitary District of Chicago has appropriated to broadcast facts relating to its reason for being and its side of the water diversion controversy with the federal government. Just how much water does Chicago need to divert from Lake Michigan and the Great Lakes system to protect its water supply and maintain its remarkably low typhoid death rate? Perhaps a better way of putting the question would be to ask just how much should be allotted to Chicago. As the question now stands most people in Chicago, if they know anything at all about the controversy, see mainly the health side of it with water power decidedly as a side issue, while most people outside of Chicago, if they know or care anything about the case, see principally the fact that Chicago persists in making an illegal and disproportionately large diversion of water from the Great Lakes. The average individual soon is lost in the maze of lowered lake levels, early gentlemen's agreements in Congress, Illinois Valley protests, huge costs for sewage treatment, dilution factors, states rights, prehistoric outlets and actual present-day diversions, an intricate conglomeration of law and engineering, romance and sanitary science. Surely $50,000 is small enough for an advertising appropriation for this $75,000,000 going concern whose main business is to maintain the health of 3,000,000 people.

The 1922 Typhoid Honor Roll

SANITARY engineers, public health officers, and all others who have contributed in any way to the rapid decline of typhoid fever in the United States during recent years are to be congratulated on the remarkable showing for the year 1922 just made available through the prompt annual survey of typhoid fever in cities of 100,000 and over now made for the eleventh time by the *Journal* of the American Medical Association. Eighteen cities, as compared with the previous high record of ten, are on the 1922 typhoid honor roll, as having a typhoid death rate of two or less per 100,000. Three of these eighteen cities reported no deaths whatever from typhoid and seven cities had a typhoid death rate of from 1 to 0. All but five of the entire sixty-nine cities had typhoid death rates of less than ten. The highest in the list were Trenton with 15.9 and Nashville with 16.2, both well under the 20 per 100,000, which for many years was considered a creditably low rate.

The mass figures for the fifty-seven cities for which figures going back to 1910 are available show a decline in the typhoid death rate from 19.52 to 3.15 per 100,000, while the total deaths dropped from 4,114 to 851, although from 1910 to 1922 the total population under consideration increased from 21 to 27 millions. This is an actual saving of 3,263 persons from death by typhoid in 1922 as compared with 1910. A far larger saving would be shown by computing the typhoid deaths year by year at the 1910 rate.

The 1922 record for the sixty-nine cities is most gratifying, full of uncertainties as to the causes of some of the highly divergent rates as it certainly is. For instance, although the *Journal* comments on the probable causes of the typhoid rank held by some of the cities, it does not attempt anything of the sort for Trenton, which, it is only fair to that city to state, had a 1921 rate and also an average for the five years 1916-20 far below the figure for 1922. Trenton uses filtered Delaware River water and there is no apparent reason why, so far as the public water supply is concerned, its typhoid rate should not be as low as Paterson's, which also has a filtered water (from the Passaic), but Paterson had a typhoid death rate in 1922 of only 2.1 as compared with Trenton's 15.9. Jersey City and Newark in the same state, both with unfiltered supplies from upland sources, had a 1922 death rate of 1.6 and 2.7 respectively. Why Trenton makes so poor a showing is a proper subject for investigation.

More College-Bred Engineers for the Railways

ENGINEERING personnel problems on the railways have become sufficiently acute for the higher officials to take cognizance of them. Studies have disclosed that college men are not going into the service of the railways; in fact, investigators find that only about 5 per cent of the engineering graduates seek railway employment. This is far different from the old days of extensive construction when civil engineering and railway engineering were practically synonymous, and the young engineer drifted naturally into railway work.

Those who have the interests of the railways at heart recognize that the problems of the railway today cannot be met satisfactorily by the man whose greatest asset is his energy and physical strength, his ability to drive things through to a physical conclusion. Officials with a wider appreciation of the economic aspects are now needed, and they can be secured best from among men of technical training, rather than from those who come up through the ranks as foremen, roadmasters and telegraph operators. The problem now is one of operation, of improvement and increased facilities and of efficient maintenance of equipment and roadbed. It is a transportation question which involves economics, and deals more intimately with the complications of a highly specialized civilization than with the lines and grades, mules and mess camp of a construction job. Engineers, but of a different type, are needed just as much as in the old construction days.

Unquestionably it was the appreciation of the shortage and need of college men in railway work which led to the appointment by the American Railway Engineering Association of its recently announced committee on education. So far, apparently, the A. R. E. A. committee has concerned itself mostly in suggesting to the colleges methods whereby they may improve the teaching of transportation. But the difficulty now is not so much in presenting better collegiate material to the railways nor even in persuading the railways that they need the college trained engineer. What must be done is to persuade the young engineer that he has a future in the railway.

While one of the objects of the committee will be to let the colleges know the kind of teaching needed, the education on the part of the Association must extend to the railways themselves. It will be their great obligation to take care of the student when he is ready to enter the railway's employ. Probably this point of overcoming the reluctance of the roads to encourage and develop its technical recruit, once he is in the service, is the greatest service the committee can render.

Assurance that railway technical employees have equal opportunity with those outside will go a long way toward recruiting more of them. Officials must recognize that if these men are to be loyal to them, they themselves must be loyal to the trained employee, whose attainments must be recognized by reasonably adequate compensation and by advancement. Some of the traditions that stand in the way of promotion can undoubtedly be done away with sufficiently to enable the individuals in the engineering staff to progress toward the top in at least as favorable a manner as the untutored maintenance-of-way man or telegraph operator. The railways have a reputation of being a poor place to work, a place where many of the desirable, modern factors are lacking. Few engineers at present would recommend that their own sons seek railway employment.

When the committee's work has been assimilated by the officials on the roads, the collegiate problem of producing men to fill these positions of promise will probably be found to have solved itself.

Land Dredges for Southern Drainage Work

IT seems a fair conclusion from the records given in the article on drainage ditching in Mississippi that walking-dredge service in southern overflow and marsh lands is a question of weather and land conditions. Where these are favorable, or even where they are not notably bad, the land excavator has an economic place in drainage ditching which cannot be overlooked. Certainly it should not be put out of consideration because delta-land ditching practice in the past has not given it recognition.

Briefly the situation which confronts drainage engineers is this. Excavation by floating dipper dredges is so much less expensive that it is cheaper to dig a ditch large enough to give the dredge passage than to reduce the yardage by digging a smaller ditch requiring the use of other equipment. Engineers, therefore, have designed drainage ditch systems for construction by floating dredges. This has resulted in the upper reaches of ditch being larger than need be to satisfy the requirements of hydraulic design. In brief, unsymmetrical ditch systems have commonly been designed and built to meet the requirements of a construction method.

Again, with floating dredges, ditches have generally had to be excavated from outlet to source and, as a navigable channel is at all times a requisite of construction, it has also been necessary to joint up adjacent ditches by connecting channels not required except to shift the dredge from one unit of the system to another.

A method of avoiding these objections by using a combination outfit of floating dredges and land dredges of the "walking" type is suggested in the article referred to. This article makes out an excellent case for the walking dredge as a companion to the floating dredge in drainage ditching. Its case will be improved when full advantage of its possibilities is taken in designing ditch systems. For example, the common custom of paying for a minimum size of ditch based on floating dredge requirements instead of for the actual size, however small, of ditch dug is a case for remedy.

All things, however, are not favorable to the walking dredge. It has been developed mostly in northern drainage work and particularly in Minnesota and northern Wisconsin. In these fields the conditions are generally more favorable than in the delta lands of the south for a heavy land-traveling machine. The swamp land and muskeg of the north are fairly substantial ground in the dry summer season and in winter the soil, though soaked, is stiffened by frost. Some of the slough lands of the delta region are seldom dry for any considerable period and when wet are impassable for any heavy land-traveling machine. As indicated in the article, the chief causes of delay in walking-dredge work were slipping off wet banks into the ditch and miring in the "dry" bayous. Weather and land conditions are the factors controlling success.

Flat-Slab Designs for Two Railway Elevated Stations

Varying Conditions at Adjacent Sections of Lackawanna's East Orange Grade Elevation Viaduct Required Two Differing Types of Flat-Slab Details and Design

By M. Hirschthal.
Concrete Engineer, Delaware, Lackawanna & Western R.R., Hoboken, N. J.

As a part of the third-tracking and grade elevation of Lackawanna R.R. through East Orange, N. J., it was necessary to build two elevated structures with the new stations at Brick Church and East Orange, consisting each of a long stretch of flat-slab reinforced-concrete viaduct with station facilities at both the street and track levels. As noted in *Engineering News-Record*, March 22, 1923, p. 536, the Brick Church viaduct has its outer row of columns set back from the face of the viaduct resulting in cantilevers, while the East Orange viaduct has fascia columns. Architecturally and structurally this results in two quite different types of structure, a comparison of which is the subject of this article.

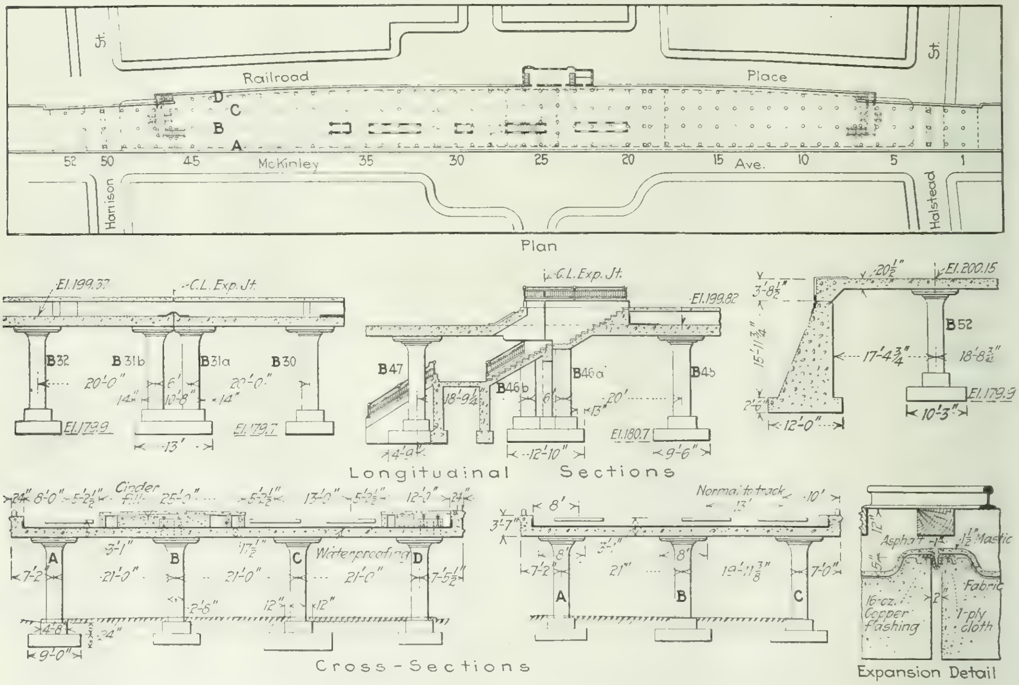


FIG. 1—DETAILS OF THE BRICK CHURCH VIADUCT AND STATION, DELAWARE, LACKAWANNA & WESTERN R.R.
Drawing shows plan of station, three typical longitudinal sections including expansion joint, and two typical cross-sections.

Brick Church General Details—The Brick Church viaduct is an all-concrete structure 1,085 ft. long from end to end and may be considered as consisting of three parts, viz:—one at each end of sufficient width only for the acommodation of three tracks, and the one (by far the largest) in the vicinity of the station proper, providing platform facilities for the latter and therefore considerably wider than the ends mentioned above. The columns are arranged in 52 transverse bents 20 ft. apart c. to c. except at the west end and in four longitudinal rows, "A," "B," "C" and "D," except at the two ends where row "D" on the north side is omitted. (Fig. 1.)

Transversely the columns are spaced 21 ft. on centers with 7 ft. 2 in. and 7 ft. 5½ in. cantilevers, resulting in panels only slightly oblong. This transverse spacing prevails throughout the tangential section while for the curved portion at either side the three southerly rows are kept on a continuous line until the near-curb lines (bents 4 and 49) of Harrison and Halsted Sts. are reached; the constriction is confined to the northerly panel, the column line being kept parallel to the north face with an overhang similar to that at the tangent section. This arrangement obtained except at the stairways and at the elevator shaft of the island platform where of necessity the lines of columns were displaced.

Harrison St. at the west end of the viaduct is an important and much traveled thoroughfare, crossing the tracks at an angle of about 86 deg. with the tangent to the express track produced. A line of columns was placed at that angle along the center line of the street and two 20 ft. clear spans were provided on either side for driveways, making the column spacing 22 ft. 8 in. c. to c. measured at right angles to the column bents, while the spans adjacent to the driveway on either side were made 18 ft. 9 in. centers. Bents 47 to 52 inclusive are parallel to the street line.

For the transverse spacing at this end the southerly row of columns was continued to the abutment while on the north side the line of columns was made parallel to the north fascia from the point where the third longitudinal row (C) of columns intersects the east curb column bent (49). The interior row of columns was located centrally between these two. To minimize the effect of expansion upon it, the exterior stairway from the north platform is made part of this section of the viaduct, the expansion joint being located at the head of these stairs because of the change in cross-section at the end of the platform.

At Halstead St. the requirements are not quite as severe and driveways of 16 ft. 4 in. clear between curbs were found to be satisfactory, so that it was not necessary to disturb the longitudinal column spacing, of 20 ft. centers, prevailing along the main part of the viaduct; the transverse column arrangement is similar to that at the Harrison St. end with reference to the fascias.

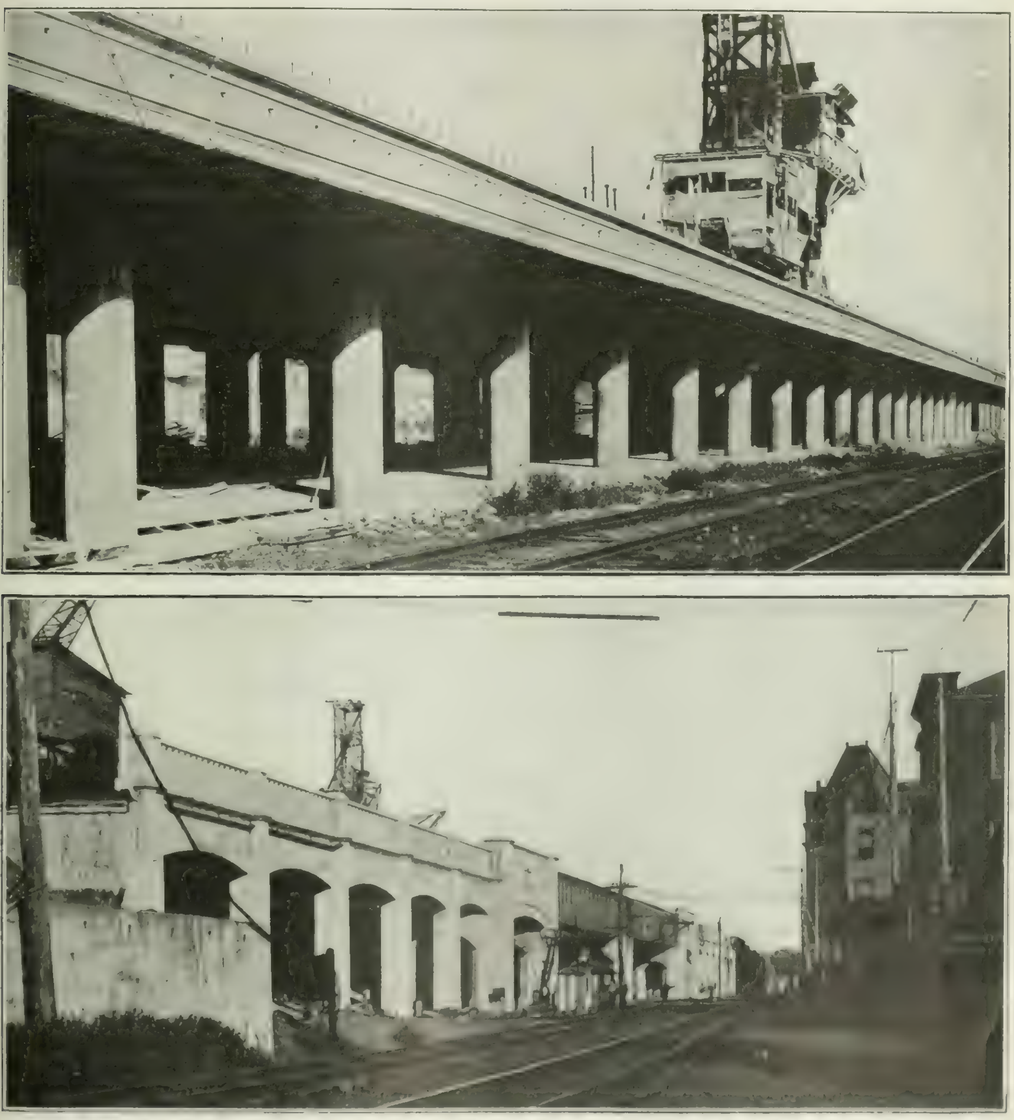


FIG. 2—SIDE VIEW OF TWO FLAT-SLAB VIADUCTS ON THE LACKAWANNA GRADE ELEVATION

Upper view shows Brick Church station [illegible] columns set back from the parapet [illegible] lower view is the Main Street crossing of the [illegible] with the [illegible] Main Street

Here again the north stairway was made part of the end section of the viaduct for the same reason.

To obviate the necessity of driving to either end of the viaduct when desiring to reach some point on the other side a double driveway is provided on the line of Prospect Place, (bents 18 to 20), adjacent to the station.

The main portion of the viaduct running for the full length of the platforms is divided into three sections by two expansion joints consisting of a double row of columns 6 ft. on centers making two of the sections about 250 ft. long and the third about 300 ft. in length. The longitudinal column spacing is 20 ft. centers throughout this main portion of the viaduct with 3 ft. overhangs at the expansion joints. The station is located midway between expansion joints, in order that its connection with the viaduct may be affected by temperature stresses as little as possible.

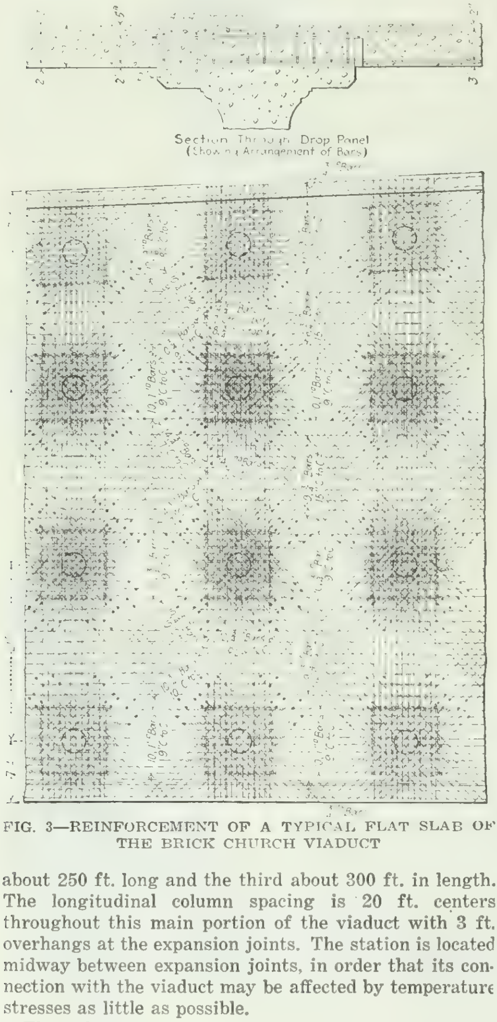


FIG. 3—REINFORCEMENT OF A TYPICAL FLAT SLAB OF THE BRICK CHURCH VIADUCT

The columns are circular in cross-section and are designed as hooped reinforced columns, both the longitudinal bars and spiral reinforcement being considered as taking the vertical load as well as the concrete in the ratio of the moduli of elasticity of the two materials. The longitudinal bars extend and are bent into the slab. The columns are all supported on spread reinforced-concrete footings, the double row of columns at the expansion joints being carried on single footings for each pair of columns.

Loadings—The slab is designed to take locomotive loadings as well as those of the platforms and the canopy column concentrations, the following methods being pursued in figuring the moments due to the engine loading:

A system of spans from one expansion joint to the next is taken as a unit of a continuous structure. The train load consists of two E-65 engines followed by a uniform load of 6,500 lb. per lin. ft. and was so placed as to satisfy the conditions respectively of maximum column reactions, maximum negative moments at the support adjacent to the end and over the interior columns, and also of maximum positive moments at the centers of the end and interior spans. For the computation of moments in the transverse direction, a uniform load w was assumed so placed along the line of tracks (longitudinally) as to produce maximum moments corresponding to those found for the conditions of the locomotive concentrations, and the moment from this uniform load was equated to that derived for the concentrations from which resulted the equivalent uniform load. This gave the basis for the moments transversely; the live-load being spread over 13 ft. and each track located on the transverse column system the maximum moments for one track, two tracks or three tracks loaded was obtained and the maximum used. Moments were then found for the dead-load including the canopy column concentrations as well as for end column restraint and together with the impact combined to obtain maximum conditions.

The next step was the distribution of these moments over the various bands. The maximum positive live-load moment longitudinally, was considered spread over 13 ft. and resisted by the two half longitudinal bands and the two diagonal bands in inverse ratio of the distance of the center of each band to the center of loading; the resulting moment in the diagonals was increased by the ratio of the spans. Since the diagonals also resist a portion of the moment transversely, one half the average of the transverse moments at the edge of each panel was considered distributed to the transverse and diagonal bands in proportion to their spans. When the diagonals were of unequal length, the sum of their portion of the longitudinal and transverse moments was distributed between them inversely as the square of the diagonal spans. The dead-load moments were likewise distributed and impact added by formula $\frac{LL^2}{DL + LL}$.

The reduction of these moments for the design of column capitals and the shortening of span resulting therefrom, was based on the coefficients of the Chicago Building Code, viz: 0.8 for negative moments, 0.6 for positive moments of main bands and 0.4 for positive moment of diagonal bands.

The reinforcing steel was then selected for each band based on a thickness of slab 1 ft. 8 in. with 10 in. additional for the drop panels, the required number of bars being bent up over the supports and carried into the adjacent panels, while temperature steel was provided in the upper plane in the longitudinal direction as shown in the typical panel, Fig. 3.

Stairways—One of the interesting features of this viaduct is the design of the stairways, already referred to, at each end of the westbound platforms. Inasmuch as the whole structure has cantilever fascias, it was necessary to design a cantilever stairway and in order to provide sufficient vertical clearance under the soffit of the stairs to permit of use as a portion of the driveway, it became imperative to make a turn in the stairway, parallel to the street line. This turn in the stairway produced complications of two kinds, which resulted, first, in sloping the main slab in order to provide sufficient headroom for pedestrians along the stairway, and second, in a two-way cantilever slab for the stair platform at the turn so as to provide the maximum headroom under the slab for the driveway. To make the sidewalk of the street accessible to the space under the main viaduct there was left an opening under the stair stringers sufficiently wide to form a passage. A flight of stairs in each direction from the platform connecting the island stairway with that from the north platform provides access both to the sidewalks of the street and the walk under the viaducts.

Station Details—The station construction both under the track slab and in front of the viaduct is of reinforced concrete up to the elevation of the track platforms and is of brick above that line, the molding on the viaduct fascia being carried around the station building as the line of demarkation between the concrete and brickwork. Concrete walls under viaduct are brick-faced.

For architectural reasons as well as to facilitate driving in and out of the station there was provided a large opening at the street fascia of the station building requiring the construction of a long-span reinforced-concrete girder which supports reinforced-concrete beams, spanning from the main viaduct slab to this girder. Pockets were provided in the main slab so that these floor-beams would transfer their reactions directly to the viaduct columns along the lines of which they were placed. To prepare for subsequent erection of the canopy columns supported by these beams, openings as well as anchor bolts were provided, and these occurring near the supports of the beams required special provisions for shear in the form of haunches and stirrups closely spaced.

A novel feature of the design of this viaduct, also present at the East Orange structure, is the placing of drainage channels under the platforms at their edges and pitching the slabs slightly in that direction to take care of the water from the tracks, platforms, and also from the canopy roofs, by means of pipes emptying into the channel. Shallow openings, 4 ft. x 12 in. are provided immediately above the waterproofing and the protection coat, at ten-foot intervals, while clean-cut openings, 2 ft. x 2 ft. 8 in. so designed as to permit of flushing in case of necessity are left every forty feet.

The waterproofing which was carried clear across the slab and up the sides of the parapets consists of a two-ply membrane of asphalt-saturated "Karnak" cloth laid in "Karnak" asphalt protected with two ¾ in. thick layers of asphalt mastic for the slab, and brick for the parapets. The expansion joint is waterproofed in addition with sheet copper and asphaltic cement filled as per detail in Fig. 1 which is the type that has been used on all the viaducts.

The columns, fascias and the faces of the abutments are bush-hammered in order to enhance the appearance of the structure, as well as to remove surfaces otherwise used for literary purposes by the juveniles.

The construction work was carried along in transverse sections of three to four bays each from west to east without any serious delays. The H. F. Curtis Co., which had the contract for this section of the work, elected to use steel sectional forms for both the viaduct and the retaining walls.

Details of East Orange Structure—The viaduct in connection with the East Orange station is 842 ft. long and in contrast to that at Brick Church, comprises three different types of construction. The problem presented itself of harmoniously connecting them architecturally as well as structurally. It would not be amiss to state

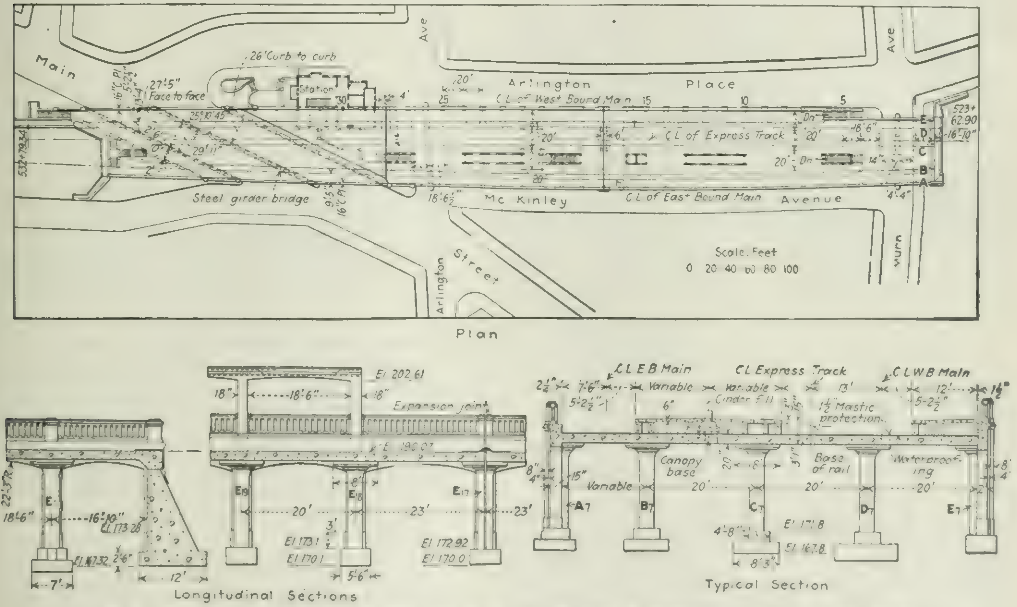


FIG. 1—EAST ORANGE STATION, DELAWARE, LACKAWANNA & WESTERN GRADE ELEVATION

Drawing shows plan of track level with under structure shown dotted, typical longitudinal sections and cross-section.

the reason for the variation in type of construction.

Main St. is the most important thoroughfare in East Orange with a double-track trolley line, and heavy vehicular traffic requiring wide driveways 26 ft. clear between curbs. This, coupled with the facts that the center lines of tracks and street form an angle whose skew is 65 deg. and the tracks on a curve tend to accentuate the skew, results in fascia spans of 70 ft. for the inside (concave side) of the curve, and 75 ft. for the outside, precluding the use of reinforced concrete for this portion of the structure. The triangular section remaining west of this construction is moreover not adaptable for column and four-way slab construction which prevails east of Main St. so that the girder and slab type was substituted.

Due to the presence of the street car line operated by the overhead trolley system, a minimum overhead clearance of 14 ft. was required, and to obviate the necessity of increasing the grade of the railroad tracks at this point due to excessive slab depth a floor slab was designed of 30 in. girder beams varying in spacing from 2 ft. to 5 ft. filled solid with concrete, with 3 in. protection both top and bottom forming a solid floor 3 ft. thick, (Fig. 5). The fascia girders were not encased because of the increased load and because all portions are accessible to painting. An expansion joint was located near the center of the east sidewalk span, both the structural steel construction and reinforced-concrete work being cantilevered from the spans beyond.

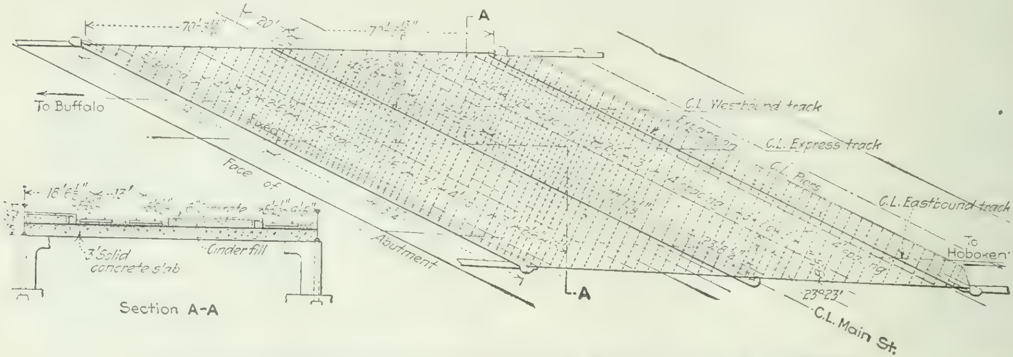


FIG. 5—PLAN SHOWING DETAILS OF SKEW STEEL BRIDGE ACROSS MAIN STREET

The girder beams are supported by three lines of piers, 2 ft. 6 in. thick, with arched openings, the ends of the piers encasing the structural steel columns which support the fascia girders. These piers are carried on continuous reinforced-concrete spread footings for the full length, requiring an I-beam grillage only at the center column which carries the two 75-ft. span girders.

The triangular section west of the structural steel spans consists of a pier 2 ft. thick with arched openings symmetrical with those of the other side of the 10-ft. sidewalk, surmounted by a reinforced-concrete slab which is continued over the rest of the triangular section until the abutment is reached, being supported by the fascia columns and arched girders as well as a row of columns and girders on either side of the stairway. The thickness of the slab over the sidewalk span is 1 ft. 7 in. and the reinforcement is normal to the pier line while the slab over the remainder of the area is 2 ft. 7 in. thick, the reinforcement being varied for the varying spans normal to the line of the stairway.

Flat Slab Design—East of Main St. the structure is a cantilever flat slab supported on 34 bents of columns; bent 34, the end of the triangle, consists of a single column increasing to a 5-column bent on the east row of the expansion joint, bent 28. The longitudinal spacing of the bents for this section is 21 ft. 4 in. c. to c. to conform with station requirements, the station occupying practically the whole length. Bent 26 is located along the center line of Arlington Ave., which forms an angle of about 86 deg. with the center line of express track and the two adjacent bents, 27 and 25 with a spacing of 18 ft. 6½ in. centers parallel to the line of 26 provide 13 ft. 10 in. clear roadways. The remainder of the bents are placed at right angles with the center line of express track and 20 ft. apart c. to c. except the five in the vicinity of Munn Ave., at the east end of the viaduct, which are 18 ft. 6 in. centers.

Due to the fact that this viaduct has fascia columns there are five longitudinal rows, marked "A," "B," "C," "D" and "E," for facilities similar to those of Brick Church carried by four rows. Since the curvature along the track at this viaduct is taken by the eastbound track, it is the southerly panels that are made to vary while the "B," "C," "D" and "E" rows of columns are kept parallel and 20 ft. apart c. to c., resulting in square panels; the south face and column row "A" are carried parallel to the eastbound track and this end spacing varies from 17 ft. 5 in. to 11 ft. 3 in. The stairway at Munn Ave. beginning at bent 6 reduces the column spacing for the two northerly rows from 20 ft. to 15 ft. centers from this point to the abutment. Fig. 4 shows the general plan, the parts under the slab being shown dotted, and longitudinal cross-sections.

The triangular section was completely isolated by an expansion joint transversely at bent 28 and one parallel to the street line at the end of the cantilever. The only other expansion joint is at bent 17 which is also the center between two driveways providing access from one side to the other between streets. Like those of the Brick Church viaduct the columns are circular and hooped except the fascia columns which for architectural reasons are of a combined section. All the columns are supported on independent spread footings. The design of the slab is similar to that at Brick Church with the difference, however, that the ends were considered restrained by means of the fascia columns and arches and thus affected the moments transversely while the triangular section with its heavy cantilever and variation of number of bays presented a variety of conditions of loading to be investigated. The resulting moments were treated similarly to those described in connection with the Brick Church viaduct and the reinforcement selected using similarly a 1 ft. 8 in. thickness of slab and 10 in. additional at the drop panels.

Expansion—The difficulty in connection with the design of the expansion joints east of Main St. was that of determining the direction of the expansion and its action on the structural steel section with its longitudinal girder parallel to the track and transverse floor beams normal to the street line, together with the action on the triangular reinforced-concrete section. It was determined to put one joint transversely at the end of the triangle as well as one along the hypotenuse which is the junction of the structural steel and concrete structures. The detail of the intersection of these two joints which now appears simple, with a puzzle until solved. The details of this intersection as well as other details of this joint are shown in Fig. 6. For architectural effect the fascia columns at all the expansion joints were made single instead of double columns and were split as shown also in Fig. 6. This same cause resulted in the treatment of the canopy columns and supports so that they were carried by one section and cantilevered over the other.

The station itself is of brick with gray terra cotta trimmings—Renaissance style. The entrance to the station on Arlington Place being several feet higher in elevation than that at Main St., the plaza was set at the elevation of the waiting room floor level, so that the stairway to the island platform could be reached without descending a flight of stairs. Stairs, however, provide access to Main St. and Arlington Ave. sidewalks.

The architectural treatment of the viaduct was a problem not only of producing a pleasing structure but also of keeping the various portions in harmony while treating them in accordance with the material of which they were constructed. The design of the portals over the sidewalk spans accomplishes this purpose, completely separating the two materials yet forming a connection between them. To increase the effectiveness of the treatment the structural steel girders were painted concrete color. All the columns are faced with pilasters projecting above the top of the railing and connected with flat segmental arches, below the slab. The balustrade between the pilasters is of open concrete construction. The canopy columns on this viaduct differ from those of Brick Church which are of structural steel, in being of concrete, and therefore subject to architectural treatment. Concrete arches are sprung between the canopy columns which were first poured to the springing line of the arches and which were provided with steel plates embedded and secured with anchor bolts firmly bonded into the columns. After the structural steel bracket was bolted to the plate above mentioned, and the I-beam purlins erected, the concrete canopy roof slab was poured together with the arches and the coping which was added to enhance the appearance.

To prepare for future electrification sufficient platform clearances were provided, for third-rail installation, as well as foundations for catenary supports, so either emergency would be met. The detail of the catenary support for the platform side was so designed as not to interfere with pedestrians.

The expansion joint through the stairs from the island platform was treated somewhat differently from that at Brick Church. The stairs were cut immediately below the main slab and the stairs and strings below this point were cantilevered from the columns at the stair landing.

Construction—The sequence of construction was governed by the necessity of having the Main St. crossing covered at the earliest possible moment; this portion of the construction was therefore first completed followed by the portion west of this, after which the flat slab work east of Main St. was poured, the columns of course being poured in advance of the slabs. The forms in this structure were of wood, except for the circular columns, forms for which were of steel. Hyde, McFarlin & Burke handled this work. The waterproofing for this viaduct is similar to that at Brick Church with the exception that Hastings asphalt mastic blocks, 1¼ in. thick, were substituted for the mastic laid in place, resulting in quite a saving of time.

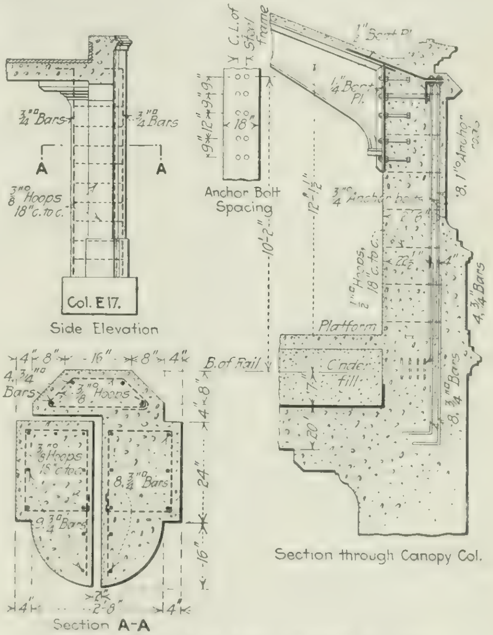


FIG. 6 DETAILS OF EAST ORANGE VIADUCT

A comparison of the two types of viaducts is interesting. The advantages of the cantilever type (Brick Church) are economy of construction particularly where foundation work is expensive, the simplicity of the architectural treatment, greater rapidity of construction, and the availability of the space under the cantilevers for driveway, hence less property damages. The advantages of the column fascia type (East Orange) are the elimination of the cantilevers, amenability to special architectural treatment, greater freedom in the location and design of stairways, the availability of greater space under the viaduct for commercial use, and better connections with the station construction.

These viaducts were designed under the direction of the writer, with the Main St. crossing under A. E. Deal, bridge engineer, and the stations under F. J. Nies, architect. O. H. Kellogg is resident engineer and M. H. Doughty, division engineer. Both design and construction are in final charge of George J. Ray, chief engineer of the railroad.

Analysis of Principles Affecting Passenger Station Design

Abstract of a report submitted by the Committee on Yards and Terminals to the annual convention of the American Railway Engineering Association held in Chicago, March 15-17.

A COMPREHENSIVE analysis of the principles affecting the design of passenger stations deals specially with the proper relations between the amount of business handled and the size and arrangement of the various station facilities. Conclusions presented are given below and the accompanying table indicates the relations which should exist between business handled and facilities provided in passenger stations for main-line traffic.

1. The through and loop types of stations are superior to the stub type from the standpoint of train operation.

2. The number of station and approach tracks required to handle a given traffic depends on type of station, location of coach and locomotive facilities, size of station, length of station tracks, character of traffic, design of throat and method of operation.

3. For through passenger train operation a stub terminal station will accommodate on an average two trains per track per hour, and a through terminal station between two and three trains per track per hour.

4. A ratio of from 2.5 to 3 station tracks to one throat track should be adequate if the throat is properly designed.

5. All stations should have a sufficient number of long station tracks to accommodate the longest trains.

6. Station platforms at car-floor level are superior to those at the level of top of rail, as the hazard and inconvenience resulting from the use of car steps are eliminated and the handling of passengers is expedited. However, the high platforms interfere with inspection of equipment.

7. There are many advantages in the use of separate platforms for trucking and for passengers, as station operation is facilitated and passengers are saved annoyance.

8. The requirements of through passenger and suburban service are so dissimilar that it is desirable to make a complete separation of the two classes of service.

9. Ramps are desirable where their use does not increase the distance traveled to reach a given point, and where the gradients are not in excess of 10 per cent.

10. The principal station facilities, such as information booth, ticket office, baggage check counter, parcel check room, etc., should be located in proper sequence along the line of travel and should be clearly indicated.

11. A complete separation of inbound and outbound traffic, particularly in large stations, is desirable, so that there will be no conflict between lines of travel moving in opposite directions.

12. Constructing rentable office space in connection with passenger stations offers opportunities for assisting in carrying the interest charge resulting from the construction of stations.

13. If the station building is surmounted by an office building the entrances to the latter should be independent of the station. However, consideration should be given to the possible patronage of occupants of the office building.

14. A passenger concourse is very desirable and is used effectively in many stations as an exit passage way, which permits arriving passengers to reach the street without passing through the station.

15. The required width of passenger concourse depends upon the character and amount of traffic and number of entrances and exits from the concourse.

16. A train concourse is advantageous, as it permits of serving one station platform by several train gates or conversely the serving of several platforms from one train gate. In stub stations it permits trucking from one platform to another without entering the passenger concourse.

17. A width of 20 ft. for a train concourse is adequate if it is not used extensively for trucking.

18. The waiting rooms should be located at one side of the line of travel, but near to the passenger concourse and adequately equipped with bulletin boards, clocks and other information devices so that passengers will be content to remain in the waiting room.

19. The practice of installing pay toilets is increasing. They are favorably considered where installed and are the source of a substantial revenue.

20. Ticket offices should be located adjacent to the direct line of travel, but should be so arranged that passengers waiting to secure tickets will not interfere with the general flow of traffic.

21. The parcel check rooms should be easily accessible for both inbound and outbound passengers and should have every facility for handling parcels quickly. Where the amount of business justifies, separate counters should be provided for receiving and delivering parcels.

22. The extent of cab facilities depends on the size of the city, character of taxicab service and other means of local transportation. In cities where good taxicab service is provided at a reasonable rate an ever-increasing percentage of passengers is using that service as a means of reaching and leaving the station.

23. Concessions have proved profitable in most stations and are desirable not only for producing revenue but as a facility which adds to the comfort of the passenger.

24. The relation which should exist between business handled and the size of facilities is subject to variation due to local conditions, class of traffic, type of service rendered, outside competition, large variations in estimates of normal rush-hour business handled and the varying ideas of what constitutes adequate service.

25. The following table represents under average conditions the relations which should exist between business handled and the size of through passenger (not suburban) station facilities:

RELATIONS BETWEEN BUSINESS HANDLED AND FACILITIES PROVIDED AT PASSENGER STATIONS

Station Facility	Unit	Facility Required for Normal Number of Rush-Hour Passengers Indicated								
	Passengers	250	500	750	1000	1500	2000	3000	4000	5000
Area of main waiting room	100 sq ft	30	53	72	89	112	128	155	178	200
Seating capacity of main waiting room	No. of seats	143	213	270	315	400	465	570	665	750
Area of women's waiting room	100 sq.ft.	5	7	9	11	14	17	23	29	35
Area of men's waiting room	100 sq.ft	5	6	7	8	9	11	14	16	
Total area for waiting purposes	100 sq ft	55	88	116	137	167	195	238	275	306
Total seats in waiting areas	No. of seats	190	300	390	470	590	700	880	1050	1200
Total area of lobby, concourse and all waiting rooms	100 sq.ft.	80	152	208	256	320	376	472	552	624
Area of men's toilet rooms	100 sq.ft.	4	6	8	10	13	15	20	26	31
Number of men's water closets	Number	6	9	12	15	19	23	29	35	41
Number of urinals	Number	5	8	10	12	15	17	20	23	25
Number of men's lavatories	Number	3	5	7	9	11	13	18	22	26
Area of women's toilet rooms	100 sq.ft.	3	4	5	6	8	10	13	16	18
Number of women's water closets	Number	7	9	12	14	17	19	23	27	30
Number of women's lavatories	Number	3	5	7	9	11	13	17	21	25
Area of ticket offices	100 sq ft.	4	7	9	11	14	17	21	26	
Number of ticket windows	Number	3	5	7	8	11	13	16	18	21
Number of telephone booths	Number	3	4	5	7	10	13	19	25	31
Area of telegraph facilities	Sq ft	100	130	150	170	210	230	280	310	330
Total area of dining and lunch rooms	100 sq ft.	9	14	19	24	34	43	63	83	102
Total number of seats in dining and lunch rooms	Number	34	53	72	93	129	173	249	327	407
Area of kitchen	100 sq ft.	5	8	11	14	20	26	38	50	62
Area of news stand	Sq ft	115	185	240	290	380	450	565	695	820
Number of barber chairs	Number	2	3	3	4	4	5	6	7	8
		Number of Pieces of Baggage Handled Daily								
	Pieces	250	500	750	1000	1500	2000	3000	4000	5000
Area of baggage room	100 sq.ft.	20	33	45	60	87	112	166	219	272
Baggage room tailboard frontage	Lin.ft	38	62	79	95	125	150	194	230	263
		Number of Parcels Handled Daily								
	Pieces	250	500	750	1000	1500	2000			
Area of parcel check room	100 sq ft.	4	6	8	10	14	18			
		Number of Pieces of Hand-Baggage Handled Daily								
	Pieces	250	500	750	1000	1500	2000	3000		
Area of hand-baggage facilities	100 sq ft	4	6	7	8	10	12	16		

Pocket Strain Gage Gives Stresses in Concrete Roads

Instrument Slightly Larger Than a Fountain Pen Gives Well Co-ordinated Results in Field Tests

By A. T. Goldbeck
Chief Division of Tests, Bureau of Public Roads, Washington, D. C.

When the modulus of elasticity of the concrete is known the strain or deformation of the top or bottom surface of the slab is a direct indication of the stress produced. Hitherto it has been almost impossible to measure these deformations under moving loads because there have been no instruments suitable for the purpose.

A strain gage for the measurement of deformations in the top fibers of a concrete road surface must occupy very little space. It must be capable of being installed beneath the concrete surface so that the motor truck wheel may run directly over the position of installation. It must be very sensitive to extremeely small changes in length; it must be self-recording; and finally, it must be capable of recording, accurately, deformations which take place very rapidly. With these thoughts in mind the graphic strain gage illustrated by Fig. 1 was developed. A study of Fig. 1 shows that this instrument consists primarily of a simple bell-crank lever attached to the frame of the instrument by means of a thin steel ribbon which serves as a knife edge and also as a spring. The end of the short arm of the bell-crank lever bears against a movable plunger. The long arm of the bell-crank lever is sharpened to a point which rests upon a smoked glass plate held by a spring clip to the frame of the instrument. A small movement of the plunger is multiplied approximately 75 times on the smoked glass record.

This instrument is used for stress determinations in concrete roads in the following manner: By means of a star drill, a recess about 6 in. long and ¾ in. in cross-section is cut in the top surface of the road. Small brass plates, having countersunk holes, are set in plaster of paris at the ends of this recess. The strain gage is placed in the recess, the movable plunger bearing against one plate and the adjustable screw of the instrument fitting into the conical hole in the other plate. Adjustment is made until the needle is approximately in the center of the smoked glass plate. This plate is then slid along to that the needle scratches a short base line on the record. A sheet of steel, not more than $\frac{1}{16}$ in. in thickness, is then laid on the road surface over the instrument and a motor truck is run over the instrument, if desired, or in any other position on the road. If a number of runs are to be made the same smoked glass record may be used for recording approximately ten runs. This is accomplished simply by sliding the plate a small amount to change the position of the record.

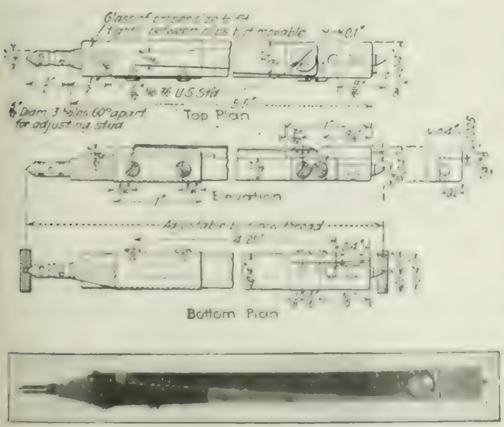


FIG. 1—STRAIN GAGE FOR FIELD TESTS OF CONCRETE ROADS

Gage set in [illegible] in. slot in pavement top gives records from which stresses due to truck load can be determined.

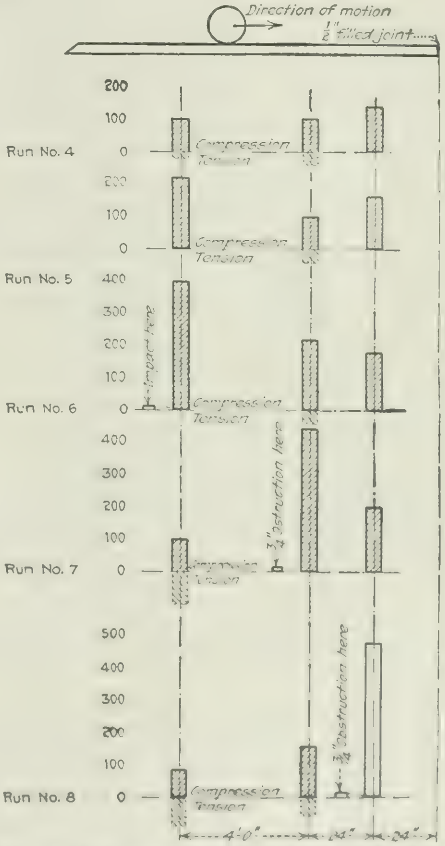


FIG. 2—TYPICAL RECORDS FROM STRAIN GAGE

Records show longitudinal stress on top of 6-in. plain slab 6 in. from side under [illegible]-ton Packard truck.

The record thus obtained consists of a short line, part of which lies on one side of the base line, indicating tension, and part on the other side, indicating the maximum compression which was produced by the test run. The smoked glass plate is then removed from the instrument and is dipped into a very thin solution of copal varnish or of collodion, after which it may be handled without destroying the record. The record is properly marked and is later examined under a microscope to determine the length of lines recorded. These

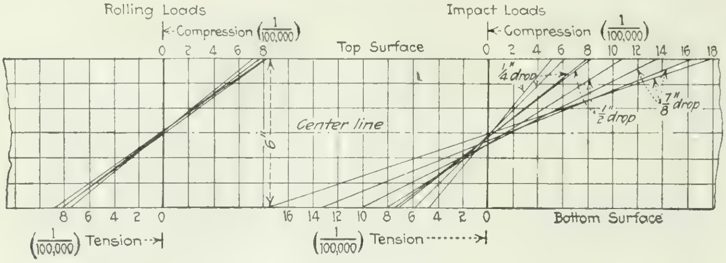


FIG. 3—CO-ORDINATION OF TENSION AND COMPRESSION

lines are directlty indicative of the stress produced in the concrete. In Fig. 2 there are shown typical records.

The ordinates above the horizontal base lines for the different runs indicate compression in the top fiber. The instruments were placed 6 in. from the side of the road in a longitudinal direction and were located with respect to a transverse joint as indicated by the dimensions given. The dotted ordinates below the base lines indicate tension in the top fibers. The high stresses in compression in the top fibers correspond to high stresses in tension in the bottom fibers. This is very well illustrated in Fig. 3 which shows tests made with two instruments, one installed at the top of the road, the other at the bottom. It will be seen here that approximately the same stress in tension is produced at the bottom of the slab as compression in the top of the slab with the neutral axis lying in the center.

Referring again to Fig. 2 there are shown some records in which the motor truck ran over a ⅞ x 4-in. strip of wood. The impact thus resulting immediately under the wheel is considerable. Referring to run No. 8 in which impact was produced by the rear wheel striking the road surface 2 ft. from one corner of the slab, there is shown to be high compression produced in the top fibers immediately under a wheel and therefore high tension in the bottom fibers. It is thus illustrated that even when the wheel is placed quite close to the corner of a slab high tension may be produced on the bottom rather than on the top of the slab. No doubt under favorable conditions the reverse condition of stress may result.

The one outstanding feature of the investigations thus far made is the fact that at the edge of the slab the highest stress in tension is apt to occur immediately under the wheel on the bottom of the slab, and at the corner of the slab high tension may also be produced in the top fibers.

From recent investigations on fatigue it would seem that if the fiber stress produced by loading exceeds approximately 50 per cent of the modulus of rupture of concrete, not very many applications of such high loads can be made without causing cracking of the concrete. On the other hand, if the loads applied produce a stress in the top or bottom fibers less than 50 per cent of the modulus of rupture of the concrete those loads may be applied a very large number of times without producing cracking. The fiber deformations measure the fiber stresses when the modulus of elasticity of the concrete is known, and if we wish to determine whether or not any particular concrete road is being over-stressed by heavy trucks this can readily be done by taking stress measurements such as I have described and the actual test procedure would require only a few hours.

It has been suggested also that by such measurements a highway department could determine quite accurately when to impose seasonal restrictions on heavy loads and when to withdraw such restrictions. It would seem that every highway department should know what factor of safety their concrete roads have under their legal limit of loading, and with the means now developed this information can be obtained with comparative ease.

Coatings That Prevent End Checks When Drying Lumber

WOOD dries more rapidly from the end grain than from the side grain, and is apt to check and split during seasoning unless end drying is retarded by some means. For this reason it is advisable to use a water-resistant end coating on wood during air seasoning or kiln drying, especially on woods which are difficult to dry and on short kiln samples. The Forest Products Laboratory, Madison, Wis., gives the following precautions:

> Either the cold or the hot coatings can be used effectively for drying temperatures up to 140 deg. F. Temperatures much above this cause blistering in the cold coatings but make the hot coating plastic enough to form new surfaces as fast as the old ones break. For this reason the hot coatings are apt to be more effective than the cold coatings for temperatures from 140 up to 170 deg., where they liquefy to such an extent that they run off. No coating has been found which is entirely satisfactory for temperatures above 170 deg. Cold coatings are perhaps somewhat better than hot coatings for temperatures above 170 deg. and for use on kiln samples when the temperatures are high enough to cause the loss of part of a hot coating.
>
> Cold coatings to be effective should have about the consistency of heavy syrup. The amount of filler required ranges from two to four parts by weight to one of the vehicle. Cold coatings used at the Forest Products Laboratory have been found effective about in the following order, the most effective being placed first: Hardened gloss oil and air-slacked lime with the oil evaporated to the consistency of thin syrup before adding the lime (very cheap); chinawood oil and barytes (cheap); linseed oil and white lead, very heavy (moderate cost); linseed oil and red lead, very heavy (moderate cost); high-grade spar varnish and barytes (expensive).
>
> The hot dips are effective in the following order: 213-deg. coal-tar pitch (cheap); 254-deg. coal-tar pitch (cheap); rosin and lampblack, 100 parts of rosin to 7 parts of lampblack (moderate cost).
>
> Some asphalts are highly moisture-resistant, but they are hard to apply because of the high temperatures required to make them plastic. Paraffine has proved satisfactory as an end coating for stock during air seasoning, but cannot be used in the kiln because of its low melting-point.
>
> Excessive shrinkage of the wood and rough handling often cause the end coatings to chip or shear off, and a fresh application of the coating must be made.
>
> To reduce end-drying sufficiently there must be a thick coating over the entire end surface. When hot dips are used, the wood should be dipped half an inch into the liquid.

Spread-Base Caissons in Boston Bank Foundation

Backfill Around Small Shaft Over Working Chamber Acts as Load to Assist Sinking of Caissons

A DEPARTURE from conventional methods of foundation construction has been made in the foundations of the First National Bank building, Milk and Devonshire Sts., Boston.

This building is shaped like a blunt wedge, 107 to 160 ft. wide and 260 ft. long, will have ten stories above the street and two below, and will have its lowest basement floor 33 to 49 ft. below the curb. The borings taken show hardpan at a grade varying from El. —35 to —37, or from 55 to 57 ft. below the curb. This hardpan is glacial till, composed of hard packed sand and boulder clay, and is overlain by a layer of fine sand varying from 8 to 10 ft. in thickness, above which is blue clay. The hardpan was at such a reasonable depth below the lower basement of the bank that it seemed wise to carry the foundation of so important a structure to this material.

It was found that the sand stratum was under a considerable hydraulic head, and could not be penetrated by open methods below El. —25 without loss of ground, which would be likely to do serious damage, as the surrounding heavy buildings rest on the clay above the sand.

Under these conditions a combination of open well and pneumatic methods was applied by means of a special caisson system devised by the Charles R. Gow Co., the foundation contractors. This system, for which patents are pending, represents a development by this firm of its ordinary method of sinking open caissons, resulting in the use of precast concrete caissons with working chamber larger than the superimposed shaft, a construction by which earth loading is used in sinking in place of external loading and the air leakage minimized. A typical section of one of these caissons is shown in Fig. 2.

In building such a caisson a starting pit is dug and sheeted the size and depth of the spread base. In the pit is cast the reinforced-concrete working chamber, which has no steel cutting edge. Over the working chamber is built a hollow concrete shaft, which forms the passage through which the soil is removed and which, when filled with concrete, becomes the pedestal for the steel column of the building.

While it was generally assumed that a load upwards of 8 tons per square foot on the hardpan was safe, in view of the lack of actual data it was considered important to definitely establish its bearing value. The first caissons were therefore designed on a basis of 5 tons per square foot, to give an extra margin of safety, and when sunk to the hardpan were utilized for making tests. The hardpan at this level is under a considerable hydraulic head, and while the material is very hard under normal conditions it readily softens under an unbalanced head. This was proven by the first two tests, which were made on unconfined bottom areas with the air pressure removed and relatively little water on the area being tested. Both of these tests developed serious settlement, as expected, the unbalanced head softening the hardpan so that it bore no resemblance to the hard, unyielding material which in compressed air could be flaked off only with difficulty by the use of a sharp miner's pick.

A third test was then made on a steel plate with its edges under a concrete seal 3 ft. thick, poured under compressed air. After this concrete had set and the air pressure and lock were removed, the caisson was immediately filled with water to approximately the normal hydraulic head, and a very satisfactory test was made, which proved that the soil was capable of supporting 8 tons per square foot without excessive settlement. However, in view of the importance of the structure and its intimate relation to surrounding buildings, a more conservative loading seemed warranted. Therefore, a unit soil load of 5 tons per square foot for the exterior and 5½ tons per square foot for the interior caissons was established as the basis of design.

This loading required caisson bases of varying sizes,

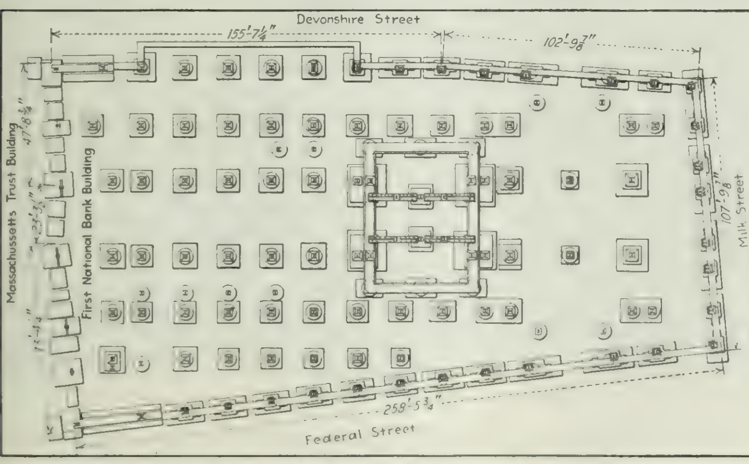


FIG. 1—CAISSON PLAN, FIRST NATIONAL BANK
Total number of caissons 104; depth from curb to hardpan about 55 ft of which 8 to 10 ft goes through fine, wet sand

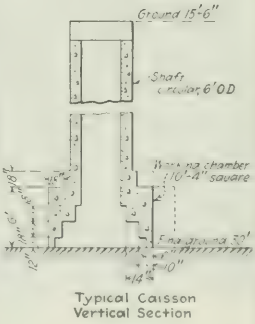


FIG. 2—TYPICAL CAISSON (VERTICAL SECTION)

ranging from 6 x 6 ft. up to 10 x 31 ft. In all there are 104 caissons.

In preparing to sink the caisson, after the starting pit is excavated and the bell-base cast therein, a short section of shaft is constructed before further excavation is started. When this is properly set and the inside forms stripped, excavation is started from within, a portion of the excavated material being carried away and the rest deposited on the bell as it sinks, to increase the weight and as backfill. The weight of the caisson and the backfill is sufficient for sinking. According to Col. Gow of the contracting firm, with this form of caisson the deeper it sinks the easier it goes, due to the increasing load and the practically constant friction of the bell sides. As excavation proceeds, additional lengths of shaft are added as required; this process is continued until the condition of the bottom becomes hazardous.

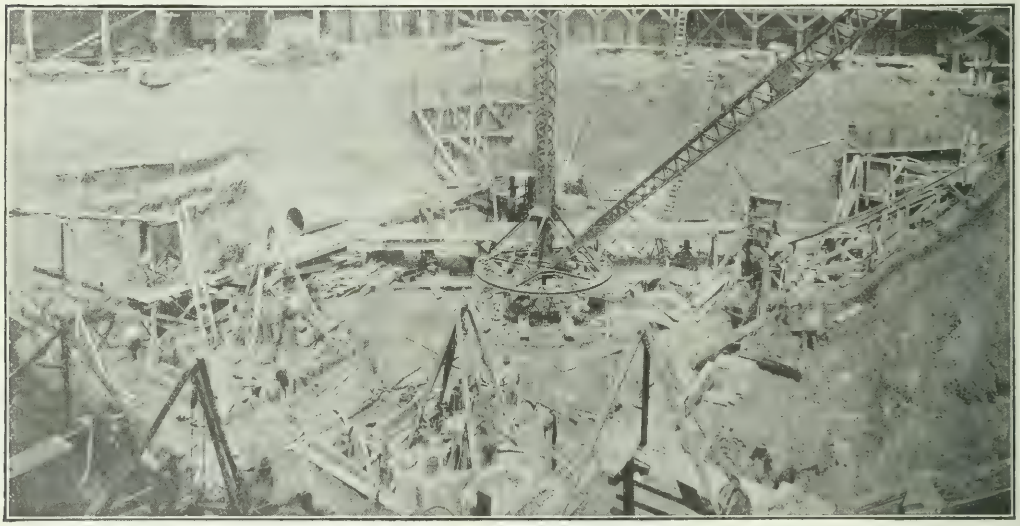


FIG. 3—FOUNDATION SITE AT START OF CAISSON WORK, FIRST NATIONAL BANK, BOSTON

FIG. 4—BAGS OF EARTH READY FOR HOISTING FROM WORKING CHAMBER

At this point two steel diaphragm lockheads are set and bricked in the shaft, thus forming an air lock, and the balance of the excavation is carried on under air pressure, varying from 10 to 18 lb. per square inch. Muck is taken out in heavy canvas bags instead of in buckets as before, as these bags are more easily stored in the confined space within the lock.

The caissons under air are lowered by momentarily reducing the pressure and thus utilizing what might be called air hammer in addition to the weight of the caisson and backfill to force the drop. The caissons are at all times kept on line by bracing the shafts against the sides of the starting pit and undercutting rapidly at points which show a tendency to lag.

When hardpan is thus reached all the overlying material is cleared and reasonably leveled. A concrete seal of proper thickness is placed, and allowed to set 24 hr. under pressure, at a temperature of about 80 deg. F. When this has been done, the lockheads are removed and the balance of the caisson is concreted. To date practically all the caissons for half the building are complete and the method has worked out very satisfactorily.

The methods applied on this work were in fact a development from the open caisson system known as the "Gow caisson pile" originally designed by Col. Gow for underpinning buildings along the Washington St. subway, in Boston. It consists of excavating in the open with the aid of telescoping steel cylinders driven down one inside the other as excavation proceeds, until the desired stratum is reached, and then constructing the footing by belling out from this shaft—with or without the use of sheeting, dependent on the material in which the belling is done—in somewhat the same manner as employed in the Chicago well system.

The First National Bank employed Stone & Webster as general contractors, for whom the Charles R. Gow Co., New England agents of the Raymond Concrete Pile Co., devised the methods and are the foundation subcontractors. York & Sawyer are the architects for the bank and H. G. Balcom is their consulting engineer.

Records of Walking Dredge Work in Delta Land Drainage

Best Results Shown in Dry Digging—Wet Weather Causes Trouble—Delays Classified—Comparison Made With Floating Dredges—Combined Plant Superior

BY ALBERT S. FRY
Morgan Engineering Co., Memphis, Tenn.

WALKING dredges were used to excavate approximately 3,000,000 cu.yd. of earth in constructing 113 miles of drainage channels in the Black Bayou and Murphy Bayou drainage districts in Washington County, Mississippi. Comparison of these machines with floating dredges and records of output and particularly of delays make this work of special interest to drainage engineers and contractors.

Material and Equipment—The soil ranged from a sandy loam to a stiff wax gumbo. The greatest width which the machines could span was about 30 ft., which limited the maximum base width to 12 ft. with the side slopes fixed at 1 on 1 and with depths ranging up to 8 ft. Excavated material for the greater part of the work was deposited on both sides of the channel leaving a berm 10 ft. wide between the margin of the excavation and the toe of the spoil bank as shown in Fig. 1. Openings for drainage into the new channels were left at intervals of approximately 500 ft. On part of the work, the "walkers" were used to make a pilot cut down the line of a ditch too large for the machine to excavate full size, and in this case all of the spoil was thrown on one side of the channel, leaving the other side free to receive the balance of the excavation which was done by a floating dredge. These machines are known as cross-walking dredges.

Each machine consisted principally of a wooden deck wide enough to straddle the excavation and strong enough to support the machinery, the load from the deck being carried through a large wooden truss, Fig. 2, on each side to four wooden shoes at the corners. These shoes support the machine while it is working. Midway between each pair of side shoes is a similar shoe which is arranged on a sliding mechanism and does not move with the machine.

When ready to walk, the machine is raised so that its weight is resting pivoted on the center shoes and is removed from the corner shoes. The entire machine then slides forward and the weight is again brought onto the corner shoes. The center shoes are returned to position and the machine is ready to walk again or to continue excavation. Each machine had a boom 42 ft. long and a bucket rated at 1½ cu.yd. The bucket is a shovel or pan, the general shape of which is shown by Fig. 3 and which excavates about double its rated capacity by reason of its shape and the method of digging. The distance between the inside of the shoes was about 30 ft. for machines 1 and 2, the Black Bayou District dredges, and 32 ft. for Machine 6, the Murphy Bayou District dredge.

Each machine was operated by oil engines. The crew consisted of four men: a shovelman of considerable experience to operate the levers which control the hoist and backing lines with which the digging is done; a craneman to control the swinging and dumping movements; an engineer to run the engines and look after the machinery, and an oiler. In addition, a teamster was required to haul fuel and supplies, and a dynamite man to blast stumps from the path of the excavator. There was also a man in charge of each machine.

In building Machine 6, as a result of experience with Machines 1 and 2, the distance between shoes was increased because the first two machines had difficulty in doing satisfactory work on the maximum size of ditch where top width and width between shoes are the same.

Progress and Output—All three machines maintained good rates of progress after they were once in operation, considering the conditions under which they had to work. Machine 1 completed its contract on Nov. 21, 1920, Machine 2 on Dec. 27, 1920, and Machine 6 about Sept. 15, 1921. Table I shows the total work done by each machine together with the average monthly progress. In this table, 25 days are deducted from the total time Machine 6 was on the job for time that it was digging on another job. The progress of the three machines is shown graphically in Fig. 4.

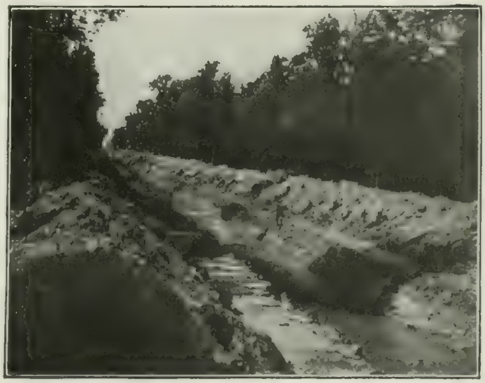


FIG. 1—DITCH DUG BY WALKING DREDGE
Shoes of dredge form well packed berms on each side of the ditch.

The best individual record was made by Machine No. 2 excavating five miles of new channel in five weeks, about 125,000 cu.yd. which is a monthly rate of 100,000 cu.yd. This record was made under most favorable conditions for a machine of this type straightaway digging in dry ground. The channel excavated had a bottom width of 6 ft. for the upper two miles, 8 ft. for the next two miles, and 10 ft. for the fifth mile. The depth of excavation averaged about 8 ft. and the maximum depth for a short distance was 10.2 ft. Following this record, the machine slowed up, but in the succeeding three weeks such a rate was maintained that during the first eight weeks of operation 166,000 cu.yd. of earth were moved at a monthly rate of 83,000 cu.yd. During this time, 6.6 miles were excavated, 3.3 miles per month.

Machine 6 exhibited the second best monthly record by excavating 89,600 cu.yd. in March, 1921. Four miles of channels were dug, the bottom widths ranging from 6 to 12 ft. and the depths from 7 to 9 ft. In September, 1920, this machine excavated 87,300 cu.yd. from a ditch with a bottom width of 12 ft. nearly equalling its best record.

Machine 1 made no monthly record that approaches either that of Machine 2 or Machine 6; it did, however, perform more consistently over the length of its contract than the other machines. Its best record was set for the first five months of 1919 when 273,600 cu.yd. were excavated at a monthly rate of 54,700 cu.yd., about 2 miles of new channel being excavated per month.

Delays Recorded—A record was kept by the resident engineer of the time lost by each machine whenever this time was as much as a day. The progress chart Fig. 4 shows the durations of and reasons for the principal delays, but the scale is such that delays of less than about 7 days cannot be shown. On each job there were, of course, many delays of a few days which are not apparent on the chart.

The delays recorded were of four general classes: (1) Walking the machine across country from a completed ditch to the beginning of excavation on another ditch; (2) soft condition of the ground and high water in the ditches; (3) repairs to the dredge or its machinery; and (4) scarcity of labor and epidemic sickness of the crew forcing a shutdown. The percentage of total time, counting from the date each machine began excavation, consumed by delays is shown for each dredge by Table II.

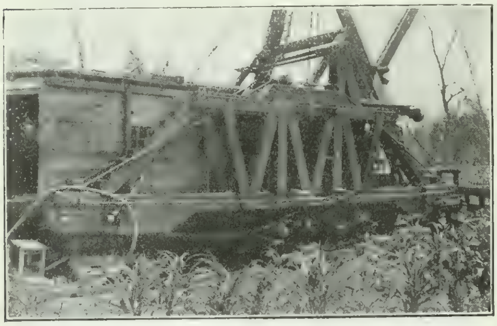


FIG. 2—SIDE TRUSSES CARRY LOAD TO CORNER SHOES

It will be observed that each machine lost nearly the same per cent of time in moving from one piece of work to the next. The layout of the ditch systems was such that the distance between the end of work on one ditch and the beginning of work on the next was usually from 1 to 2 miles. This distance was ordinarily walked and the machine was digging again in from 3 to 8 days. In a few instances, however, considerably more time was lost. For example, Machine No. 6 lost 25 days in walking between the heads of two ditches only about 1½ miles apart, the boggy nature of the ground near the upper end of one of the ditches making it almost impossible for the machine to go through.

Soft or wet ground is probably the greatest drawback that walking machines have in excavating ditches in the kind of country found in the Mississippi delta. When the ground is dry and firm, a walking dredge can move along at a rapid rate but when the ditch location runs through especially low boggy ground or follows a bayou the great weight makes operation very difficult and uncertain and results in miring. After rains, the soil on the berms becomes soft and slippery. At such time, the machines had considerable difficulty in working and several times were unable to keep their footing and slipped into the ditch. Excessive rainfall which produced high stages of water in the low bottom lands and in the ditches made working practically impossible and it was necessary to suspend work until the waters had gone down. Machines 1 and 2 were delayed only a few days by high water as they were favored by unusually dry weather during the greater part of the time they were at work and the time lost by these two machines for the second cause of delays represents almost entirely delays from having to go through boggy ground or bayous or from slipping into the ditch.

Repairs occupied from 9.3 to 12.9 per cent of the total operating time. The repairs necessary were such as might be expected in the operation of the machines on the kind of work performed.

Machines 1 and 2 began work in the early part of 1918, at which time labor was scarce owing to the war. However, no great amount of time was lost from this cause. Common labor to clear the right-of-way ahead of the machines was scarce and was also inefficient and on occasions, the dredges were delayed for short intervals waiting for right-of-way to be cleared ahead of the machine. The first influenza epidemic attacked practically all the men in the crew of Machine 1, and 11 days were lost on that account. Machine 6 lost practically no time from lack of labor, the only occasion being a few days for the crews to celebrate on holidays.

Comparison With Floating Dredges—The chief advantage of walking dredges lies in the fact that the upper ends of drainage systems can be dug to the size required to fit into a balanced drainage plan. In the past, in the South, the floating dredge has been the chief means used for digging the upper end or lateral canals as well as the larger outlet canals of a drainage system. This has been because the floating dipper dredge has been the cheapest known method of excavating earth channels and it has been cheaper heretofore to pay for the volume of excavation in the minimum sized ditch that can be dug by a small floating dredge than it has been to excavate a smaller ditch by some other means.

The weight and amount of machinery on the smallest dipper dredges in use are such as to require a width of hull which necessitates digging a ditch about 12 or 14 ft. on the bottom with side slopes of 1 to 1 or ½ to 1 in order to permit the passage of the hull. From a hydraulic standpoint, a ditch of this size is not required for the upper few miles of each lateral ditch in an economically planned drainage system for flat lands. The construction of such ditches by floating dredges to over-size dimensions has resulted in the unbalancing of many drainage systems by funnelling the runoff from excessive rains down these upper ends of canals to the detriment of the lands farther down stream where the limits of economic drainage have permitted the construction of channels which are only large enough to take care of the amount of water required by the hydraulic basis of design and which are not of sufficient size to carry off, without over-

TABLE I PROGRESS SUMMARY OF WALKING DREDGE WORK

Machine No	Total Exc. Cu.Yd.	Total Miles Exc.	Total Months On Job	Aver. Per Month Cu.Yd.	Aver. Per Month Miles
1	867,700	32.8	19	45,600	1.7
2	1,114,100	41.6	22.2	50,200	1.9
6	1,092,000	39.8	23.6	46,300	1.7

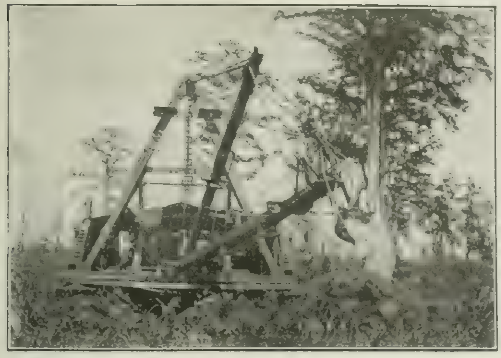


FIG. 3—FRONT VIEW OF WALKING DREDGE

Dipper shaped and operating like a scoop has considerable overload capacity.

flowing, the amount in excess of the hydraulic requirements which comes down from the upper canals. Furthermore, a floating dredge must be large enough to dig the channels which lie between and connect the upper ends of the canal system and furnish outlets for these upper ends. The size of the connecting channels is usually determined by hydraulic requirements and a dredge large enough to dig these channels is of such size that it must excavate the upper ends of the laterals oversize.

The walking dredge offers a solution to this difficulty and by its use on the upper ends of lateral canals, a perfectly balanced drainage system can be constructed. Ordinarily the absolute cost is not increased for it is quite usual in walking dredge excavation to pay for the volume of material that would be paid for if the work was done by a floating machine. In both the Black Bayou and Murphy Bayou Districts, the contractor received payment for ditches with a bottom width of 12 ft. although the actual widths constructed were 6, 8, 10, and 12 ft. depending on the hydraulic capacity required.

Another virtue of the walking dredge as compared to the floating dredge is that it requires no water. There are probably few drainage districts where construction has not been seriously delayed by the lack of sufficient water to float the hulls of dipper dredges. In the Black Bayou District, the walking machines were making steady progress while floating dredges were forced to lie idle for several months because the time when the latter were ready to start work was during one of the driest periods ever known in central Mississippi.

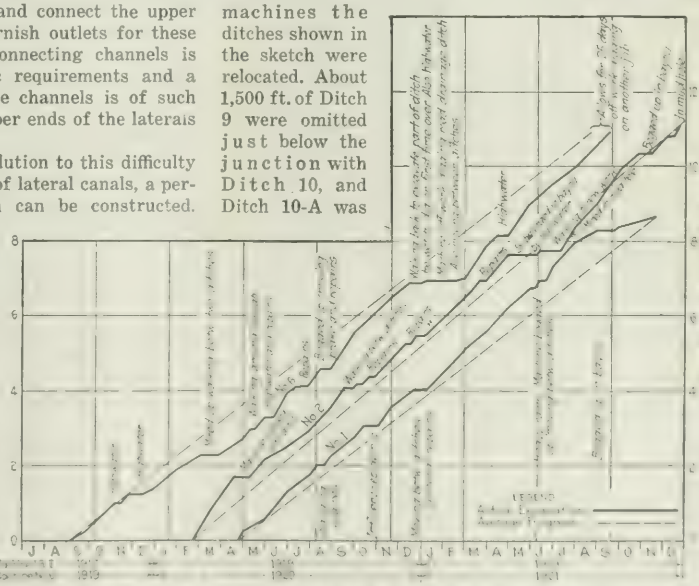


FIG. 4—PROGRESS CHART OF DREDGE OPERATIONS

Delays noted are summarized according to four principal causes in Table II.

One other advantage of the walking dredge is its flexibility in moving from one ditch to another. A floating dredge must dig a connected system of drains as floating is the only means of transportation which the dredge has without the dredge being torn down and rebuilt. The walking dredge can dig a disconnected system of ditches and can dig a few miles on the upper end of one channel, then walk across country a mile or more if necessary to the upper end of another channel and thus progressively excavate the upper ends of the ditches.

This ability of the walking dredge to travel across country from one ditch to another also permits of different design of a drainage system than where floating equipment is used. In the latter case, the canal system must be so laid out that the ditches in any job to be done by one machine form a connected system which the machine can dig by floating its way around on all of the work. Where a walking dredge can be used, the designer is free to lay out a ditch system without the necessity of the ditches connecting. This may be of decided advantage in certain cases. For example, Fig. 5 shows a rearrangement of some of the channels in the Murphy Bayou District that was made after it was found that a walking dredge was to be used for part of the work. At the time the drainage system was designed, it was not known what type of machinery would be used for construction and consequently the design was made so that floating equipment could be used. After the contract was let for the work to be done by walking machines the ditches shown in the sketch were relocated. About 1,500 ft. of Ditch 9 were omitted just below the junction with Ditch 10, and Ditch 10-A was added to furnish a new outlet for the upper part of Ditch 9 and for Ditch 10. This change made possible a better drainage unit in so far as Ditches 9 and 10 were concerned, and also relieved the main outlet for the district from taking care of the drainage from these ditches. It also permitted the raising of the grade line and the decrease in size of the lower end of Ditch 9, which made possible a desirable re-location not feasible under the original layout. The net result was a better design and a saving in cost.

There are many drainage units that do not require the construction of ditches larger than a walking dredge can dig and where this is true, the system can ordinarily be completed sooner with this type of machine. It is also possible to partially excavate outlets down channels where the finished width is greater than the machine can dig, the excavated spoil all being deposited on one bank and the channel ultimately being excavated to full size by a floating dredge or other excavator, placing the balance of the material on the opposite bank. This plan of operation sometimes serves to furnish a partial outlet for a drainage unit at an earlier time than would be possible if it were necessary to wait for the work to be done by a floating excavator. This was done in the Black Bayou District when a walker made a pilot cut on a large outlet canal to provide a partial outlet for a system of ditches dug by the walker and which otherwise would have had no outlet until a floating dredge could have excavated the whole channel several months later. In a large drainage district a combination of walking and floating excavators will provide drainage and complete the work quicker than will floating equipment alone.

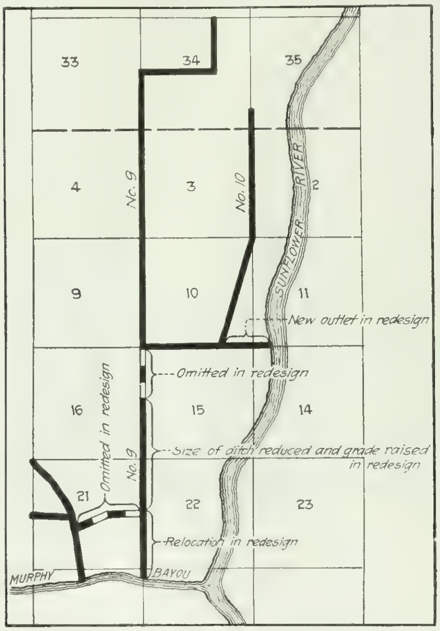


FIG. 5—REDESIGN OF DRAINAGE UNIT

Use of walking dredges capable of traveling overland made it possible to reduce size and to omit connecting ditches.

Naturally the walking dredge has its drawbacks. Most troublesome of all is the leaving of short dams across a ditch for the machine to walk upon when required to cross the ditch. For example, the dredge may have excavated a lateral ditch for a few miles down to the junction of this lateral with its outlet canal, the latter having been already dug by a floating dredge or other excavator. The walker will then leave a dam across the lateral, usually about 40 or 50 ft. long, but sometimes even longer, to walk upon in leaving the ditch.

Dams were left in some cases at curves in the ditches because of the inability of the machine to make a short turn and cut the ditch around the curve. When heavy rains fill the new excavation behind the walker, the difficulties of excavating from under water coupled with the advantages of working in a dry or almost dry ditch are such that the machine will leave a short dam of earth to hold back the water and will start new excavation on the downstream face of the dam. In the course of the whole job, these short dams accumulate in number. Before final acceptance, it is necessary to remove all of these dams by means of dynamite, teams, and scrapers, or men and shovels. The dredge itself cannot go back over the work because it is not equipped with backing machinery. On one ditch plugs were left at intervals of about every quarter of a mile, the plugs being removed later on by a floating dredge following down the ditch from another part of the work.

There is nothing difficult in the actual removal of such dams of earth but it is one of those little things on a big drainage job that the resident engineer usually finds it hard to have done. These dams represent small pieces of work scattered over a big area and are usually fairly inaccessible so that the contractor needs considerable urging to remove them.

The operation of walking dredges is also hindered to a certain extent by the fact that the machines can only travel forward. It is absolutely necessary to complete the work the first time over or finish it by other means.

Walking dredges are greatly handicapped when forced to work in boggy ground or bayous or to work after heavy rains which soften the top soil and make the footing slippery and insecure. The machines are very heavy and mire down badly in soft ground. The record of progress and delays previously discussed brings out this fact very clearly. In some cases in soft ground logs and poles were laid on the berms to make better footing for the shoes. This practice proved objectionable, however, because the logs and poles would fall into the ditch. The performance of the machines in digging ditches in bayous and very low boggy ground demonstrates that these machines are not well adapted to working under such conditions, although short sections of such ditches can be excavated as parts of contracts, the major part of which consists of work to which the machine is better suited.

The great weight of the machines on the berms sometimes tends to produce caving of the banks where the ground is soft or unstable. Slippery berms, even on ground otherwise solid, after rains are also likely to cause a machine to slide into the ditch. Extricating the machine is a difficult and costly task and delays the work. One of the machines in the Black Bayou District partially overcame this disadvantage by removing with the shovel the wet slushy material from the surface of the berms before moving forward, scraping off in this way just enough earth to get down to a solid footing.

TABLE II—SUMMARY OF MAJOR DELAYS

	Total Days Lost			Per Cent of Total Time Lost		
	Mach. No. 1	Mach. No. 2	Mach. No. 6	Mach. No. 1	Mach. No. 2	Mach. No. 6
Moving dredge	34	48	57	5.9	7.1	7.9
Ground soft or wet	44	106	95	7.6	15.7	13.2
Repairs..................	60	87	62	10.4	12.9	8.6
Labor scarcity and sickness	22	13	4	3.8	1.9	0.5
Totals	160	254	218	27.7	37.6	30.2

High water in the excavated channel usually forces a shutdown until the water recedes. Some work was done by all three machines with the ditch filled or nearly filled with water but the water was a handicap and progress was slow. As mentioned before, the method of leaving dams in a ditch to hold back the water was resorted to in such cases. The walking machine prefers just enough water in the ditch to make the dipper shed well.

The Black Bayou dredges were built to span a top width of about 30 ft. and the Murphy Bayou machine about 32 ft. In certain cases, where the bottom width was 12 ft. and the cut was more than 8 or 9 ft. the machines were unable to span the full top width of ditch. In such instances, shoe tracks were cut down on either side of the ditch to such a depth as would reduce the width to be spanned to the distance between shoes. This inability to span the ditch made it necessary to cut down sometimes 3 or 4 ft. into the berms. Where this was done, the actual width of unexcavated berms was necessarily reduced. The practice of benching down into the slopes of the ditch was not especially desirable but was the only way that the work could be done by the machine. This kind of construction also made necessary the excavation of considerable yardage in excess of that required which necessarily tended to delay progress, increase the cost to the contractor, and make larger spoil banks than would result from the actual ditch prism itself. Constant vigilance was required by the resident engineers and inspectors to prevent the machine operators from cutting the top width too narrow where the width was nearly the same as that of the machine span.

A point that may be mentioned as affecting the relative cost of work done by a floating dredge or a walking dredge is that the clearing ahead of the latter within the top width of the channel is more costly because the stumps must be blasted out. The enormous strength of the floating dredge enables stumps of huge dimensions to be lifted or nosed out of the channel section with little or no blasting required.

The work was carried out under the supervision of the Morgan Engineering Co., Memphis, Tenn., under the direction of Ned H. Sayford, vice-president. E. C. Wild was resident engineer on the Black Bayou District and T. P. Anderson was resident engineer on the Murphy Bayou District. The contractor for all the work was the J. B. Arpin Dredging Co. of Grand Rapids, Wis.

Results of Water Waste Survey in Detroit

A three-year pitometer survey of water waste in Detroit, Mich., resulted in a saving of 22.5 m.g.d. or 24 gal. per capita. Of this, 9.5 m.g.d. was underground main leakage, 3.4 m.g.d. unmetered fixture leakage and 9.6 m.g.d. metered fixture leakage. These figures are given in the latest annual report of George H. Fenkell, superintendent and general manager. He states, with reference to the extent to which metering reduced house waste, that while universal metering has not entirely eliminated house waste it has helped to reduce it considerably. Metering reduced the quantity used for sprinkling, for cooling in summer and for preventing freezing in winter but it had not materially reduced the waste through defective and leaking fixtures. Of 33,906 services investigated for leaking plumbing fixtures 50 per cent were found wasting through leaking toilets, taps, etc. Upon notice of defective fixtures owners of unmetered services in most cases were found 10 days later to have had repairs made. The yearly saving uncovered by the survey netted $204,000.

A. A. E. Helps to Expose "Chief Draftsman Dobe"

Interests Advertising Clubs in Unfair Advertising Which Is Vigorously Condemned by Vigilance Committee

FOR a number of years advertisements similar to the following have been appearing in different papers throughout the country.

> MEN WANTED to become draftsmen —Salary $250 to $300 monthly when competent. Chief draftsman will train you at your home, also furnish FREE all *tools.* Training given until in position at above salary. Address Chief Draftsman Dobe, 1951 Lawrence, Div. 75, Chicago.

In 1918 members of the American Association of Engineers became concerned about this advertising and began to urge the Association to cleanse advertising of misleading statements concerning educational qualifications and salaries of engineers.

In the fall of 1921 resolutions passed by the Philadelphia Chapter and a letter from Robert W. Shelmire came before the National Executive Committee, which pledged the association to do all in its power to stop such misleading advertising and directed that in such endeavors the assistance be enlisted of the Associated Advertising Clubs of the World and the United States Post Office. A committee of the Chicago Chapter consisting of W. A. Artingstall, chairman, Paul Hansen, and Robert W. Shelmire, was appointed to collect data for the assistance of the National Vigilance Committee. Since then the Association has been active in its efforts to get action in the case but has not been successful until last month when the National Vigilance Committee of the Associated Advertising Clubs of the World issued as its Bulletin No. 48 the following:

"Chief Draftsman Dobe" purports to be an experienced employer of draftsmen for a large and well-known firm of engineers. He offers to train personally (by correspondence) candidate student draftsmen.

Advertising extensively in magazines, "Chief Draftsman Dobe" tells an interesting story.

By assembling various statements taken from the Dobe copy and follow-up literature, it is found that a 15-year-old boy with ability to read, write, use figures and follow instructions, can study under Dobe for the equivalent of three to six weeks of solid eight-hour days, and then be prepared to earn, and in fact, is guaranteed a salary of $250 to $300 a month with $450 on the side at home.

A magnificent set of drafting tools are advertised "Free" as an inducement to prospective students. However, the approximate sum of $65.00 is charged for the course and must be paid before the "free tools" belong to the student.

Investigation of the truth of the claim that positions paying $250 to $300 per month will be available to Dobe graduates, shows that not one of a number of engineering contractors will retain a draftsman in a permanent position paying $250 a month without years of experience.

The "Chief Draftsman Dobe" copy is exceedingly misleading. Young men expecting exceptional results are disillusioned because of the exaggerated promises made. The so-called "Free Offer" is used in direct violation of the recommendations of this committee, namely, as the "Offer" cannot be acquired without the expenditure of money.

The confidence of the public and the reputations of the advertising and engineering professions are ridiculed and belittled by advertising of the "Chief Draftsman Dobe" type.

A Study of Office-Building Live-Loads

Weighings of Occupancies in Equitable Building Show Average Loadings Ranging From 1 to 87 Pounds Per Square Foot

With an introduction by Ira H. Woolson, Chairman, Building Code Committee, Department of Commerce

The following article, based upon a study made by C. T. Coley, manager of the Equitable Building, New York City, describes a survey made of existing floor load conditions in that building, the most complete study of its kind of which I have knowledge. The work was undertaken at the request of the Building Code Committee of the U. S. Department of Commerce. The efficient thoroughness with which this work was done is plainly evident.

The committee has received numerous requests to standardize building code requirements for allowable floor loads in all ordinary occupancies. Existing requirements are widely variant, even in cities near each other. These variations result in annoyance and confusion to architects and engineers, and, so far as such requirements are unduly severe, they waste material and uselessly increase building costs. The committee desires to comply with these requests, and to this end is endeavoring to secure all possible information of actual floor load analyses or calculations upon every kind of occupancy, except that for private dwellings, which is of minor importance and has already been treated in an earlier report.

Very little is found in print upon the subject. A search of the libraries of Congress and of the United Engineering Societies revealed practically nothing upon the weight of ordinary commercial or industrial occupancy, except some excellent studies of office occupancies made by C. H. Blackall, of Boston, and an extensive analysis of loading due to motor truck storage, by E. L. Verveer, *Engineering News-Record*, Feb. 9, 1922, p. 238). The weight of human beings in congested and freely moving masses has also been quite well determined by Prof. L. J. Johnson in this country and Prof. W. C. Kernot in Australia. Prof. C. J. Tilden (*Transactions*, American Society of Civil Engineers, 1913), also made rather extensive studies of the impulse effect of moving masses of people in sitting, rising, and rapid movement from one position to another, as on bridges or boats.

Doubtless many investigations of floor loading have been made for private purposes in various classes of occupancy, and if copies of these could be obtained for Secretary Hoover's Committee they would be of real service in its work. Office building loadings are now fairly well covered, though additional information would be helpful. We are greatly in need of data on loadings in schools, churches, hotels, assembly halls, theatres, hospitals, workshops, factories, printing establishments, machine shops, public garages, etc. If a person has any floor load studies and has not the opportunity to have the work duplicated, but would be willing to loan the material to the committee, it would be very gladly received and promptly returned after being summarized. It is also hoped that this appeal may stimulate others to make similar surveys in some of the above name occupancies for the aid of the committee. **Ira H. Woolson.**

New York, Feb. 28.

DURING the latter part of 1922, a detailed investigation was made of live-loads on several floors of the Equitable Building, New York City. This structure is well known as perhaps the largest office building in the world, and the varied nature of its occupancy made observations possible which should be useful in the design of future office buildings and proper regulation of those already in use. The study was instigated by the Department of Commerce Building Code Committee, which is investigating the possibilities of greater economy in structural design, and the objects were to determine the maximum, minimum and average floor loads existing in actual office practice; the nature and distribution of such loads; and the relations which they should bear to the assumptions for design of floor slabs, floor beams and columns as governed by prevailing building code practice. With this in mind it was necessary to determine the actual weights of office furniture and merchandise, also its location with reference to partitions and floor beams. In order to cover a wide range of usual office building occupancies, three floors were selected, representing light, medium and heavy classes of occupancy, and the entire area of these three floors was surveyed. Several other offices on various floors, representing what appeared to be unusually heavy occupancy, also were investigated. The whole survey covered over 200 rooms.

The investigation was planned and supervised by C. T. Coley, M. E., manager of the building. A force of five men equipped with platform scales and field book spent several days weighing and tabulating every article of furniture within the areas mentioned. Sketches were prepared for each office, showing the location and weights of all articles of furniture, so that the distribution of loads could be quite closely determined. Figs. 1, 2 and 3 are typical examples of these sketches.

General Results — Following is a brief tabulation showing the outstanding features of the report on this study; Fig. 4 also summarizes the observations graphically. It will be noted that little difference exists in the average loading of the floor selected as the heaviest in the building and that which appeared at first glance the lightest.

MAXIMUM, MINIMUM AND AVERAGE LIVE-LOADS IN EQUITABLE BUILDING

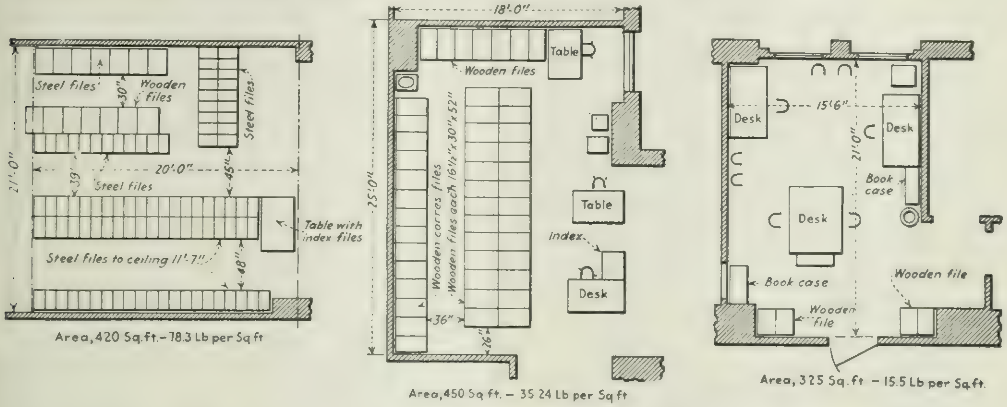
	No. of Offices	Maximum Lb. Sq.Ft.	Minimum Lb. Sq.Ft.	Average Lb. Sq.Ft.
Light occupancy floor (20th)	67	55.4	.87	10.26
Medium occupancy floor (37th)	64	30.73	3.27	10.67
Heavy occupancy floor (11th)	62	33.84	5.00	13.96
Total and average	193			11.6
Selected heavy occupancies throughout building.......	14	78.3	21.4	42.4

The weights given do not include the radiators, which averaged 200 lb. each, with two to each bay, located under the windows. These would add approximately 1 lb. per square ft. for all exterior bays.

The weight of the partitions was not included in the calculations. These in general are 3-in. hollow tile plastered each side, and a careful weighing of one which was being removed showed a weight of 30 lb. per square foot, or approximately 350 lb. per running foot.

The weight of occupants has been taken at 150 lb. per person, which figure is probably too high, as a considerable portion of such occupants is females, whose average weight probably would not exceed 120 lb.

Discussion of Results—The careful sketches of load arrangement make it possible to throw some light on the prevailing method of assuming uniformly distributed live loads as a basis for floor design, and help to indicate what relation such assumptions should bear to actual total loads. Examination of bays for which the live load was more than 25 lb. per square foot shows wide variation in the distribution of such loads. The larger proportion was found, as might be expected, within a zone approximately 3 ft. wide around the walls, the remainder being distributed variously in the centers of the rooms. In one or two cases, however, the major proportion of all the load was situated away from the walls and this condition must be provided for by designers. There is also the probability that practically all furniture may be collected in the central portion of a floor area when occupants are moving, or when painting or cleaning is in progress. The sketches show that the heavier loads, such as library shelves and double filing cabinets, are likely to be located away from walls and partitions, obviously for ease of access.



FIGS. 1 TO 3—TYPICAL OFFICES WITH HEAVY TO LIGHT OCCUPANCY

Fig 1—File Room of Bonding Company
Summary of Loads.

		Lbs.
	Floor covering, linoleums	630
2,178	File drawers, 10 lb	21,780
	Racks for same	4,300
2	Card cabinets, 100 and 300 lb	400
6	Card cabinets, 50 lb	300
1	Flat top desk	200
7	Steel file cabinets, 340 lb	2,380
7	Steel file cabinets, 200 lb	1,400
5	Wooden file cabinets, 250 lb	1,250
5	Step ladders, 50 lb	250
	Total	32,890
	Total floor area, 420 sq.ft.	
	Load per sq.ft., 78.3 lb	

Fig 2—File Room of Electric Company
Summary of Loads.

		Lbs.
	Floor covering, linoleum	675
47	File cabinets, 300 lb	14,100
2	Tables @ 150 and 100 lb	250
1	Desk	200
1	Stand	25
1	Water cooler	90
2	Chairs @ 35 lb	70
3	Persons @ 150 lb.	450
	Total	15,860
	Total floor area, 450 sq.ft.	
	Load per sq. ft., 35.2 lb	

Fig. 3—Office of Electric Company
Summary of Loads.

		Lbs.
	Floor covering, linoleum	488
3	Flat top desks @ 400 lb	1,200
8	Chairs, 3 swivel @ 35 lb., 5 arm @ 25 lb.	230
2	Bookcases @ 440 lb	880
4	File cases @ 273 lb	1,092
2	Stands @ 25 lb	50
1	Hat tree @ 18 lb., cuspidors and baskets, 30 lb	48
7	Persons @ 150 lb.	1,050
1	Water cooler	90
	Total	5,128
	Total floor area, 325 sq.ft.	
	Load per sq.ft., 15.5 lb.	

Among the heaviest occupancies found is the stack room of a large law library. The entire floor area is covered with rows of steel stacks placed back to back with 32-in. aisles between rows, and extending from floor to ceiling, the story height being 11 ft. 7 in. There is a main aisle 4 ft. wide crossing the middle of the room at right angles to the stack rows. The total weight was taken as found and consisted of the following:

	Lb.
556 shelves of books, 75 lb.	41,700
114 empty shelves, 25 lb	2,850
Books on floor	500
7 ladders	100
2 persons, 150 lb	300
Total	45,450
Area, 588 square feet	
Load per square foot, 77.3 lb	

It is evident that if the possibility of all shelves being filled should be considered, the average loading would be increased to 87 lb. per square foot.

Safes—Examination of all the floor sketches shows but eight articles of furniture (safes) over 2,000 lb. in weight. A number of sectional filing cases and bookcases with contents weighed much more, but these weights were distributed over such a large area that they could not be regarded as concentrated. Of 35 safes and safe cabinets, 22 weighed less than 1,000 lb.; 5 between 1,000 and 2,000 lb.; 2 each weighed 2,200 lb. and 2,360 lb.; one each weighed 2,800 lb., 3,000 lb., 3,500 lb. and 4,250 lb. This seems to indicate that if care in regulation of occupancies were exercised, considerable economies might be possible in providing for concentrated loads. To what extent such regulation is practical is a matter for deliberation.

As would naturally be expected, the live-loads were found lighter next the outside walls. Single-row filing cases, cabinets, safes, bookcases and bins are usually located against blank interior walls. Whether by accident or otherwise, the heavier loads were not found where partitions cut up the floor space into small rooms, indicating that allowance may not be necessary for both removable partitions and heavy floor loads.

Combination of Loadings—Several instances were found where two adjacent floor bays supported average loads of 25 lb. or more, but in no case were two adjacent bays in excess of an average of 40 lb. per square foot.

There are but two or three instances in the floor plans discussed where three offices or store rooms meet at the same column and it is probable that this condition will be found but rarely in buildings designed for a sufficiency of light and ventilation. In view of this and of the surprisingly light average floor loads discovered, it becomes an interesting question whether in a building of this type further reductions in loads assumed for column design could be made with safety. The building was designed for a live load of 100 lb. per square foot on the first floor and 75 lb. on all others.

Cincinnati Weighings—A less exhaustive but nevertheless interesting investigation of office floor loading was recently made for the committee by Capt. M. W. McIntyre, manager of the Union Central Life Insurance Co. building, Cincinnati. This study included several large sections of different stories devoted to clerical and filing purposes. Each individual piece of furniture was not weighed, but the average weight of representative articles was carefully ascertained and this result applied to furnishings of four floors.

All files, desks, etc., were considered as being 100 per cent full or furnished with all necessary accessories. Following are the results of Capt. McIntyre's investigations:

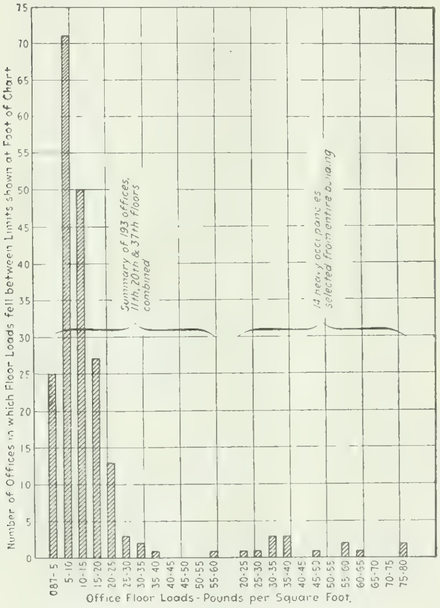


FIG. 4—FREQUENCY OF FLOOR LOADS, EQUITABLE BLDG.

	Area, Square Feet	No. Pieces of Furniture	Total Weight Lb.	Weight of Furniture Per Sq.Ft. Lb.
Section A	10,339	635	104,478	10.05
Section B	9,303	637	27,085	2.91
Section C	7,348	273	36,306	4.92
Section D	10,339	702	121,388	11.74
Average	9,332	561.5	72,314	7.405

Weight of employees, computed at the rate of 150 lb. each, added from 0.9 to 1.75 lb. per square foot of floor area. Seven individual offices similarly surveyed showed an average weight of furniture of 7.66 lb. per square foot. This building incidentally was designed to carry a live load of 100 lb. per square foot on basement and first floor, 75 lb. on stairways and corridors, and 50 lb. on other floors.

Insurance Office—The committee has investigated the live loads in a reference room of a New York insurance company, equipped with heavy steel filing cases for large Sanborn insurance map books. This was considered to represent unusually heavy occupancy. The cases were placed back to back and occupied a floor space approximately 5 ft. x 22 ft. and were 55 in. high. It was found that the case with its aisles for access occupied a space of 247 sq.ft. and weighed with contents 10,620 lb. Observation showed it liable to use by no more than 12 men simultaneously. The total load thus occasioned amounted to 50.3 lb. per square foot.

Boston Studies—C. H. Blackall, a prominent architect of Boston, Mass., and Arthur G. Everett, of the Boston Building Department, published in the *American Architect and Building News* for April 15, 1893, the results of their investigation of three prominent office buildings of that city. The buildings were examined very carefully and copious notes taken of room dimensions, occupancy and details of contents. Average weights were assumed, based on averages for the various articles of furniture. The human occupancy was taken as the greatest known to have occurred in each of the offices investigated. The nature of occupancy was sufficiently diverse to be representative. Following is a résumé of the results obtained:

Building	No. of Offices	Total Area, Sq.Ft.	Total Weight, Lb.	Weight Per Sq.Ft. Lb.
Rogers Bldg.	41	18,127	294,984 lb.	16.8
Ames Bldg.	70	32,151	544,419 lb.	15.6
Adams Bldg.	99	26,183	425,109 lb.	16.7
Average				16.3

The ten heaviest loadings in each building averaged 25.9, 29.8 and 29.0 lb. per square foot respectively. The highest load found was 40.2 lb. per square foot. In only 12.4 per cent of the offices was the floor load in excess of 25 lb. per square foot, and in only 26 per cent did it exceed 20 lb.

Mr. Blackall recently conducted a similar investigation of live-loads in the Little Building, Boston, which is reported in the *American Architect and Architectural Review*, Jan. 3, 1923. Sixty-four offices were surveyed, the results indicating live-loads even less than those discovered in his earlier investigations. The maximum floor load was 14.7 lb. per square foot, and but four offices had loadings over 10 lb. per square foot. The minimum loading discovered was 1.3 lb.

A full interpretation of the data described discloses many significant facts which space does not permit of presenting here. A detailed report on floor loads in office buildings and other occupancies will be prepared by the committee as soon as sufficient information is obtained, and recommendations for minimum floor load requirements will be made.

Mr. Blackall's data of 1893 were the only important source of information on this subject until the investigations recently completed. A few isolated observations on school floor loads have been published, and the Building Code Committee has been able to obtain from private sources some additional information on other occupancies. The total is lamentably small, however, and all who can and are willing to supply reliable information of this sort are strongly urged to report it to the committee's office at the Department of Commerce, Washington.

Cost of Seal Coat on Wood Block

Through error the cost of placing a bituminous seal coat on wood block paving as described by James McElroy in *Engineering News-Record*, March 22, 1923, p. 531, was given as 76c. per square yard. The figure should be 7.6c. About 13,000 sq.yd. were sealed at this cost.

Ten-Year Test Shows Pavement Wear and Repair

Traffic Tonnage of Street Increases Threefold—Areas Repaired from 3 to 150 Per Cent—Openings Affect Condition

By R. A. MacGregor
Assistant Engineer, Department of Public Works, Manhattan Borough, New York City

A NUMBER of sections of test pavements were laid on Second Ave., from Houston St. to 23rd St., Borough of Manhattan, New York City, in 1912 and 1913. Sheet asphalt, both manufactured and rock, asphalt blocks of manufactured and rock asphalt, Medina sandstone, wood blocks and granite blocks were all represented.

Generally, the length of each kind of pavement was two blocks with one or two intersections, though the variations of a kind were less than a block in some cases. Second Ave. was chosen as the traffic was practically uniform over the length repaved; also, the amount of traffic was heavy enough, both in amount and in individual truck weights, to give results in a reasonable time.

TABLE SHOWING PERCENTAGE OF AREA REPAIRED ON SECOND AVE. TEST PAVEMENTS

	Kind of Pavement	1913	1914	1915	1916	1917	1918	1919	1920	1921	Total
Houston St. to 3rd St.	Asphalt Block	0.1	1.7	5.7	3.1	28.2	23.8	12.2	24.9	11.0	110.7
3rd St. to 4th St.	Medina Cubes	2.2	9.2	6.6	...	...	...	...	...	...	
3rd St. to 4th St., west side	Medina Cubes	...		...	9.2	10.2	3.8	41.9	58.6	....	141.7
3rd St. to 4th St., east side	Durax	Laid	Dec.	1915	0	0	2.7	0	5.4	0	8.1
3rd St. to 4th St., west side	Asphalt Conc.	Laid	Oct.	1921	...	.		...	...	0	
4th St. to 5th St.	Medina Large		6.6	3.0	4.7	4.7	25.8	5.2	6.5	2.4	58.9
4th St. to 5th St.	White Oak Bl	Laid	1922								
5th St. to 7th St.	Short-Leaf Pine	0	0	0	0	0	0.8	0	0	0.1	0.9
7th St. to 9th St.	Sh. Asph. Open	0	0	6.0	4.0	4.4	9.6	1.2	2.4	7.6	35.2
9th St. to 11th St.	R. Asph. Bl.	0	3.0	9.0	18.4	37.3	15.6	23.0	31.5	11.4	149.2
11th St. to 13th St.	Sh. Asph. Close	0	0.1	4.0	0.4	3.1	4.5	0.4	3.4	1.7	17.6
13th St. to 15th St.	Long Leaf Pine	0.1	0	0	0	0.1	0.2	0	0.6	2.0	3.0
15th St. to 17th St.	Asph. Bl.	13.0	6.0	19.0	17.3	35.7	29.1	5.0	32.5	6.6	164.2
17th St. 19th St.	Short-Leaf Pine	0.5	0	0	0.4	0	0.5	0.2	0.3	1.5	3.4
19th St. to 21st St.	Rock Sh. Asph.	16.3	15.2	16.0	20.9	29.8	12.9	(Entirely	resurfaced 1919)	in	111.1 to 1919
21st to 23rd St.	Gran. Bl.	1.8	0	8.0	0.7	0	0	0	0	0	10.5

Traffic Conditions—In 1911 the traffic varied from 59 tons per foot of width to 91 tons, an average of 72 tons, with about 90 per cent of it on iron tires. In 1916 the traffic was from 144 to 188 tons per foot of width with an average of 167 tons and about 59 per cent on iron tires. Since 1916 no traffic count has been made on these particular blocks, but a count on this avenue farther north shows an increase in tonnage of 29 per cent, making a probable average today of about 220 tons per foot width per day of 10 hours. All these traffic counts were made from 8 a.m. to 6 p.m.

A double-track street railway extends the full length and this area was paved with asphalt or with the same kind of pavement as the side road. The number of tons per foot width is calculated on the full width of the roadway, viz., 60 ft., but owing to the comparatively light street car traffic, this does not materially affect the weight per foot of width. However, considering standing vehicles and street cars, the traffic lane next to car tracks probably carries 50 per cent more than the average.

Kinds of Pavement—The first three blocks were laid with asphalt blocks; then two blocks of Medina sandstone, 3½-in. cubes and 5-in. deep blocks; two blocks of short-leaf pine; two blocks of sheet asphalt, open binder; two blocks of rock asphalt blocks; two blocks of asphalt, close binder; two blocks of long-leaf pine; two block of asphalt blocks; two blocks of short-leaf pine; two blocks of rock asphalt sheet, and two blocks of granite, with portland cement joints.

The asphalt blocks of manufactured asphalt were made and laid in compliance with the standard specifications of 1911, which permitted considerable variation in grading of aggregate and in penetration, etc., of the asphaltic cement. Actually over 12 or 13 different variations of penetration and ductility of asphaltic cement were used, but without any outstanding improvement over the blocks laid prior to this test.

The rock asphalt blocks were specified to be of material from the mines at Ragusa, Sicily, as was the rock sheet asphalt. The rock asphalt blocks and the rock sheet asphalt were only 2½ in. thick, while the ordinary asphalt blocks and sheet asphalt were 3 in. thick.

The wood blocks were of long-leaf and short-leaf pine, both kinds treated with three kinds of oil, heavy and light creosote oil and water gas tar and with 16 lb. and 20 lb. of oil per cubic foot, making 12 variations in all. A small area in one intersection was laid with Australian tallow wood, a hard wood much like white oak. It was untreated, but had a color like very old white oak. The blocks were about the same size as the pine blocks, and have been entirely replaced.

The granite section was laid with standard blocks 5 in. deep on a 1-in. sand cushion. The joints were filled with a portland cement grout.

The 1915 annual report shows the condition of the various pavements in December, 1915, three years after completion.

In the spring of 1921 a careful examination of the wood block pavements was made by the writer and some other paving engineers. These engineers found no material difference in the kinds of wood, except that the long-leaf pine showed slightly less wear than the short-leaf pine and that the water gas treated block showed up at least as well as any and perhaps a little better than the other oils. The location of the various oils and treatments was not known to these engineers until after inspection.

An examination was made in October, 1922, by the writer and the following notes were made:

Asphalt Block (Houston St. to 3rd St.)—The surface is in fair condition, though wavy. Deformation of blocks is common. One measured 11 in. wide and 12 in. long, many 7 in. wide and 12 in. long. The original size was 5 in. wide and 12 in. long. Courses are bowed from 18 to 20 in. in 10 ft. This deformation proves, in the writer's opinion, the want of uniformity in the blocks, though the method of manufacture would seem to insure it.

Durax (3rd St. to 4th St.)—This shows some wear at the joints in the intersection of 3rd St. under the cross traffic, but the rest of the area shows practically no wear, the blocks are smooth and the joint filler flush with the surface.

(A new pavement of white oak blocks laid 1922, from 4th St. to 5th St.)

Short-Leaf Wood Blocks (5th St. to 7th St.)—The surface is practically perfect; 6 or 7 blocks were found in the light oil section, showing decay in one end for 1 to 2 in.

Sheet Asphalt—Open Binder (7th St. to 9th St.)—Surface is very wavy all over; waves short and about ¾ in. deep; general condition is fair.

Rock Asphalt Blocks (9th St. to 11th St.)—No joints can be seen and entire surface must have been covered with sheet asphalt patches.

Sheet Asphalt—Close Binder (11th St. to 13th St.)—The surface is much better than the open binder area, with about one-third as many waves and these ½ in. or less in depth.

Long-Leaf Pine Blocks (13th St. to 15th St.)—The surface is practically perfect; no decayed blocks were found.

Asphalt Blocks (15th St. to 17th St.)—The surface is very wavy; courses are bowed 2½ to 3 ft. in 10 ft., with hollows 1 to 1½ in. in depth.

Short-Leaf Pine Blocks (17 St. to 19th St.)—The surface is practically perfect; no decayed blocks were found.

Rock Sheet Asphalt (19th St. to 21st St.)—This has been entirely resurfaced by the burner method.

Granite Blocks with Cement Grout (21st fo 23rd St.)—The cement joints are all about ½ in. below the surface and about one-fifth of the area has been repoured with asphalt filler. The blocks have worn smooth and the surface is very good.

The accompanying table gives the percentage of repair on each test area.

These test pavements prove the wonderful wearing qualities of wood blocks if the pavement is not damaged and weakened by cuts. About 5 per cent of the areas between 5th St. and 7th St. and between 13th St. and 15th St. was disturbed by cuts and about 10 per cent between 17th St. and 19th St.

While the rock asphalt pavements in this test have given poor results, many other rock asphalt pavements throughout the borough have given excellent wear, most of them having been laid between 1897 and 1900.

The comparison of close and open binder is decidedly in favor of the close binder, repairs being just half and the surface now much better.

Conditions on this street have been such as to give practical uniformity throughout as to cuts and traffic and these test pavements afford a good object lesson.

Municipal Leagues and the Engineer

After 10 years' existence the membership of the League of Minnesota Municipalities has grown to 200, with full-time officials and field agents working jointly with the Municipal Reference Bureau. It supports a magazine and has 16 committees on civic problems. What the league does for the engineer was stated by Carlos W. del Plaine recently before the Minnesota Surveyors and Engineers Society:

> Wherever a municipality is an active member of the league, there the work of the engineer is made easier. The reason for this is that no city or village can be an active member of the league without realizing the necessity of efficiency in government. And no municipal government is efficient unless it has a competent engineer supervising the work done. The league gives engineering advice to its members but does not do any engineering work whatsoever. Instead it urges that competent engineers be employed and emphasizes the fact that real economy is effected when good engineers are employed at reasonable prices rather than any kind of an engineer merely because he is low-priced.

Refuse Incinerators Advised for City of Boston

ABANDONMENT of garbage reduction at Boston, Mass., and the building of eight incinerators of the type being promoted by the Balmer Corporation, New York City, together with the substitution of the contract system of garbage and refuse collection for the 60 per cent of the material now being collected by the city direct, are the chief recommendations of a report recently made to the city authorities by Colonel George A. Johnson, consulting engineer, New York City. It is assumed that Coleman Brothers Co., the present contractors for garbage disposal by reduction, would willingly terminate the contract piecemeal as the proposed incinerators were completed. Utilization of heat from the incinerators for the production of electric current for sale by the city is proposed in the report. The incinerators would be similar to those at Montevideo, Uruguay, and the plant contracted for recently by the City of Charlestown, W. Va.

Colonel Johnson's summary of estimates for his plan, slightly rearranged but with no change otherwise, is given in the accompanying table. It will be noted that by assuming a heavy decrease in the cost of collection and a considerable revenue from heat and clinker utilization, and by assuming also that the present contractor would cancel the unexpired portion of his ten-year contract in force July 1, 1922, Colonel Johnson figures a "potential annual saving" of $543,506 by means of the changes which he proposes, or about one-third of the total present annual cost of garbage, ashes and refuse disposal.

Colonel Johnson's report, without the numerous and voluminous appendixes, is printed in the Boston *City Record* for March 3.

ESTIMATED POSSIBLE SAVINGS ON GARBAGE, ASHES AND REFUSE COLLECTION AT BOSTON, MASS., AS GIVEN IN REPORT BY COL. GEORGE A. JOHNSON

Total combined refuse, 482,147 tons annually, of which the garbage amounts to 78,609 tons; ashes, 371,278 tons; rubbish, 32,260 tons.	
Total cost of collection and transport to destructor stations of 482,147 tons of combined refuse	$864,390
Annual saving over present collection costs	461,415
Total cost of building and completely equipping the eight destructor stations, having a total daily rated capacity of 1,950 tons, or 711,750 tons annually, which is 48 per cent in excess of the total present annual production of combined refuse	2,255,000
Annual cost of operation and maintenance of the eight destructor stations, including a 10 per cent fixed charge on the capital investment to cover interest, depreciation and sinking fund	640,930
Total cost of building auxiliary power development plants at [6 of the 8] stations	1,023,695
Annual cost of operation and maintenance of the 6 auxiliary power development plants, including a fixed charge of 10 per cent on the capital investment to cover interest, depreciation and sinking fund	222,869
Combined cost of building the eight destructor stations and the 6 auxiliary power development plants	3,828,695
Combined annual cost of operation and maintenance of 8 destructor stations and the 6 auxiliary power stations, including fixed charges to cover interest on the capital investment, sinking fund, repairs and replacements	863,799
Annual revenue derivable from electric current produced at the 6 auxiliary power stations, based on present amounts of refuse, and with current valued at 1c. per kw.-hr.	477,350
Annual revenue from clinker from 8 stations, 167,820 tons at $0.30 per ton	50,346
Revenue derivable from marketable electric current and clinker produced	527,696
Net total cost to the city for the incineration of 482,147 tons of combined refuse annually	336,103
Total annual net cost of collection, delivery and incineration (made up of net cost of incineration, $336,103, plus $864,390 for cost of collection and transport to destructor stations of 482,147 tons of combined refuse)	1,200,493
Present total cost to the city for refuse collection and disposal	1,748,999
Net cost under new plan	1,200,493
Potential annual saving by adoption of the new program involving collection and incineration of the combined refuse	548,506

Railways of Russia, the Balkans and the Baltic States

Russian Problem of Long Standing—Fair Progress in the Balkans—Many Gages a Problem in the Baltic States

This is the last of three articles on the European railway situation by the London correspondent of ENGINEERING NEWS-RECORD. *The first on the general subject appeared in the issue of Mar. 8, and the second on conditions in France, Germany and Poland in the issue of Mar. 15.*

THE present deplorable state of the Russian railways is due not entirely to the Soviet revolution but also to the lack of railway development in the policies of Czarist governments. The lack of suitable railways was felt long before the war when there were insufficient trains to carry the ordinary passengers in addition to the products of industry. True, certain lines appeared well organized and service on these routes was good; on the lines running from east Germany to Petrograd and Moscow, for example. But here the influence of other countries aside from Russia was felt, because the traffic on these lines was largely international both in passengers and freight. Where Russia alone had to be served the systems were deplorably organized.

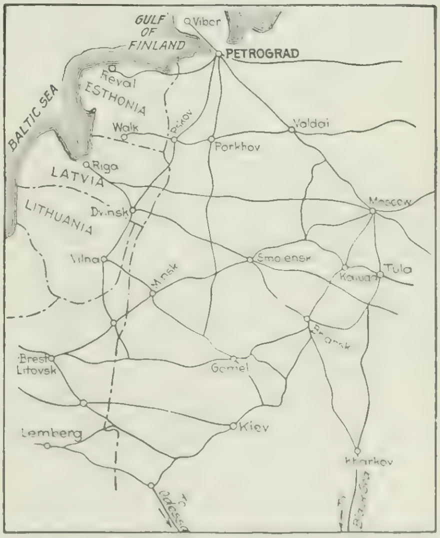
The need Russia felt then has been made even greater today owing to the lack of organization of any type throughout the country. The lines are laid out on the main economic routes, and usually well-laid, but the majority of them have been uncared for for the past eight or nine years and relaying with new metal and ties has become an urgent necessity.

Physical Condition Cuts Capacity—As matters now stand the ties and track support are in so bad a condition that freight trains of only moderate weight can pass over at greatly reduced speeds, or on some sections train services are impossible. In other cases the metal must be entirely renewed and a heavier type laid before any sort of traffic can pass. Bridges also are lacking and those destroyed during the revolution have only been rebuilt in part. A few have been rebuilt on a permanent basis on one or two of the main routes, but on the whole it may be said that 80 per cent of the railway bridges need renewal. The same applies to other equipment such as depots and repair sheds. That part of this very essential equipment which was not totally destroyed was rifled. Up to now very little has been done to replace this equipment, while the railway signalling and telegraphic services are conspicuous by their absence.

Of rolling stock there is very little of serviceable value. At present the number of locomotives available for haulage is under 10,000 while an additional 12,000 are rusting in the yards for lack of major or minor repairs. The number of passenger coaches which will hold the track average about two per locomotive in addition to one per locomotive awaiting rebuilding or repairs. The freight cars available for transport are about twenty per locomotive with another ten held up for repair. In some of the larger cities workers are engaged in repairs to the railway stock but this work is necessarily slow because the machine tools and other equipment have been in use since about 1912.

Naturally, on account of the huge areas to be served by transport it is impossible to tide over the present period by employing road services; in fact the roads that do exist are just about in as sad a condition as the railways, so no palliative can be looked for in this direction.

Concentrate on Food Carriers—The Soviet transit authorities are endeavoring to remedy the existing state of affairs by concentrating their efforts on the reorganization of those lines which are essential to the transport of foodstuffs. There are various long lines reaching to the food-growing districts and these before the war carried the bulk of the Russian traffic. Here the present track is to be renewed where necessary and heavier rails laid to carry the heavier freight trains which will be run when the agricultural industry has again got into its stride. This applies particularly to southeast Russia, where it is hoped to develop grain growing to a large extent, and also to the service between Petrograd, Moscow and the Black Sea ports.



RUSSIA'S PRINCIPAL RAILWAY LINES

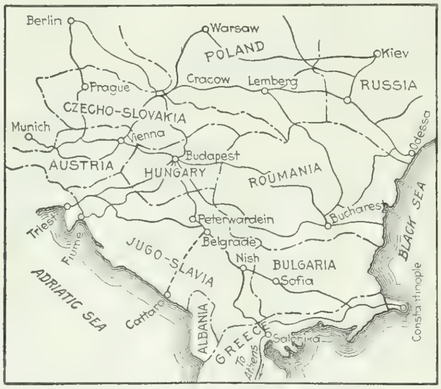
Unfortunately for railway construction, Russia is not a highly industrialized country like Britain, for example, and that material which can be constructed in Russia must be transported over very long distances to the point of use. Again, a large part of the new material must be purchased outside Russia when finances or guarantees are available, and when some sort of transport from the Russian ports to the shops and damaged systems can be organized.

Russia is enormously handicapped in the work of railway construction by the fact that her system was quite inadequate before any war or revolution damage was done. Her system was under very irregular control and lines were laid either for military purposes or as the result of the influence of some industrial magnate.

The lack of skilled railway personnel also is felt. The majority of qualified engineers, belonging as they did to the bourgeoisie, were either imprisoned and executed or driven from the country. Russia, before any sort of railway system can exist in her country, has to attract and safeguard foreign interests as well as skilled technical brains.

The Balkan Railways—A railway map of the Balkan countries, Jugoslavia, Albania, Bulgaria and Greece, will show a distinct scarcity of railway lines. Three main lines traverse Jugoslavian territory, two Bulgarian and one Greek. Aside from the connections between Budapest and Trieste and Fiume, and the projected line from Belgrade to Cattaro, there seem to be no lines impinging on the northern side of the Adriatic. Despite this the Balkans are among the most important of the railway areas in Europe. Direct rail communication between western Europe and the East must pass right through the Balkan countries. The business man from France or Germany to Constantinople must pass through Belgrade, the capital of Jugoslavia, and this city was the center of a vast continental traffic including express routes from France to Russia, Poland to Greece, London to India and Russia to the Adriatic.

This favorite fighting ground of Europe has had a large part of its system destroyed and the remainder completely disorganized. Serbia, now part of Jugoslavia, suffered early in the war, and the entire system was demolished, railway track and bridges being blown up. That part of Austria-Hungary which is now under the Jugoslavian monarchy underwent some damage to the railway system, but this was practically confined to the rolling stock, the permanent way and bridges being little interfered with. The Bulgarian system was kept in fairly good condition by German engineers but since the war there has been no organization at all, and the future railway system must be reconstructed almost from the beginning as far as personnel is concerned. The locomotives and rolling stock especially are among the most primitive in Europe.



RAILWAYS IN THE BALKAN STATES

Balkans Make Progress—The Balkans have, however, not been slow to reconstruct. The Serbian or other Jugoslavian lines were in a condition to carry freight within a year of the armistice, though locomotives and rolling stock are still very short of that country's requirements. Owing to the fact that Jugoslavia is a new state, created at Versailles, immense difficulties have been in the way of reorganization, and materials, money and skilled labor are lacking. However, this state has been able to raise sufficient money and find enough men to put the lines in order so that heavy traffic can be carried at a reasonable speed on all the lines of the pre-war system. In addition new lines are to be built linking Belgrade, the capital, with Cattaro, the state's new port on the Adriatic.

It is in rolling stock, however, that Jugoslavia's chief need lies. For normal passenger and freight operation this new state requires upwards of 2,000 locomotives and 0,000 cars and coaches. She now possesses about 60 per cent of each requirement, and of these half are constantly under repair, owing to the fact that the best of the rolling stock was captured during the war, and taken into foreign territory. In addition to this handicap, the railway repair shops and depots now within Jugoslavian territory were destroyed during the war. This necessitated repairs to locomotives and cars being done in foreign shops, and labor troubles in the shops of the repairing concerns have proved a serious hindrance to the normal operation of the Jugoslavian railway system. The bulk of this work was undertaken by Austria where the currency was favorable. The rolling stock situation has been partially improved by taking reparations from Germany in the form of locomotives. Delivery of this material has been on the whole good and has enabled Jugoslavia to go ahead with the reorganization of traffic.

Shortage of Rolling Stock—The other systems in the Balkans have suffered less from permanent way destruction but quite as much from the wearing out of rail stock. Bulgaria now is very short of locomotives and has placed contracts in German shops for the construction of new stock. The rolling stock position in Greece is especially serious and she has practically no equipment in really first-class condition. On the other hand, her system was practically untouched by the war. The Greek railways were never of very much account, however, so that her shortages affect the rest of Europe very much less than the deficiencies in Jugoslavia and Bulgaria.

The Balkans as a whole are suffering from the lack of skilled railway workers and much of the present labor has practically no experience of either rail maintenance or operation. This is due not only to war losses but the upheaval caused by the division of Austria-Hungary and the various industrial and political disturbances which are notoriously inseparable from southeast Europe. The eight-hour day is also a contributory factor to unrest and inefficiency. More workers have had to be taken on for less work and this, combined with a greatly increased wages bill, has driven operating costs to an unprecedented height.

Owing to the shifting of political boundaries Jugoslavia especially finds herself unable to cope with the present traffic demands. To deal with existing and potential traffic the existing routes are to be reinforced by one or more lines, depots are to be doubled in number and in size and pre-war repair sheds rebuilt and their number increased. The Balkan area is not short of skilled executives but they are rapidly coming to the realization that forces of specialized workers are essential to successful railway operation. Accordingly the state is taking this problem in hand and making specialized instruction a part of the reorganization scheme.

The difficulty now is lack of adequate finances, in spite of certain sums raised abroad, in America for example, and an item on next year's budget of some million dollars or so.

The Baltic States—One of the great problems confronting the three new states, Esthonia, Latvia and Lithuania, is the reorganization of the railway system. These three states are on the east of the Baltic and were formerly part of the Russian Empire. The result of this was that all the railway systems in Russia turned about the two chief cities, Petrograd (then St. Petersburg) and Moscow. Consequently, when these three states were created they found themselves saddled, not with complete railway systems, rolling stock and staffs, but outlying sections of a former system with rolling stock and staff grouped round the Russian capital. Latvia is the best off of these three because railways had been constructed to serve the port of Riga. All three republics suffer not only from shortage of the lines but also from the fact that they all run straight from Poland through to Russia.

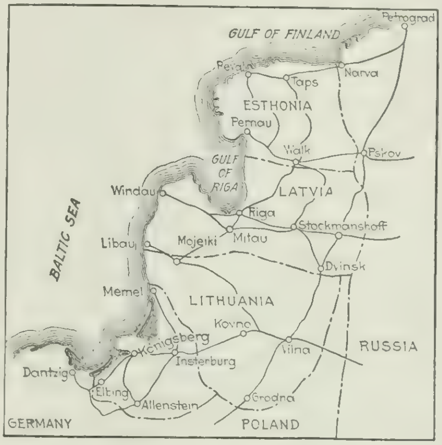
The Gage Problem—Another handicap in the situation is that these three new states have probably the largest assortment of gages that it would be possible to find anywhere. Latvia has both the standard gage (4 ft. 8½ in.) and the Russian broad gage. The other two states have lines of both these gages in addition to one or two meter-gage lines, and also side lines of apparently any gage that it pleased the engineer to lay down. This complexity of gages means a large amount of complete rebuilding before through traffic can be run, on all except one or two lines.

Lithuania, the most southern of these states, has a total railway mileage of 3,200 km., rather more than half being broad gage, the rest being made up of the standard and narrow gages. Most of this system has fallen temporarily into disuse because, during the war, first the Russians seized their locomotives and rolling stock, then the Germans took a hand—between the two, Lithuania was left with next to nothing. She actually possesses now about 10 broad-gage and 60 narrow-gage locomotives, about 3,000 freight cars, and 300 passenger coaches; hardly sufficient stock to make the systems pay. Before the war this section of the Russian railways yielded a net profit of ten million rubles, it is now less than a hundredth of that sum.

Situation in Esthonia—Esthonia is slightly better off, due to the fact that her proximity to Petrograd has given her rather a larger network of lines, and also because the important port of Reval is in her territory. Most of this system is built on the Russian broad gage (5-ft.) while subsequent or less important lines have been made narrower. In all, this republic owns 650 km. of state-owned narrow-gage line and 300 km. of privately-owned narrow-gage. Owing to the flat nature of the country railway construction is easy and no natural obstacles are found. As a matter of fact the grades in Esthonia nowhere exceed 0.01 per cent and all curves have a radius exceeding 1,300 ft. Esthonia is fortunate in that the majority of her lines were constructed by Russian engineers, whose construction code was very strict. So far as railway stock is concerned this state possesses 200 locomotives, 450 passenger coaches and about 5,000 freight cars—inadequate for efficient transport in normal times, but quite good enough to cope with present traffic needs.

Except at the important centers of Riga and Reval the repair shops and depots are but poorly equipped. The greater proportion of the repairs in pre-war times were executed in Russia, while the well-equipped repair shops existing in the areas under discussion were stripped either during the war or during the revolution.

The greatest need of these Baltic states is the service of skilled technical personnel. The engineers formerly were Russians, servants of the Czarist government, and now either dead or living in foreign countries. The same applies to the skilled railway workmen. Most of these were withdrawn into the Russian army and, after the revolution, put to work on Russian railways. In these circumstances the three republics find themselves compelled to train an entirely new staff, both of skilled engineers and laborers.



BALTIC RAIL LINES NOT INDEPENDENT SYSTEMS

Fewer Marine Borers in San Francisco Bay in 1922

MARINE borers in San Francisco Bay were less prevalent in 1922 than in 1921 due to fewer available breeding places and a shorter season because of the higher percentage of fresh water and also colder temperatures. Examinations made by the San Francisco Bay Piling Committee, as reported at a recent meeting of the American Wood Preservers' Association, indicate that the ravages of "*Teredo navalis*" may be much curtailed if "marine sanitation" is persisted in. Such "sanitation" according to Charles A. Kofoid and Robert C. Miller who have charge of the biological section of the committee, consists in the removal of untreated timbers which might serve as breeding places and a general "policing up" to remove from the shores of the bay driftwood, old hulks, etc., which might provide foci of infection for commercial structures.

Practically without exception, says the report, replacements have been made with treated piles and engineers have shown a disposition to remove old piling before driving the new, rather than following the careless practice of re-driving alongside of the old piles, leaving the untreated stumps to harbor a multitude of borers. Attacks by *Teredo* on untreated timbers, which reached a climax in 1919 and 1920, were considerably less in 1921 and had still further declined in 1922.

Eighteen of 69 Large Cities on 1922 Typhoid Honor Roll

No Typhoid Deaths in Providence, New Bedford and Yonkers—Nashville Has Highest and Trenton Next to Highest Rate

OF THE 69 cities in the United States with a population of 100,000 and over, typhoid statistics for 1922 show 18 cities on the honor roll with from 0 to 2 deaths from typhoid per 100,000; 29 cities fall in the next class with rates from 2.1 to 5; 17 rank from 5.1 to 9.2; and 5 have typhoid rates of from 10.2 to 16.2. The figures for each of the 69 cities are shown in Table I, which is one of ten tables published in the *Journal* of the American Medical Association for March 10, 1923, as part of its eleventh annual survey of typhoid fever in the larger cities of the United States. Table II, from the same source, presents mass figures for the years 1910 to 1922 inclusive, covering 57 cities as against the 69 for the year 1922 alone. Table II shows that although the population of these 57 cities increased from 21 to 27 millions from 1910 to 1922, the total typhoid deaths decreased from 4,114 to 851 and the typhoid death rate per 100,000 from 19.59 to 3.15. With the exception of slight increases in 1913 and 1921 as compared with the immediately preceding year, the decline has been continuous.

Part of the *Journal's* comment on the result of its survey are as follows:

> The slight check that occurred in 1921 to the almost steady decline of twelve years has been followed, as we predicted last year, by a further decrease. Compared with 1921, 46 cities showed a diminished and only 23 an increased typhoid rate. It does not seem over sanguine, knowing what we do of modes of typhoid dissemination, to believe that city typhoid rates will decline still further. We are certainly not manufacturing typhoid carriers in the United States as abundantly as we were fifteen years ago.
>
> * * * * *
>
> Trenton affords the highest typhoid rate in northern cities, and finds itself in the third rank, having for its only companions four southern cities with a large negro population, and surrounded by rural areas in which typhoid is far more prevalent than in the neighborhood of Trenton. Trenton and Reading might perhaps profit by an anti-typhoid campaign. Is there any reason why these cities should have consistently higher typhoid rates than Paterson and Scranton?

TABLE I—DEATH RATES FROM TYPHOID IN 1922

Honor Roll (from 0.0 to 2.0)—18 Cities			
New Bedford	0.0	Scranton	1.4
Providence	0.0	Springfield	1.4
Yonkers	0.0	DesMoines	1.5
Bridgeport	0.6	Jersey City	1.6
Grand Rapids	0.6	Syracuse	1.6
Cambridge	0.9	Albany	1.7
Chicago	1.0	Akron	1.9
Columbus	1.1	Minneapolis	1.9
Boston	1.4	St. Paul	2.0
First Rank (from 2.0 to 5.0)—29 Cities			
Paterson	2.1	Fall River	3.3
Cleveland	2.2	Portland	3.3
New York	2.2	Buffalo	3.5
San Francisco	2.2	Dayton	3.7
Milwaukee	2.5	Los Angeles	3.7
Rochester	2.5	Toledo	3.8
Lowell	2.6	Baltimore	4.0
Newark	2.7	Tacoma	4.0
Philadelphia	2.7	St. Louis	4.2
Hartford	2.8	Omaha	4.4
Seattle	2.8	Richmond	4.4
Cincinnati	2.9	Pittsburgh	4.6
Oakland	3.0	Kansas City, Mo.	4.9
Worcester	3.1	Detroit	5.0
Salt Lake City	3.2		
Second Rank (from 5.0 to 10.0)—17 Cities			
Wilmington, Del.	5.1	Youngstown	6.2
Washington, D. C	5.2	Norfolk	6.4
Indianapolis	5.4	Kansas City, Kan.	7.0
San Antonio	5.6	Houston	7.3
Camden	5.7	Fort Worth	7.8
Spokane	5.7	Louisville	8.0
Dallas	5.8	Memphis	8.9
New Haven	5.8	Reading	9.2
Denver	5.9		
Third Rank (from 10 to 20)—5 Cities			
New Orleans	10.2	Trenton	15.9
Atlanta	10.9	Nashville	16.2
Birmingham	12.5		

TABLE II—TOTAL AVERAGE TYPHOID DEATH RATE (1910-1921)

	Total Population (57 Cities) Estimated by the U. S. Census Bureau Methods	Typhoid Deaths	Typhoid Death Rate Per 100,000
1910	20,996,035	4,114	19.59
1911	21,545,014	3,391	15.74
1912	22,093,993	2,775	12.56
1913	22,642,972	2,892	12.77
1914	23,191,951	2,408	10.38
1915	23,740,930	2,068	8.71
1916	24,205,359	1,842	7.61
1917	24,740,068	1,647	6.65
1918	24,971,278	1,557	6.23
1919	25,526,186	987	3.87
1920	26,154,013	921	3.52
1921	26,561,469	978	3.68
1922	26,936,843	851	3.15

As Table I shows, Reading has the highest rate of the cities in what the *Journal* calls the second rank, having had a typhoid death rate in 1922 of 9.2 per 100,000. Paterson fell just short of getting on the honor roll, its rate having been 2.1. The Scranton rate of 1.4 was still lower.

The Trenton typhoid rate in 1921 was only 8.9 and the average for the years 1916-20 still lower—8.6—while for 1911-15 the average was 22.3. Nashville shows steady improvement: 16.2 for 1922 against 20.4 in 1920, 20.7 for the five years 1916-20; 40.2 for 1911-15 and for 1906-10 the very high average of 61.2 typhoid deaths.

Canadian Institute Committee Reports on Salaries

First Part of Classification Report, Now Before Members, Deals With Salaries—Section Relating to Fees Will Follow

PART I of the report of the committee on classification and remuneration of engineers dealing with compensation and classification for those not in consulting practice has been received by the council of the Engineering Institute of Canada and published for the information of its membership. It is anticipated that the report will be discussed in the various branches and that the branches will express their wishes with regard to its adoption by the Institute. Part II, relating to fees for special work, particularly in consulting practice, is expected by the council at an early date.

The committee was constituted in March, 1920. In its deliberations it has taken account of reports from the various branches of the Institute, from the British Columbia Technical Association, and from certain engineering societies in the United States, as well as that of Engineering Council. It has availed itself also of information published from time to time in the technical press and has considered the classification of the Dominion government engineering and allied services made under the supervision of the Civil Service Commission of Canada.

The committee considers a standardized classification as being a first essential toward any concerted effort for proper engineering compensation and has devoted much study to the formulation of an appropriate classification and scale of remuneration. With some alteration, it has adopted, as a basis for its classification, that proposed by Engineering Council, but it has discarded the subdivision into professional and sub-professional service. It has also given to the college graduate, for the first year or so after graduation, less advantage over the non-graduate with experience, but has allowed a greater advantage thereafter until the higher positions are reached. The committee points out that the title attached to an engineering position need not necessarily indicate the grade that would be accorded that position in its classification. The title of "chief engineer" of a small industrial concern or municipality might in the matter of duties and qualifications correspond to a grade considerably lower than that of a chief engineer who, in a position of great importance, might have to be a man of the highest engineering ability with executive attainments. The committee accords the title of chief engineer to such positions only and considers them as outside the scope of classification.

Proposed Classification—The classification prepared by the committee contemplates eight grades as follows: Grade I, assistant chief engineer; Grade II, engineer; Grade III, senior assistant engineer; Grade IV, assistant engineer; Grade V, junior assistant engineer; Grade VI, junior; Grade VII, senior aid, and Grade VIII, junior aid.

An assistant chief engineer (Grade I) would have administrative charge of a technical organization or a main division thereof, determine general policies under limitations of law, regulation, or other fixed requirements, would have final responsibility in the preparation of reports, estimates, designs and specifications, and for the construction, maintenance or operation of engineering works, would have full charge of collection and presentation of data in valuation proceedings, or direct the most comprehensive lines of engineering research. To qualify for this grade the committee requires an appropriate training and experience of at least twelve years, of which at least four years shall have been spent on similar work in a subordinate position and at least five years in responsible charge of important work, together with fundamental training equivalent to that represented by a professional degree from a recognized institution, or additional experience of at least four years. Positions corresponding to this grade might be assistant chief engineer, city engineer, superintending engineer for a province, etc.

The engineer (Grade II) would have responsible charge of determining policies for a major subdivision of an organization, under general administrative direction and within the limits of general policies; would prepare for final executive action reports, estimates, designs, specifications and valuation studies and data, would have immediate charge of construction, maintenance or operation of engineering works of major importance, direct major lines of engineering research or furnish for executive action expert advice on engineering works, or policies. His qualifications should comprise professional practice or executive charge of work for at least eight years, of which at least three years have been spent in similar work in a subordinate position, and at least three years in responsible charge of work, fundamental training equivalent to that represented by a professional degree from a recognized school or at least four years of additional experience. Positions corresponding to this grade might be engineer, district engineer, designing engineer, etc.

The senior assistant engineer (Grade III) would, under general administrative and technical direction, have responsible charge of an intermediate division of an organization, exercise independent engineering judgment and assume responsibility in studies and computations and would have immediate charge of construction, maintenance and operation of important engineering works, or conduct or direct important lines of engineering research. Qualifications should include active professional practice or executive charge of work for at least five years, of which at least three have been spent in similar work in a subordinate position and at least one year in responsible charge of work; training equivalent to that represented by a professional degree from a school of recognized standing, or at least five years of additional experience. Positions corresponding to this grade would be senior assistant engineer, division engineer, or engineer of a department.

Assistant engineer (Grade IV) would, under specific administrative and technical direction, have responsibility for the conduct of a minor subdivision, collection and compilation of data for special items of engineering study, immediate charge of field survey projects, or of design and construction, would lay out and develop work from specifications and supervise the work of a drafting or computing force, or conduct specific tests or investigations of apparatus, materials or processes. Qualifications should include experience of at least three years, of which one year shall have been spent on similar duties in subordinate positions; fundamental training equivalent to that represented by a professional degree from a school of recognized standing, or additional experience of at least five years. Positions corresponding to this grade would be assistant engineer, estimating engineer, chief engineering draftsman, engineer on construction, etc.

The junior assistant engineer (Grade V) would, under immediate supervision, take charge of drafting squads, direct a field party on surveys or construction, direct the computation of surveys and estimates, design minor engineering works, compute data for reports or records, investigate minor details of engineering work, perform tests of apparatus, material or processes, or have charge of inspection of engineering works under construction. Qualifications should include experience of at least two years in similar duties in a subordinate position, fundamental training equivalent to that represented by a professional degree from a school of recognized standing, or an education equivalent to graduation from a high school and at least four years of additional experience. Positions corresponding to this grade would be junior assistant engineer, inspecting engineer, etc.

A junior (Grade VI) would supervise the plotting of notes and maps and be competent to use surveying, measuring and drafting instruments, take charge of parties on survey or construction work, to design details from sketches and specifications, to compute data for reports or records, to inspect or investigate minor details of engineering works, to supervise construction or repairs or to check plans, surveys, and other engineering data. Qualifications should include experience for at least one year in similar work in a subordinate position, fundamental training equivalent to that represented by a professional degree from a school of recognized standing or education equivalent to graduation from high school and at least three years of additional experience. Positions corresponding to this grade would be senior draftsman, inspector, etc.

Senior aid (Grade VII) would prepare general working drawings where design is furnished, plot notes and prepare maps, design simple structures, make computations and compile data for reports and records, prepare routine tests of apparatus or materials, run surveying instruments and adjust and care for same, compute surveys and estimates, make minor engineering computations, and inspect incidentally construction or repair work. Qualifications should include experience for at least two years in work of a nature to qualify for this grade, education equivalent to graduation from a high school, and familiarity with the use of the slide rule and of logarithmic and other simple mathematical tables. Positions corresponding to this grade would be draftsman, leveler, transitman, etc.

Junior aid (Grade VIII) would trace and letter maps and plans, make simple drawings from sketches and data, make minor calculations, run type or leveling rod, perform other miscellaneous subordinate duties in survey party and field or office as directed. Education should be equivalent to graduation from a high school. Positions would be tracer, chainman, rodman, etc.

Proposed Compensation—In arriving at a scale of remuneration the committee has taken into account the opinion of members of the Institute throughout Canada as to reasonable compensation and points out that these show a very wide range, especially in the higher grades. The variation does not appear to be a matter of location and as an illustration it cites the report of the Vancouver branch, where the scale of remuneration proposed by a committee appointed by the branch was raised from 15 to 20 per cent for the intermediate grades at a general meeting of the branch. No attempt was made to give different salary schedules for the various services, such as railroad, municipal or industrial. Duties of the same nature, the committee says, should command the same remuneration, other conditions being the same, whether the work is done in the service of a railroad, municipality, or industrial concern. The range between minimum and maximum allows latitude for the varying abilities of individuals.

The committee feels that while the rates of remuneration proposed may seem too low to many members of the Institute, it would be advisable to be moderate in the first scale; otherwise there would be danger of defeating the object for which the schedule is designed. It points out also that there would be no hope of making a schedule effective if it be made so high that many members of the profession not members of the Institute would be satisfied to accept lower salaries. The committee is of the opinion that salary ranges for the engineering positions in the Dominion government service are inadequate for the professional qualifications exacted. It recommends adjustments to give either higher salary ranges for the present specifications or reduced qualifications for the present salary ranges, if it is desired to attract and retain a staff of properly qualified engineers for government service. The following table summarizes the recommendations of the committee as to the grades, experience, and salaries:

Grade	Title	Years With Degree	Years Without Degree	Salary Range— Min.	Max.
VIII	Junior Aid	0	0	600	1,200
VII	Senior Aid	0	2	1,200	1,800
VI	Junior	1	4	1,800	2,400
V	Junior Asst Engr	2	6	2,400	3,300
IV	Asst. Engr.	3	8	3,300	4,200
III	Senior Asst Engr	5	10	4,200	5,400
II	Engineer	8	12	5,400	no limit
I	Asst Chief Engr	12	16	7,200	no limit

Blowout in Relaid Cast-Iron Pipe

By McKean Maffitt
Superintendent Water-Works, Wilmington, N. C.

A RECENT blowout in an 8-in. water main at Wilmington, N. C., together with a number of similar blowouts a few years ago, illustrates the results of carelessness in handling cast-iron pipe and the importance of thorough inspection of pipe when it is being handled.

In 1910 the Wilmington water-works was partly rebuilt. All of the work was done by contract under the supervision of engineers employed by the city. In the course of this work certain mains were moved from one street to another. The pipe was to be taken out of the ditch, cleaned, re-coated, inspected and tested before being relaid. There was no great care used in the handling of the pipe and the inspection and testing must have been very slack. Immediately after installation we had four blowouts from cracked pipe. In every case the tar could be seen in the cracks showing that the cracks were simply covered up with the tar coating.

In the next thirteen years we had no trouble with this pipe, but a few weeks ago there was a blowout under normal pressure conditions. The immediate cause of the blowout was a crack about 4 ft. in length, running along the longitudinal axis of the pipe with several smaller cracks radiating out from the large crack in every direction. An examination of the metal of several pieces of the broken pipe showed cracks that were full of rust, cracks that were partly in new metal and partly old metal. One of these cracks, which was visible from the inside of the pipe but not visible from the outside of the pipe, was so bold that the piece of metal showed the crushing-in of the pipe (a straight edge showed a misalignment of nearly $\frac{3}{32}$ in.).

The marvel is that this pipe should have held the domestic and fire pressure for thirteen years without showing any sign of leakage. It also shows that a little carelessness in handling cast-iron pipe will materially injure it, though a thorough inspection should have shown the cracks present.

T.N.T. Moves Rock on Tieton Dam Project

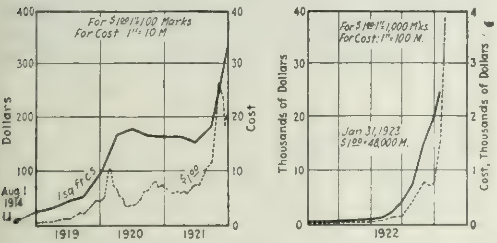
Twice in the construction of the Tieton Dam for the Yakima irrigation project in Washington, large quantities of rock have been loosened and moved by the explosion of charges of T.N.T. The first blast, fired on March 5, 1922, used five tons of the explosive and the second blast fired on Dec. 19, 1922, employed 11.4 tons of T.N.T. Both blasts were on the line of the spillway excavation and were so located that rock blown off into the canyon below would serve as part of the fill for the dam. In the first blast the explosive was loaded into three pockets, spaced 26 ft. apart, and located 74 ft. in from the surface of the bluff, measured horizontally. The central charge consisted of 1.5 tons and the two other pockets each contained 1.75 tons of explosive. This blast broke up and loosened 22,100 cu.yd. of rock, of which 13,700 cu.yd. fell into the river channel within the limits of the dam fill. In the second blast the explosive was placed in eight pockets, two containing 1.2 tons each, and the other six 1.5 tons each, all spaced about 34 ft. apart and located about 50 ft. horizontally from the face of the hillside. This blast loosened 19,000 cu.yd. The work is under the direction of F. T. Crowe, construction engineer, U. S. Reclamation Service, Rimrock, Wash.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

A Graphic View of German Economic Conditions

Sir—The two accompanying diagrams show in an impressive way the economic catastrophe that has occurred in Central Europe. The data are taken from a great number of contracts, mainly for factories and other buildings of the ribbed-slab floor type, carried out by a large reinforced-concrete firm on the German upper Rhine. For those living in a country of more or less sound economic conditions, it will be difficult to imagine what an increase of prices by hundreds of per cent in one week or less means. Calculations, disposition, right business methods are impossible of execution. The fatal curves show what is happening—a convergence towards a vertical asymptote!



3-YEAR RISE IN GERMAN CONCRETE COSTS

Neustadt, a. d. Hdt. 3. Feb. 1923. ARN. ESCHER.

Baltimore Water Sedimentation

Sir—In my article published in your issue of Feb. 1, p. 204, "Experiments on Formation of Floc for Sedimentation," I note that while the curves in Figs. 2 and 3 are plotted correctly, the legend is reversed. It should be:

———————— velocity 0.96-1.15 (solid line)
- - - - - - - - velocity 1.15-1.25 (broken line)
. . . . velocity 1.26-1.35 (dotted line)

This incorrect presentation produces an entirely different conclusion from that expressed in the text of the article.

Baltimore, Md., EDWARD S. HOPKINS,
Feb. 21, 1923. Chemist.

Treatment Conditions in Concrete Tests

Sir—With reference to the effect of integral waterproofing compounds on the strength of concrete it is important to bear in mind the difference to be expected between tests of specimens cured under ideal laboratory conditions and those cured under conditions more nearly similar to what is found on the job.

In the tests of the U. S. Bureau of Standards reported in Technologic Paper 174, comparison was made between the effects of CAL, a patented calcium oxychloride compound, on concrete specimens (6 x 12 in. cylinders) cured in damp sand, and exactly similar specimens, made at the same time, stored in the laboratory air at an average temperature of about 66° F. and an average relative humidity of 65 per cent.

The results of 28 days showed an average strength of 94.5 per cent of normal (average strength of untreated specimens) for the treated concrete stored in damp sand, and an average of 104 per cent of normal for the treated concrete stored in air.

In the same series of tests 1:3 mortar specimens stored in air showed an average strength of 28 days of 108 per cent of normal, for specimens treated with 5 per cent of the compound.

RICHARD H. CATLETT,
Hagerstown, Md., Gen. Mgr. CAL Chemical Co., Inc.
March 2, 1923.

Ton-Mile Freight Costs on Great Lakes

Sir—*Engineering News-Record*, Feb. 22, 1923, p. 364, gives a table credited to a committee of the Western Society of Engineers, showing the annual interest and maintenance cost of several waterways and the similar cost per ton-mile of freight traffic. It occurs to me that it might be of interest to your readers to compare the data given with those pertaining to the Great Lakes.

In the following table the figures appearing in your printed article are rearranged but unchanged. A slight discrepancy appears in the data on the Allegheny Waterway. Assuming the correctness of the first and second columns, the ton-mile cost in the third column should be 0.028 instead of 0.016 as printed. However, the effect of any such typographical error does not affect the totals, appreciably.

WATERWAY IMPROVEMENT COSTS

Waterway	Ton-Miles Per Year (Millions)	Total Annual Cost (Includes Annual Maintenance plus 5% of First Cost)	Cost of Improvement per 1,000 Ton-Miles per Year, Including Maintenance
Allegheny	10.2	$288,000	$16.00
Mississippi (mouth of Missouri to Cairo)	175	989,000	5.65
Warrior system	173	775,000	4.47
Monongahela	782	1,700,000	2.16
Mississippi (Vicksburg to New Orleans)	750	1,600,000	2.15
Sacramento	96	132,750	1.38
Ohio	4,220	4,600,000	1.10
Total—River waterways	6,206	10,084,750	1.62
Great Lakes system	60,420	6,309,000	0.104

The data for the Great Lakes appearing in the above table were taken from the 1921 Annual Report of the Chief of Engineers, U. S. Army. The first cost of all federal improvements on the various channels, locks, canals, and harbors, have been considered for the projects located on Lakes Erie, Huron, Michigan, Superior, and their connecting waterways. Five per cent of this first cost has been added to the annual cost of lock and canal operation and maintenance dredging (averages of the five years 1917 to 1921) to obtain the "Total annual cost."

	No. of Harbors	First Cost New Work to June 30, 1921	Average Annual Maintenance, 1917-1921
Inter-lake channels:			
St. Marys River including locks and canals		$25,587,451	$270,998
St. Clair River		821,385	
Lake St. Clair		2,370,483	
Detroit River		12,869,225	
Duluth District	10	11,417,179	116,754
Milwaukee District	15	7,860,808	138,525
Chicago District	7	11,987,792	130,452
Detroit District	11	6,619,994	102,288
Buffalo District	14	26,829,586	231,757
Total	57	$106,363,903	$990,774

The ton-miles credited to the Great Lakes include only commerce passing through the locks at Sault Ste. Marie—that is, commerce to or from Lake Superior, and represents the average thereof for the five year period 1917 to 1921. No records are readily available which furnish statistics for the shipping between Lake Michigan and Lakes Huron and Erie, nor of the local commerce confined to a single lake. The additional tonnage thus concerned would substantially reduce the figure $0.104 given for the "Great Lakes System" supra.

Detroit, Mich. E. M. MARKHAM,
March 8, 1923. U. S. District Engineer.

Protecting Steel Bridges from Locomotive Blast

Sir—The protection of steel bridges from the blast of locomotives is an important question and I read with interest the article on that subject in *Engineering News-Record* of Dec. 7, 1922, p. 968. In the Chicago & Western Indiana R.R. and the Belt Ry. Co. of Chicago we have had considerable success in protecting the underside of overhead steel bridges with poured concrete. As the evidence and conclusions presented in your article were unfavorable to that method of protection, you might be interested in our experience.

The typical condition of the underside of our overhead bridge at Hammond Junction (85th St. and Stewart Ave.), Chicago, is shown in Fig. 1. This bridge was built in 1916, has approximately 17½ ft. clearance, and an I-beam floor encased in concrete. It is similar to the Rock Island Lines bridge over our tracks at 79th St., built two years previously (in 1914) and shown in Fig. 1 of the above article, the principal difference being that the steel at Hammond Junction was encased in poured concrete instead of in gunite. This photograph was taken Jan. 8, 1923, seven years after completion of the bridge.

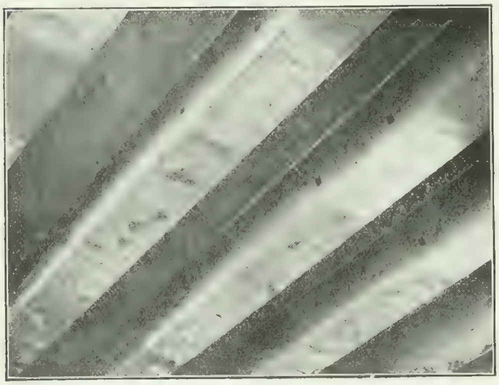


FIG. 1—POURED CONCRETE PROTECTS BRIDGE FLOOR

The concrete is in excellent condition, the form marks still being plainly visible, even directly over the locomotive blast. The small holes in the sides of the concrete casing were provided so that cast iron plates could be installed directly over the blast, but these have never been considered necessary. The tracks that pass under this bridge also pass under the Rock Island bridge at 79th St. (less than a mile north) and the traffic is almost identical at the two bridges. As conditions at those two bridges are so much alike, especially as respects traffic, clearance and age, the excellent condition of the steel protection at both places, concrete at Hammond Junction and gunite at 79th Street, indicates that either concrete or gunite, if of good quality and workmanship, will successfully withstand locomotive blast for a considerable period.

Two other points on our line where concrete protection for steel overhead bridges has given satisfaction are the street viaducts over the Belt Railway at Cicero Ave. and Crawford Ave., at the Clearing yard, Chicago. A long viaduct carries Cicero Ave. over the busy ladder and lead tracks at the west end of the westbound receiving and eastbound departure yards at Clearing. This viaduct was built in 1914 and has 22 ft. clearance. It consists of two plate girders carrying an I-beam floor encased in concrete. The photograph shown in Fig. 2 was taken Jan. 8, 1923, and shows the excellent condition of the concrete directly over a heavy traffic lead after nine years service.

The Crawford Ave. viaduct is of similar construction, located a mile east of Cicero Ave. and at the east ends of the same yards. It was built at the same time, has the same clearance, and the tracks under it likewise carry a heavy switching traffic. Fig. 3 is a general view beneath this viaduct, in which the concrete above the busy leads is in excellent condition. Incidentally, although the exposure for this last picture was only three seconds, the photographer spent nearly an hour getting the picture because of the many engine movements and the resulting smoke.

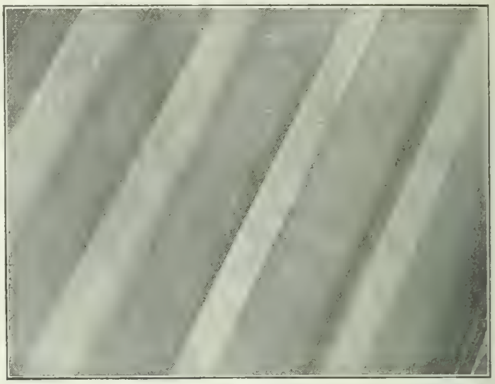


FIG. 2—STEEL I-BEAMS ENCASED IN CONCRETE

In addition to the three structures shown in the accompanying figures, the use of poured concrete protection has been made with good results on a number of other structures on these two railroads. Our experience with poured concrete has not been the same as the examples of such encasement referred to in an article of Dec. 7, 1922. In fact we have had fairly good success with the poured concrete protection. Without in any way questioning the results obtained from the use of gunite casing, the writer feels that in view of the successful use of poured concrete in certain instances, definite conclusions cannot be stated with respect to this important subject, without a wider investigation than that given in the article mentioned.

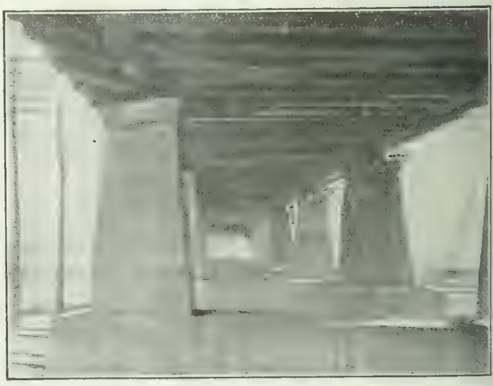


FIG. 3—CRAWFORD AVENUE VIADUCT WITH CONCRETE FLOOR PROTECTION

F. E. MORROW,
Asst. Chief Engineer: C. & W. I. R.R.

Chicago
Feb. 23, 1923.

Sweden Has 118 Water-Works Plants

Sweden had 118 water-works plants in 1920, with 283 administrative officers and 1,050 "workers," according to the Swedish Year Book for 1922. The population of Sweden at the close of 1921 is given as nearly 6,000,000.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The permissive city manager bill passed by the recent session of the New Jersey Legislature has been signed by Governor Silzer.

The New Jersey Senate has passed the house bill devoting $875,000 of money to be derived by the state from disposition of the Morris Canal to the purchase of right-of-way for the ship canal proposed to connect the Atlantic Ocean with the Delaware River.

Following rejection of both bids for the Port of Newark, the War Department is seeking to find possible private buyers. The only two bids submitted were those of the City of Newark, $3,000,000; and of Frederick C. Schneider, New Brunswick, $1,000,000.

The salary of T. Chalkley Hatton, chief engineer, Milwaukee Sewerage Commission, has been raised to $15,000 a year. The increase is attributed by the organ of the Engineers Society of Milwaukee to the great importance of the work to be done in the next year, and to appreciation by the commission of the value of Mr. Hatton's services.

Contract for the excavation and concrete work for the additional filter plant for the Baltimore water-works was awarded March 21 to the Carozza-Rowe Construction Co., of Baltimore, the lowest bidder, at $1,248,955. William A. Megraw is water engineer and James W. Armstrong filtration engineer of Baltimore.

Regrouping of railroad systems east of the Mississippi River and north of the Ohio and Potomac Rivers will be considered at hearings on tentative consolidation plans by the Interstate Commerce Commission beginning in Washington May 16. The plan outlined two years ago by the Commission regrouped these systems into nine large groups.

As a result of the disastrous Ward Island fire in New York City recently a bill has been introduced into the New York State Senate proposing an issue of $50,000,000 in bonds for the construction of buildings for the care, support, instruction and training of wards of the state. The bill provides submission of the bond issue to the people at the 1923 general election.

Legislation authorizing a bond issue of $75,000,000 for the construction of a state highway system in Tennessee has just been introduced into the legislature. Under the terms of the bill 4,000 miles of high-class highway will be constructed in 7½ years, using approximately $10,000,000 per year. Bonds are to be retired in 30 years. If passed, the bill will go to the people for a referendum vote.

Illinois Central R.R. to Build to Metropolis Bridge

To meet the requirements of its heavy main-line traffic the Illinois Central R.R. plans a 175-mile diversion in Illinois to connect with the double-track bridge over the Ohio River at Metropolis, thus supplementing the present route over the single-track bridge at Cairo. For this purpose the Southern Illinois & Kentucky Ry. has been incorporated to build a line from Edgewood to Metropolis, Ill., connecting with the Paducah & Illinois R.R. which operates the Ohio River bridge. There is to be a branch also from Akin to Benton to connect with a local coal railroad. The incorporators include C. H. Markham, president of the Illinois Central R.R.

In replying to some objections to the new line which have been advanced by towns along the present route, Mr. Markham has pointed out that the new line will not take traffic from the old one. Furthermore, it will open up a section of Illinois which is not now provided with railway facilities. To increase the traffic capacity of the present line would require grade reduction and double tracking at an estimated cost of $24,000,000, while the cost of the new single track line with a maximum grade of 0.3 per cent will be only about $17,000,000.

Water-Power Bill Commits N. Y. to $200,000,000 Expenditure

Water-power bills have been introduced in both houses of the N. Y. legislature which commit the state to a policy of development at public expense state-owned water powers of the Niagara and St. Lawrence rivers and the transmission to municipalities of electric current and energy involving an ultimate expenditure of $200,000,000.

For this year's activities $1,000,000 is to be appropriated. The work of construction is to be done under the supervision of the state engineer and surveyor who for the purposes of the law is made commissioner of hydro-electric power. Under the appropriation provided the commissioner will organize his bureau, make maps, plans and surveys, ascertain just what municipalities wish to take advantage of the law, and report to the 1924 session of the legislature where the initial development will be made, the cost of construction and the cost of transmission, including the building of the necessary transmission lines. A unique feature of the measure is that under it all existing transmission lines are made common carriers.

Other provisions of the bill include the vesting of complete control of rates in the commissioner of hydro-electric power, and the exclusion of all private enterprise from exploitation of power in the St. Lawrence and Niagara Rivers.

Lower Mississippi Problems Feature Engineers' Meeting

Spring Session of American Society at New Orleans to Discuss Troublesome River

The river and harbor problems of the lower Mississippi River will furnish the technical discussions at the spring meeting of the American Society of Civil Engineers to be held in New Orleans April 18-21. Papers which will be presented include:

"The Work of the Corps of Engineers on the Lower Mississippi," Lansing H. Beach, Major General and Chief of Engineers, U. S. Army; "The Economic Location of Jetties," Henry C. Ripley, consulting engineer, Detroit, Mich.; "The Success of the Levees During the Flood of 1922," A. L. Dabney, consulting hydraulic engineer, Memphis, Tenn.; "The High Water Fight at Old Town, Arkansas, in 1922," Louis H. Parmelee, consulting engineer, Helena, Ark.; "The Mouths of the Mississippi River," Elliott J. Dent, Lieut.-Col., Corps of Engineers, New Orleans; "River Control," John Klorer, city engineer, New Orleans, La.; "Revival of Commercial Transportation on the Mississippi River," M. J. Sanders, manager, International Mercantile Marine and the Frederick Leyland Co., Ltd., New Orleans, La.; "The Port of New Orleans, John F. Coleman, consulting engineer, New Orleans; "The Port Development Problem of the Lower Mississippi," Samuel M. Young, chief engineer, Board of Port Commissioners, New Orleans; "The Necessity of an Experimental Hydraulic Laboratory for the Solution of River Problems," John R. Freeman, Past-President, Am.Soc.C.E.; and "The Economics of Transportation on the "Mississippi River," Senator Joseph E. Ransdell, Louisiana.

EXCURSIONS PLANNED

Besides technical sessions, excursions which are scheduled include one through the old section of the city of New Orleans; another by automobile through the city which will terminate in a tea at the Country Club; and an all-day excursion by steamer to points of interest in New Orleans harbor, Inner Harbor Canal and Lake Pontchartrain.

The address of welcome to the visiting engineers will be given by John M. Parker, Governor of Louisiana. The response will be made by Charles F. Loweth, the president of the American Society of Civil Engineers.

The program as a whole has been prepared under the direction of the Committee on Technical Activities and Publications, of which Richard L. Humphrey is the chairman. The other members are John N. Chester, C. E. Grunsky, John F. [illegible] and J. J. Yates. The local arrangements are in charge of committees under the general chairmanship of W. B. Gregory.

Arch Dam Investigation Body Meets in San Francisco

At a meeting in San Francisco of the recently formed advisory committee of Engineering Foundation on the investigation of arch dams, preliminary plans were laid for carrying on the work, a number of existing dams from which useful information could be obtained by making measurements were selected and the work of making the measurements was assigned. A statement of the organization and purposes of the committee was published in *Engineering News-Record* Nov. 16, 1922, p. 857. The meeting held in San Francisco on Feb. 26 was attended by Prof. C. Derleth, Jr., chairman; F. E. Weymouth, M. M. O'Shaugnessy, D. C. Henny, Wynn Meredith, R. P. McIntosh and Fred A. Noetzli.

Provided sufficient funds are available, the committee proposes to build later one or more small dams for experimental purposes upon which tests can be made to try out various theories and get information that could not be secured by measuring existing dams. Particular attention will be given to deflections and deformations caused by temperature changes as reservoir conditions vary from full to empty.

Decision was made to make complete studies of deflections, stresses, temperature effect, etc., on the following arch and multiple arch dams: Hetch Hetchy and Lake Eleanor dams of the Hetch Hetchy project; Lake Spaulding Dam, Pacific Gas & Electric Co.; dam No. 6, Southern California Edison Co.; Clear Creek Dam in Oregon; Hubart Dam in Montana; and Black Canyon Dam in Idaho; (these last three all under the jurisdiction of the U. S. Reclamation Service); Kerckhoff Dam, San Joaquin Light & Power Corp., and Lake Hodges Dam near San Diego. Measurements on each of these dams will be under the supervision of a local committee of four engineers of which the chairman will be a member of the main advisory committee.

It is expected that the whole investigation will extend over a period of two or three years so as to secure data on all possible reservoir stages.

Funds for this work could be only partly provided by Engineering Foundation and the main part of the necessary money is to be secured from interests that would benefit by the work of the committee. Primarily these benefits are expected to make possible the construction of more economical dams of these types.

Fred A. Noetzli, 605 Market St., San Francisco, is secretary and local treasurer of the committee.

New York Dwelling Tax Exemption Held Unconstitutional

The tax exemption ordinance of New York City under which dwellings of moderate cost put under construction during the two years ending April 1, 1923, were to be exempt from taxation for ten years has been declared unconstitutional by John M. Tierney, a justice of the State Supreme Court.

The legislative act on which the New York City ordinance rests authorized any municipality in the state to make exemptions of the kind indicated. Justice Tierney holds that the act violates Article 3, Section 1, of the New York State Constitution, which prohibits the passage of "a private or local bill granting to any person, firm, or corporation an exemption from taxation on real or personal property."

Speedy appeal to the two higher courts of the state is proposed.

New Jersey Engineers License Law Effective April 8

The New Jersey act licensing professional engineers and land surveyors enacted in 1921, becomes effective April 8. After that date "no county, city, town, township, village, borough, or other municipal corporation or other political subdivisions in the state shall engage in the construction or maintenance of any public work involving professional engineering, or land surveying for which plans and specifications and estimates have not been made by, and the construction of maintenance supervised by a licensed professional engineer or land surveyor." Improvements costing less than $2,000 are exempted. Applications for licenses without examination must be in the hands of the State Board of Professional Engineers and Land Surveyors, 710 Trust Company Building, Jersey City, by April 8.

Colliding Interurban Car in Ohio Wrecks Steel Bridge

An interurban car on the Northwestern Ohio Railway & Power Co.'s line between Toledo and Sandusky struck the trusses of a 100-ft. steel span over Portage River at Oak Harbor on March 7, and wrecked it and went down with the span. There were about twenty passengers on the car, but no fatalities resulted. Investigation showed that the rear truck of the car left the track as the car neared the bridge, causing the car to move over to one side and strike the end post of the bridge. The front truck of the car remained on the track in the fall.

Burlington Line to Build Cut-Off

A 16-mile low-grade single-track cutoff line between Frederick and Vermont, Ill., is to be built by the Chicago, Burlington & Quincy R.R. to avoid the three miles of 1.25 per cent pusher grade against northbound coal and tonnage freight trains on the present line between these points. The new line will have a maximum grade of 0.25 per cent and will save three miles in distance. Passenger trains and local freight trains in both directions, as well as southbound through freight trains (having a large percentage of empty cars), will continue to be operated over the present line. The cost of the new work is estimated at $1,750,000. This improvement has been planned by C. L. Persons, assistant chief engineer, under the direction of A. M. Newton, chief engineer.

Western Society Nominates

Nominations for the officers of the Western Society of Engineers on the official ticket are announced as follows: President, C. A. Morse, chief engineer, Chicago, Rock Island & Pacific Ry.; vice-presidents, E. T. Howson, western editor, *Railway Age;* Horace Carpenter, consulting engineer, the Arnold Co. and H. H. Clark, consulting gas engineer; treasurer, G. W. Hand, assistant to president, Chicago & North Western Ry.; trustee for three years, M. M. Fowler, with General Electric Co.; members of Washington Award Commission for three years, J. L. Hecht, vice-president, Public Service Co. of Northern Illinois, and W. W. DeBerard, western editor, *Engineering News-Record.* A ticket "by petition" may be named at any time prior to April 20.

Shawver Succeeds Emerson as Wyoming State Engineer

Frank C. Emerson, state engineer of Wyoming since 1921 when he was appointed by Governor Robert D. Carey, has been succeeded by Casper D. Shawver, city engineer of Cheyenne. Mr. Emerson was appointed for a six-year term, and when it became doubtful that the new governor would reappoint him he sought, it is alleged, confirmation of his commission at the hands of the 1923 state senate. This alleged usurpation of executive power resulted in the summary dismissal of Mr. Emerson by Governor Ross. However he refused to yield his office to his successor until forced to by court action.

Mr. Shawver was deputy state engineer from 1915 until 1920.

WRECKED SPAN OVER PORTAGE RIVER, AND TIMBER TRESTLE REPLACING IT

N. Y. Power Discussed at Joint Conference

Local Sections of Founder Societies Bring Out Features of Metropolitan District Requirements

The main auditorium of Engineering Societies Building, New York City, was practically filled on the evening of March 21 at the joint meeting of the New York Sections of the four national engineering societies at which was discussed the problem of hydro-electric power for the New York City metropolitan district.

The problem which was to be discussed was outlined in the preliminary paper by Col. F. W. Scheidenhelm, which stated that the conference was called to bring to the attention of the group of societies the question of the availability of hydro-electric power for the metropolitan district, New York City. Col. Scheidenhelm outlined the general problem of the joint utilization of steam and hydro power and emphasized the current development toward having hydro power supplementary to steam rather than the earlier relation in which the opposite occurred. As a result of this there is required what is called excessive development of hydropower, by which is not meant that there is an engineering waste but that there is a greater development than would be warranted if only hydro power with its low power factor were available.

SUPER-POWER SURVEY RESULTS

The second speaker was W. S. Murray, consulting engineer of New York, who outlined the main results of the super-power survey of which he was the engineering head in its relation to the New York district. He said that of the great sources in the general eastern district, Niagara would probably eventually come into the New York district whereas the St. Lawrence would eventually come into the Boston and New England district. For the remaining interior streams of New York available for hydro power in New York City there are the Susquehanna, the Delaware, and the Hudson. The Susquehanna is a run-of-river proposition with few storage facilities. It is possible, however, to develop 800,000 hp. in connection with the super-power scheme, The Delaware, on the contrary, is a storage river, with a capacity almost equal to that of the Susquehanna. The Hudson is also a storage river with 150,000 kw. development possible by 1930 and 430,000 kw. in the eventual development of the super-power scheme.

George A. Orrok, of the New York Edison Co., emphasized the characteristics of a metropolitan service such as his company gives. He called attention to the prime necessity of a metropolitan electric service, that is, continuity, and indicated that the danger of severance of this continuity was the main possible objection against the use of hydro-electric power.

Operation of hydro-electric plants was the subject of the paper by F. A. Allner, general superintendent of the Pennsylvania Water & Power Co., which operates the 100,000 kw. Holtwood plant on the Susquehanna River. Mr. Allner showed a number of charts to prove that the continuity service from his hydro-electric plant was remarkably high.

The final paper was by Lorin E. Imlay, consulting engineer of the Niagara Falls Power Co., and detailed the progress which has been made in long distance transmission. These papers took practically all of the evening and in the remaining short period discussion was limited to the formal discussion by Col. J. P. Hogan, consulting engineer of William Barclay Parsons, on the New York State survey of water power, and W. F. Finlay, Jr., vice-president of the American Water-Works & Electric Co.

Additional Paving Brick Variety Eliminated

The Standing Committee on Simplification of Varieties of Paving Brick, co-operating with the Department of Commerce, met in Washington, March 27, and eliminated an additional variety from the "recognized" types and sizes. The variety eliminated is the repressed hillside brick, 4x3½x8½ in.

This variety was eliminated because the committee regarded it essentially as a special brick and because its volume in the year 1922 constituted only 4.1 per cent of the total shipments.

The committee re-affirmed its action of last year in eliminating as a recognized variety the wire-cut-lug hillside brick, the restoration of which had been requested by Frank B. Dunn.

Further details regarding the committee's action and of the survey on which the deliberations were based will be published next week.

More on F.A.E.S. Traveling Expenses

Two of the members of the committee of the Board of Directors of the Am. Soc. C. E. appointed to prepare the arguments for that society joining the Federated American Engineering Societies have commented further on the statement made by C. M. Holland, of the opposing committee, as to the traveling expenses of the F.A.E.S. (*Engineering News-Record*, March 1, 1923, p. 412). These two members, Richard L. Humphrey and Arthur P. Davis, say:

"The undersigned regret that Chairman Holland should attempt to divert attention from his erroneous statement that 'last year traveling expenses alone amounted to $15,000.' by his further statement—'the favorable arguments also are misleading on this point, in that they lead to the inference that only $6,600 was spent for travel during 1922, whereas the statement of the Federation shows that $8,417.65 was spent for that purpose.'

"The statement in the arguments in favor of the society joining the F.A.E.S. is correct; the item for travel in the estimated expenses for 1923 of $8,500 includes $1,900 for the traveling expenses of the secretary leaving $6,600 for the 'mileage for members of the council and of its executive board' as stated in the favorable arguments. Mr. Holland in his ineffectual attempt to point out an error in the favorable arguments makes another misstatement when he says 'the statement of the Federation shows that $8,417.65 was spent for that purpose,' i.e., for travel for 1922. The financial statement of the F.A.E.S. shows that but $7,682.70 was spent for travel in 1922."

Engineering Council Board Would Make Coal Survey

Storage Investigation Authorized At Cincinnati Meeting—Transport Committee Continued

Decision to undertake a nationwide coal storage investigation was reached by the Executive Board of the American Engineering Council of the Federated American Engineering Societies at its meeting in Cincinnati, March 23-24. General endorsement of the plan for government reorganization submitted to Congress with the approval of President Harding and Cabinet, and continuance of the Committee on Transportation, were other features of the meeting.

The object of the coal survey is "to determine the facts relating to the engineering, chemical, and economic factors involved in, and their influence upon coal storage at the mine and by large and by other consumers of coal."

The Coal Commission, it was stated by Executive Secretary L. W. Wallace, was relying upon engineering methods and engineers. The opinion was expressed that the study, to be of the greatest benefit, should be completed not later than November 1.

The Committee on Procedure of the American Engineering Council some weeks ago authorized the appointment of a Committee on Transportation to report to the Executive Board as to what, if anything, the American Engineering Council could do with propriety and effectiveness in relation to the transportation problem of the American people.

Max Toltz, chairman of the committee appointed, made a progress report to the Executive Board, pointing out that the task was such a ramified one that the committee would require more time in which to advise the Executive Board. He further indicated that probably the best service the American Engineering Council could render would be to co-operate with a number of national organizations which had been working in this field for years. It was, therefore, voted to continue the committee, instructing it to continue its conferences with various groups concerned.

J. Parke Channing of New York, chairman of the new Committee on Government Reorganization as Related to Engineering Matters, made a progress report indicating the active participation of the Federation in this sphere. The attitude of the committee toward the plan now before Congress is expressed in the following statement issued by Chairman Channing:

"As a whole engineers favor the proposed plan of reorganization of the executive departments as it applies to engineering activities, upon which activities they feel themselves competent to pass.

"While the proposed plan is not in every detail that one advocated by the National Public Works Department Association, engineers feel that the scheme is a great step in advance."

Concerning the registration of engineers, the following resolution, moved by Gardner S. Williams of Ann Arbor, Mich., was adopted

"Resolved, That it is the sense of this Executive Board that American Engineering Council should continue to collect and keep up to date a record of the engineers registration and licens-

(Continued on p. 601)

Research Main Topic Before Sewage-Works Meeting

Tests by New Jersey Experiment Station Reviewed—Urge Investigation of Potts Charges

The main topic at the eighth annual meeting of the New Jersey Sewage-Works Association, held at Trenton, March 14, was the research work being carried out at the state experiment station, New Brunswick, N. J., under an appropriation of $10,000 made half and half by the State Legislature to the station and to the New Jersey State Department of Health. The association has a research committee which is co-operating in the investigation. The subject was introduced by Dr. Thomas J. Headlee, director of the station. A detailed account of the investigations now being made was given by Dr. Wilhelm Rudolphs. The studies being made are under the direction of a full-time bacteriologist and a chemist, a botanist, and a zoologist, these three giving part time to the work. The investigations embrace detailed observations on what is going on in Imhoff tanks and sprinkling filters at the Plainfield joint disposal works near New Brunswick.

In the discussion of this paper the opinion was expressed by members of the engineering staff of the New Jersey State Department of Health that the Plainfield tanks cannot be taken as representative Imhoff tanks, since they are operated intermittently instead of continuously.

CHEMICALS IN SLUDGE DRYING

Dr. Rudolphs also stated that studies are being made of the use of chemicals to hasten drying on sludge drying beds and that alum for this purpose was giving promising results.

A paper summarizing the experiences in New Jersey under the act providing for the licensing of superintendents and operators of sewage-works was read by C. A. Capen, Jr., assistant sanitary engineer, New York State Department of Health. Candidates for licenses are given instruction by representatives of the department before taking an examination. Altogether 207 licenses have been issued, but some of these have been for a second man at the same sewage-works.

Practically all municipalities in the state seem to think, said Mr. Capen, that their responsibility is ended when they had spent money on the construction of sewage-works; that is, the municipalities generally are unwilling to spend the necessary money for operation. One of the difficulties met is the discharge of the sewage-works operators on change of the party in control of the city administration. Difficulty is also experienced in getting the cities to see the necessity for spending money to send men to Trenton for instruction and examination and to pay for the substitute operator while candidates are away. The State Department of Health notifies cities where the operator has not taken out his license. Beyond this all that can be done in case of failure to take out a license, is to refer the case to the attorney general.

The association adopted a resolution requesting the governor of the state to make a speedy investigation of the charges against Clyde Potts (a member of the association) brought by the Direct Oxidation Disposal Corporation in connection with the alleged delay of the State Board of Health in acting upon the Trenton sewage-works plan. The resolution requested investigation not only of the charges against Mr. Potts, but also an investigation of the standing of the company.

The election of officers resulted in the continuation in office of S. Fisher Miller as president and Myron E. Fuller as secretary and treasurer.

Walter J. Francis Succeeds to Canadian Institute Presidency

Following the death of Arthur St. Laurent, who was president of the Engineering Institute of Canada (see *Engineering News-Record*, March 15, p. 510), Walter J. Francis, consulting engineer of Montreal and senior vice-president of the Institute, was made president at a regular meeting of the council on March 27.

Mr. Francis' earliest professional experience was secured, after graduation from the University of Toronto, in railroad work in Canada. In 1898 he entered the service of the Department of Railways and Canals of Canada having charge of the design and construction of lift locks on the Trent canal. Later he was in charge of the construction of a large hydro-electric plant for the West Kootenay Power Co. and in 1907 was made assistant manager and chief engineer of the Dominion Engineering & Construction Co. of Montreal.

Mr. Francis was engineer for the royal commission of inquiry into the Quebec bridge disaster and reported on the wreck, developing in detail the theory for the collapse. Since 1910 his consulting work has included, among other things, designs and reports on many hydro-electric and steam power plants, investigations and reports on buildings, especially foundations, and municipal investigations for Edmonton and other Canadian towns and cities.

Besides being a member of the Engineering Institute of Canada, he is a member of the American Society of Civil Engineers, a charter member of the American Institute of Consulting Engineers, a member of the Institution of Civil Engineers, and various other technical, semi-technical, and social organizations.

$10,000,000 Appropriated for Washington State Roads

At the recent session of the Washington State Legislature $10,314,245 was appropriated for a two-year road program, which has been initiated this year. In addition, $300,000 was made immediately available for maintenance work, $1,670,000 for continuing work on the Pacific Highway, and $1,000,000 to match federal aid. The legislature also changed the title of the supervisor of highways to state highway engineer and transferred him from under the supervision of the department of public works to the highway commission, which is composed of the governor, state treasurer and three appointed members.

Failure to Ratify Compact Holds Up Power Projects

Colorado River Developments Postponed Aggregate More Than $100,000,000

Washington Correspondence

Failure to ratify the Colorado River Compact is regarded by Federal officials as a greater calamity to the West than is generally appreciated at present. The fourteen major projects which have been halted by the action of Arizona, if allowed to proceed would contribute very importantly to the prosperity of the entire West. It happens that Arizona itself is affected adversely as much, if not more, than any single state. The only encouraging aspect of the situation is that the compact stands and can be ratified at any time in the future.

The Girand project at Diamond Creek involves the ultimate investment of $70,000,000. The initial investment would be two-thirds of that amount. This project, from which Arizona would be practically the entire beneficiary, is delayed indefinitely along with the other thirteen projects.

Another of the large projects which is delayed is that of the Southern California Edison Co., which contemplated the development of a series of projects, the most important of which was the great reservoir at Lee's Ferry. That company was prepared to begin preliminary investigation and work immediately on the ratification of the compact. In that instance the delay is likely to work against the best interests of the Colorado basin since it is forcing the Southern California Edison Co. to commit itself more and more to the development of higher cost power on the headwaters of the San Joaquin. Imperial Valley suffers from the fact that the development planned by the Southern California Edison Co. would have done much to move the flood menace on the lower river.

The Flaming Gorge project of the Utah Power and Light Co. on Green River is another of the big projects halted by the failure to ratify. That company is ready to go ahead with its project which would develop 100,000 hp. and create a storage of 1,500,000 acre-ft.

The plans of the Denver Gas and Electric Co. for the development of power at Kremmling on the Colorado have been interfered with seriously. The fact that the company is preparing to erect a large steam plant near Boulder indicates that it has lost hope of being able to develop the Kremmling site in time to meet the demands which will be made upon it for additional power.

Fourth Firestone Road Essay Contest Announced

The Highway Education Board, Washington, D. C., has announced the fourth annual road essay contest which carries a prize of a four-year university scholarship. This year's subject is "The Influence of Highway Transport Upon the Religious Life of My Community." The contest is open to high school students throughout the country and essays are to be submitted to the respective high school principals by May 1. The donor of the scholarship is Harvey S. Firestone, of Akron, Ohio.

A. R. E. A. Appoints College Co-operative Committee

Personnel of the committee of the American Railway Engineering Association on co-operative relations with universities has recently been named as follows: Chairman, R. H. Ford, assistant chief engineer, C. R. I. & P. Ry.; R. N. Begien, general manager, B. & O. R.R., Western Lines; W. C. Cushing, engineer standards, Pennsylvania System; J. M. R. Fairbairn, chief engineer, Canadian Pacific Ry.; W. O. Faucette, chief engineer, Raleigh & Charleston R.R.; E. T. Howson, editor *Railway Age;* E. B. Katte, chief engineer, electric traction, N. Y. C. R.R.; C. A. Morse, chief engineer, C. R. I. & P. Ry.; G. J. Ray, chief engineer, D. L. & W. R.R.; H. R. Safford, vice-president, C. B. & Q. R.R.; W. B. Storey, president, A. T. & S. F. R.R.; Dean Wm. G. Raymond, State University of Iowa; Prof. Henry E. Riggs, University of Michigan; Prof. George F. Swain, Harvard University; Brig. Gen. C. H. Mitchell, dean faculty of applied science, University of Toronto. A few more may be added. The details of the organization of the committee were worked out by H. R. Safford, E. H. Lee and J. M. R. Fairbairn. In *Engineering News-Record*, Feb. 1, p. 201, the scope and purpose of the committee were noted.

Engineering Council Board Would Make Coal Survey

(Concluded from p. 599)

ing laws . . . for use of the constituent societies of the Federated American Engineering Societies and others, but that it assumes no control over the actions of such constituent societies in regard thereto."

The Executive Board voted to cooperate in the movement to bring about uniform safety legislation, to broaden the program of its Reforestation Committee, to study the question of constituting the American Engineering Council a clearing house on elimination of waste, and to work with the National Safety Council in plans for Conservation Week.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Spring Meeting, New Orleans, La., April 18-20.

NATIONAL FIRE PROTECTION ASSOCIATION; Boston; Annual Meeting, Chicago, May 8-10.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Detroit, Mich., May 21-25.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

The Providence Engineering Society will hold a joint meeting of its power and textile sections March 30, at which time Arthur T. Safford will speak on twenty-five years' progress in the use of water power with auxiliary steam power in New England textile mills.

The Social Organization of Hungarian Engineers, New York, recently elected the following officers: President, Alexander Strobl; vice-president, Dr. Adalbert Edek, of the Rockefeller Institute; secretary-treasurer, Julian J. Wittal, consulting engineer.

The Harvard Engineering Society will elect officers at the annual meeting to be held in New York, April 19. The nominating committee has prepared the following ballot: President, Charles J. Tilden; first vice-president, Lionel S. Marks, Cambridge; second vice-president, Charles Gilman, New York City; secretary, Theodore R. Kendall, New York City, and treasurer, Edric B. Smith, New York City.

Personal Notes

IVAN C. PETERSON and L. O. HOPKINS, formerly manager and chief engineer, respectively, of the Chicago Bascule Bridge Co., severed their connection with that company on Mar. 1, and are now engaged in a consulting engineering practice, specializing in movable bridge design, under the firm name of Peterson, Hopkins & Co., at 118 North La Salle Street, Chicago, Ill.

FRANK W. DEWOLF has resigned his position as chief of the state geological survey of Illinois to become chief geologist of the Humphreys-Fohs oil interests, with office in the Great Southern Life Building, Dallas, Texas.

Dr. IRA N. HOLLIS, since 1913 the president of Worcester Polytechnic Institute, has tendered his resignation to the Board of Directors. Dr. Hollis will remain with the Institute until a successor has been secured. He wishes to leave teaching work to devote some time to literary work. After graduation from Annapolis in 1878 Dr. Hollis spent three years in the Mediterranean, cruising, later being promoted to the grade of assistant engineer and being assigned as professor of marine engineering at Union College, Schenectady. In 1884 he served on the advisory board that built the four ships of the White Squadron and spent some months in the inspection of machinery on the Atlantic coast. On the West coast he spent three years at the Union Iron Works where some of the early ships for the new navy were then building. Previous to his election to the presidency of Worcester Polytechnic Dr. Hollis was professor of engineering at Harvard to which position he was elected in 1893. Dr. Hollis is a former vice-president and past-president of the American Society of Mechanical Engineers.

HERMAN FOUGNER, for some time past president of the Fougner Concrete Steel Co., New York City, has been elected vice-president of Thompson-Starrett Co., also of New York. Mr. Fougner has for a long time been prominent in concrete and structural steel design and construction and has served various organizations in technical and executive capacities. He was with Milliken Brothers, New York City, for a number of years, serving them not only in the New York office but in Port Arthur, China, where as engineer, he superintended the erection of the extensive steel construction in the Imperial Russian Navy Yard. He also was the sole representative of Milliken Brothers in the Far East. Later he became head engineer in the Johannesburg branch in South Africa. His early engineering in the United States was with the Pencoyd Iron Works and the American Steel Foundry Co., the latter of St. Louis.

E. W. DAVIS, county engineer of Gregg County, Texas, has been appointed county engineer of Anderson County, at Palestine.

ANDREW HAMILTON of Hamilton & Shreve, consulting engineers of Fayetteville, Arkansas, has been appointed district engineer for the National Lime Association at Dallas, Texas.

M. H. MACLEOD, vice-president in charge of construction, Canadian National Railways, has been appointed consulting officer to the executive board of the road.

A. H. NICKERSON, who since 1904 has been with the American Agricultural Chemical Co., has resigned to accept a position with Stone & Webster, Inc., in the mechanical division. Mr. Nickerson started with the former company as chief engineer, holding that position until 1921 when he was made manager of the manufacturing department.

O. THAGE is now connected with the St. Louis Structural Steel Co., steel fabricators of East St. Louis, as a structural engineer. He formerly occupied a similar position with the St. Joseph Structural Steel Co. of St. Joseph, Mo.

GEORGE C. STOWELL has become associated with H. J. Kemper, general contractor of Los Angeles, Calif., as construction engineer. He was formerly a superintendent of construction for the Home Builders Service Bureau of Atascadero, Calif.

JOHN R. CALDWELL, of Madison, Wis., has been appointed county engineer for Dane County, Wisconsin, to succeed E. J. SMITH who has resigned to enter private practice.

HERMAN GUISE, of Kewaunee, Wis., has been appointed county highway engineer for Kewaunee county to succeed MOSES SHAW, who has resigned.

G. L. CHURCH is now employed on survey work with the Mississippi River Commission, third district, engaged principally in revetment and levee work. He was formerly an assistant engineer with the Southern Improvement Co. Mr. Church is stationed at Grand Lake, Ark.

H. F. HAUSLEIN is now structural engineer with the Concrete Steel Co., having recently severed his connection with Andrew Kent Robertson as sales engineer.

THE RANDOLPH-PERKINS CO., consulting engineers, Chicago, have been retained by the City of Terre Haute, Indiana, to make a preliminary investigation and report on a comprehensive plan for reconstructing and extending the present sewer system. The probable cost will be $1,000,000.

R. A. C HENRY, formerly special engineer, Department of Railways & Canals, Ottawa, has been appointed director of the bureau of economics of the Canadian National Rys.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Water-Works Manufacturers Name Convention Committees

For the annual convention of the American Water Works Association, to be held in Detroit, May 21-25, the Water Works Manufacturers Association has announced, through President Edgar J. Buttenheim, the personnel of five committees as follows:

Transportation—Chairman, Walter H. Van Winkle, Water Works Equipment Co., New York; T. C. Clifford, Pittsburgh Meter Co., East Pittsburgh; Raymond Simon, R. D. Wood & Co., Worcester, Mass.; Joseph Ivy, American Cast Iron Pipe Co., Kansas City, Mo.; H. Brown, Neptune Meter Co., Chicago, Ill.; H. M. Lofton, Columbian Iron Works, Chattanooga, Tenn.

Entertainment — Chairman, Burt Hodgman, National Water Main Cleaning Co., New York; William Sherwood, Hersey Manufacturing Co., New York; John H. Stutt, E. I. Du Pont de Nemours Co., Philadelphia; John F. Reagan, Neptune Meter Co., New York; George Smith, Michigan Valve & Foundry Co., Detroit; Vincent McCarthy, R. D. Wood & Co., Chicago.

Exhibit—Chairman, George McKay, Jr., Leadite Co., Philadelphia; J. D. Capron, U. S. Cast Iron Pipe & Foundry Co., Philadelphia; C. C. Benney, Simplex Valve & Meter Co.

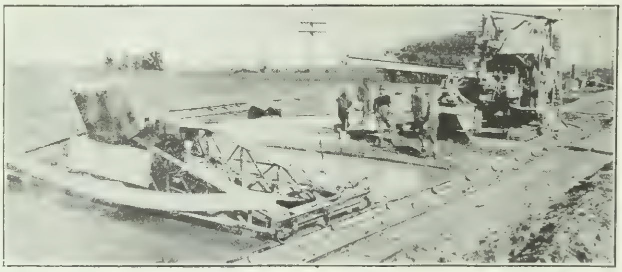
Golf—Chairman, M. F. Tiernan, Wallace & Tiernan Co., Newark, N. J.; Karl Mann, "Fire & Water Engineering," New York; E. Case, Pitometer Co., New York; John Sosnowski, Board of Water Commissioners, Detroit; R. W. Conrow, Central Foundry Co.

Press—Chairman, I. S. Holbrook, *Engineering News-Record*, New York.

Sack Supersedes Barrel as Unit of Measurement for Cement

As the unit of measurement for the quotation, sale and invoice of portland cement, the sack instead of the barrel was adopted by the Marquette Cement Manufacturing Co., Chicago, March 19. In announcing its new policy the company says that "there is no logical reason why a product shipped and used by the sack should be quoted and sold on another unit of measurement." Users of the Marquette company's product are requested to order by the sack instead of by the barrel, four sacks being the equivalent of 1 bbl.

Inquiry at the New York office of the Portland Cement Association developed the fact that no concerted move among the country's cement producers to adopt the sack unit of measurement was contemplated.



How "Ideal Section" of Lincoln Highway Is Being Built

Mechanical equipment is playing a large part in the construction of the "Ideal Section" of the Lincoln Highway, the 1½-mile length of 40-ft. concrete pavement between Dyer and Schererville, Ind., 32 miles south of Chicago. The pavement is being constructed in half widths, comprising 20-ft. strips, for which the concrete is finished with a Lakewood road finisher shown in the accompanying photograph, following close behind a Koehring paver. The contractor is J. C. O'Connor & Sons, Fort Wayne, Ind.

Following the completion of the first half of the pavement the standard wheels of the finisher were replaced with a special set, the outside ones being double-flanged while those on the inside, which traveled on the finished concrete, had a flat tread. The photograph shown is from the files of the Lincoln Highway Association. A detailed description of the design of the "Ideal Section" by W. G. Thompson, consulting highway engineer, appeared in "Engineering News-Record" of June 15, 1922, p. 982.

Alabama Power Co. Makes Aerial Survey of Tallapoosa Basin

As a preliminary step in studies for the development of additional power the Alabama Power Co., Birmingham, has undertaken an aerial survey of the Tallapoosa River basin involving about 500 sq.mi. of hilly country in eastern Alabama. The methods employed follow, in general, those used in the aerial survey of the Tennessee River in 1921 (see *Engineering News-Record*, Oct. 5, 1922, p. 552). On the new work, however, a number of improvements in technique will be made as the result of experience on the previous work. The technical direction of the survey for the Alabama Power Co. is in charge of Gerard H. Matthes, U. S. assistant engineer, Chattanooga.

Should Equipment Makers Feature Record Runs?

Opinion Favors Conservatism—Average Daily Performance the Best Criterion of Service

In last week's issue (p. 559) a discussion of policy regarding the featuring of record runs or performances of equipment and materials was opened by K. H. Talbot, speaking for the Koehring Co., Milwaukee. In this and succeeding issues the points of view of other manufacturers will be given.—EDITOR.

BY H. E. BILLINGTON

Vice-President for Sales, Thew Shovel Co., Lorain, Ohio

WE DO not favor the featuring of record runs in our advertising but we do at times mention results obtained on specific jobs under specific conditions. In every case a photograph is included which shows the nature of the work and the surrounding conditions.

There are so many factors entering into the results which may be obtained by any shovels that we hesitate even to make guarantees. This is not a matter of design or workmanship so much as the specific conditions under which they work. Much of the efficiency of any machine depends on the operator. The class of material to be handled must be considered. Then the matter of transportation is important. There are very few shovels that cannot handle more material than can be taken away from them unless they are of a size which is obviously too small for the job.

While the experienced contractor cannot be fooled by figures obtained on ideal jobs under ideal conditions or by figures which represent a record-day run under pressure, the man just entering the field may be misled. This may cause him to bid on jobs at a figure too low to be profitable to him or anyone else. This action is, of course, reflected on the seasoned contractor who actually knows his costs.

Our policy is based on the belief that the advertising of record runs injures the new contractor, injures the older contractor through inexperienced competition and injures us through the consequent depression.

BY W. A. CATHER

General Sales Assistant, Worthington Pump & Machinery Corp., New York

SHOULD record runs be advertised? Certainly yes—and also positively no! To my mind the whole matter depends upon one thing, namely, the impression created in the reader's mind.

Some machines operate almost automatically. They are started and stopped by hand, but in between these two events the machine takes care of itself; a steam pump is representative of this group. I believe that if Worthington builds a certain type of steam pump that is above the usual in quality and the ability to live long, giving us an example of long service, we are justified in advertising this particular performance. The impression we wish to give is that this style of pump is durable, and if the pump is durable no harm and some good is done.

Along these lines is an advertisement featuring a Worthington gas engine that broke all records for continuous operation. This was due in a very large measure to the machine itself—so we advertised the record run.

There are, however, certain machines whose capacity and performance depend so much upon the skill with which they are operated that it is quite misleading to quote records. An exaggerated example of this can be had in an ordinary shovel. The output, or capacity here is entirely up to the man who handles the shovel. In a lesser degree the same is true of steam shovels and concrete mixers. In such cases there may be some reasonable doubt as to the advisability of advertising big capacity records, unless the copy is prepared in such a way as to produce the impression that the machine under discussion is capable of standing hard, severe and ordinary machine breaking service.

In our work we have not been able to draw a definite line in this matter but decide each case separately. We did and still do advertise the world's record for gas engine continuous duty. But we deliberately laid aside the truly marvelous record of low maintenance cost for several hundred water meters. Why? Simply because we didn't want to create the impression that *all* of our meters would do the same.

By Lion Gardiner

General Sales Manager, Lakewood Engineering Co., Cleveland

I AGREE with Mr. Talbot's comments relative to the use of record runs in advertising matter. Such runs are misleading, particularly because the stage frequently is set to make a good showing through tuning up the organization for the run and being sure that there is an adequate supply of material available.

When we consider the factors of material and labor supply, weather conditions and similar variables which so materially affect the job progress, it must be admitted that as a basis for estimating such data are not valuable. There may be the indication of maximum capacity from a mechanical viewpoint, but what really counts is the day-in-and-day-out continuity of operations. From this viewpoint longtime average runs will offer more benefit to the manufacturer, and at least be of more value to the reader, than the occasional flashes.

In the same category falls the publishing of cost data in terms of dollars. Nothing can be gained unless the number of men, the hourly rate and many other conditions are given. For example, the fact that a steel tower can be erected for $1.50 per foot might mean one thing in an open territory but be an entirely different figure under highly unionized conditions. Data such as are under discussion require careful analysis and a complete account of the variable conditions; otherwise their influence may be unfortunate.

By R. G. Miller

Secretary and Sales Manager, Browning Co., Cleveland

WE CERTAINLY agree with the Koehring Co. and do not believe in any kind of a display which will mislead prospective purchasers. In a few cases we have based our advertising on performances of certain cranes, but these have always been average runs and where the cost of operation has been used, it has been taken over a period of from 10 to 12 years.

Some members of our organization feel that possibly we are a little too conservative in our statements, but our policy is to sell locomotive cranes only when they are the most efficient machinery possible for the job.

Additional Comment

Forthcoming issues will contain comment on the subject of record runs by:

H. S. Strouse
Pawling & Harnischfeger Co.
H. B. Bushnell
Western Wheeled Scraper Co.
H. T. Gracely
Marion Steam Shovel Co.
J. H. Gregory
Barber-Greene Co.
D. C. Grove
Blaw-Knox Co.
M. Ramsay
Bay City Dredge Works.
C. F. Messinger
Chain Belt Co.
C. F. Ebert
Osgood Co.

By Julius S. Holl

Advertising Manager, Link-Belt Co., Chicago

I AGEE with Mr. Talbot. On all engineering jobs designed and built by this company, our policy is to withhold advertising for one year. Thereafter, we can advertise a performance and not a promise of a performance. Mr. Piez, our president, made this ruling some 15 years ago.

Most new products brought out by this company are manufactured on a small scale and sold to customers who will try out the machines under varied conditions of service. Sometimes we wait several years before we attempt to exploit, through advertising, the merits of such equipment. The Link-Belt automatic chain tightener used on automobile front ends was sold two years before any advertisement of it appeared in the trade press.

(*To Be Continued Next Week*)

Business Notes

W. J. Savage, since 1920 manager of sales has been promoted to the position of vice-president of the Heltzel Steel Form & Iron Co., Warren, Ohio.

B. C. Collier, vice-president and general manager of the Cement Gun Co., Allentown, Pa., has been made president of the company, succeeding W. J. Roberts, who recently resigned.

James Allinson, formerly manager of the New York office of the Allison Steel Products Co., has been appointed sales manager, succeeding James L. Barrett, resigned.

Charter Gas Engine Co., Sterling, Ill., announces the purchase of the entire Mietz oil-engine business heretofore carried on in New York City by the August Mietz Corp. and the Reliance Oil Engine Corp. All physical assets of the Mietz organization are being moved to the Charter plant in Illinois.

C. B. Gould, formerly sales engineer in the home office of the Barber-Greene Co., Aurora, Ill., has been made district manager and placed in charge of the company's office in Detroit. Mr. Gould is a graduate of the University of Illinois and has served with the company more than a year. He was previously with the engineering and erection department of the Stephens-Adamson Co.

Clifford F. Messinger, for the past three years general sales manager of the Chain Belt Co., Milwaukee, has been elected second vice-president. He was graduated from the Sheffield Scientific School, Yale University, in 1911 and entered the employ of the Chain Belt Co. the same year, where he has occupied the positions of advertising manager, manager of concrete mixer sales and general sales manager. He is also a director of the company and a director of the Interstate Drop Forge Co., Milwaukee.

Q. & C. Co., New York City, has been placed in charge of sales for the Interstate one-piece guard rail formerly manufactured and sold by the Interstate Railway Supply Co., Cleveland. The device will be known as the Q. & C. Interstate one-piece guard rail. This company has also been appointed sole selling agent for the Trench-Zepp stone ballast cleaner, made by Littleford Bros., Cincinnati. The device will be known as the Q. & C. Zepp stone ballast cleaner.

Reading Iron Co., Reading, Pa., manufacturer of wrought-iron pipe, has appointed Lawrence F. Whitney as assistant to G. Bronson Philhower, Jr., district sales manager for New England, with headquarters at Boston. Mr. Whitney had formerly served with the Kay Manufacturing Co., South Norwalk, Conn., and is the inventor of the free floating flexible shaft coupling which bears his name.

Toch Bros., New York City, announce the removal of their executive and sales offices from 320 Fifth Ave. to 110 East 42nd St., New York. This is the fourth move that the company has made in seventy-five years.

C. J. Jackson has been appointed to the sales force of the G. Drouvé Co., Bridgeport, Conn., manufacturer of Anti-Pluvius skylight and sash operators.

Federal Paving Co., Chicago, at its recent annual meeting underwent a reorganization. Frank Novotny was elected president, succeeding W. S. Pace, who has severed his connections with the organization. The other officers elected were: B. Weis, vice-president; Morris Sabath, treasurer; and Albert Sabath, secretary.

A. S. Mirick has been appointed district engineer of Western Pennsylvania, with headquarters at Pittsburgh, for the Eastern Paving Brick Manufacturers' Association. Mr. Mirick is a graduate of Cornell University and has had an engineering experience extending over a period of more than 30 years, a large portion of that time in charge of road and street paving. Among other connections he has been with the New York State Highway Commission, the State of Nebraska, as chief road engineer and lately in private practice as consulting engineer on municipal and highway construction.

Equipment and Materials

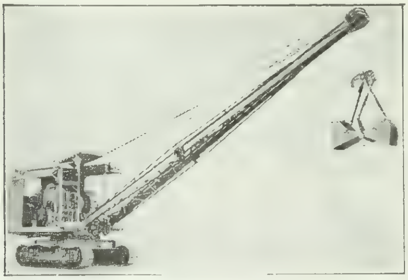
Improved Shaft Bearing for Light Centrifugal Pump

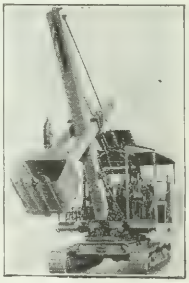
The Evinrude Motor Co., Milwaukee, announces a recent improvement in the bearing equipment of its contractor's light-weight centrifugal pump. To support the pump shaft at the lower end a ball thrust bearing has been provided in place of the lignum vitae plug heretofore used. After a six months' test the company has found that the ball bearing greatly increases the life of the lower bearings and also makes the pump operate more effectively. This improvement can be installed in pumps now in the hands of users.

Crane Excavator Combines Five Units in One Machine

Combining five units in one machine the gasoline crane excavator made by the Koehring Co., Milwaukee, may be used as crane, dragline, clamshell, pile driver, or power shovel. All models are equipped with four-cylinder gasoline engines and mounted on multiplanes. Three sizes of machines are provided having lifting capacities at 12-ft. radius of 7, 12, and 20 tons.

Among the distinctive features claimed by the manufacturer for this crane excavator is its interchangeability on clamshell or dragline work, where it is necessary merely to change buckets and shift a clutch. The outfit uses a two-line speed, the higher speed for clamshell and the lower for dragline operation, resulting in a greater yardage of clamshell work than could be obtained by a machine limited to speed designed only for dragline work. Conversion of the outfit to a power shovel is effected by a change of booms and the addition of dipper handle.

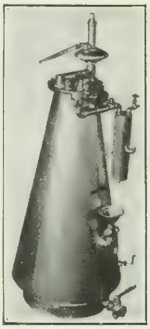




Stress is laid upon the ability of the Koehring crane excavator to boom in and out under load continuously, a desirable feature in restricted quarters. This result is accomplished by the use of a spurgear drive, preventing cutting of the threads, and by an outside double equalizing band friction clutch equalizing stresses on boom members. An advance in design also is claimed for the steering mechanism, which, by shifting one lever to any of four positions, makes the machine turn right or left or travel forward or backward, at high speed or low speed. All levers are banked at the front right-hand side.

Portable Acetylene Generator

The Alexander Milburn Co., Baltimore, manufacturer of oxyacetylene welding and cutting equipment, has recently placed on the market an addition to its line in the form of a portable acetylene welding generator designed to obviate the use of high-pressure cylinders. The generator is of 30 lb. carbine capacity, or equivalent to 150 cu.ft. of cylinder gas. It has few parts, operates automatically without clock or motors and has a steel body, welded throughout. All parts are accessible.



This generator is intended to meet a demand for a source of acetylene gas without the transportation delays and higher costs of depending on cylinder gas. It weighs 200 lb., is 5 ft. 3 in. high and has a diameter of 24 in. at its base.

Welding Detail Aids Reclamation of Steel Valve Bodies

The fact that the composition of the filler rod often has much to do with the success of oxyacetylene welding is demonstrated in the following instance cited by the Linde Air Products Co., New York:

A valve manufacturer, who was successfully employing oxyacetylene welding to reclaim iron castings in which defects showed up during machining, was not meeting with equal success in his attempt to reclaim defective cast-steel valve bodies. This manufacturer made many efforts to overcome the difficulties he encountered and finally consulted an oxyacetylene engineer.

After the engineer had made several test welds, using different kinds of filler rod, he found that a particular rod, which the manufacturer had never tried, produced satisfactory welds on the cast-steel valve bodies. This discovery has resulted in the reclamation of quantities of defective cast-steel valve bodies, and in the saving of considerable time formerly wasted on unproductive machine work.

NATIONAL LUMBER MANUFACTURE ASSOCIATION held its twenty-first a nual meeting at the Grunewald Hot New Orleans, March 21-22.

Publications from the Construction Industry

Mechanical Mucking — LAKE SUPERIOR LOADER CO., Duluth, Minn., explains in a 24-p. illustrated booklet the operation of its mechanical mucking device, called the Shuveloder, for handling broken rock in tunnels and mines. The device is operated by compressed air and has an overall length of 6 ft., width of 4 ft., and height of 4½ ft., and weighs 4,600 lb. A dipper pivoted on a pair of arms is crowded into the material to be loaded, swung upward through a vertical arc of about 270 deg., and discharged into narrow-gage cars directly behind the machine. The booklet presents operating data in the form of several reports indicating the economy of the Shuveloder over hand mucking.

Rail Steel Reinforcement—The volume which was reviewed in this column in the March 15 issue, p. 515, and credited to the Laclede Steel Co., St. Louis, was published by the Reinforcing Bar Division of the Rail Steel Products Association, of which the company named is a member. The following companies, members of the association, are in a position to distribute copies of the book: Laclede Steel Co., St. Louis; Calumet Steel Co., Chicago; Inland Steel Co., Chicago; Burlington Steel Co., Ltd., Hamilton, Ont., Can.; Buffalo Steel Co., Tonawanda, N. Y.; Pollak Steel Co., Cincinnati.

Road Building Equipment — GOOD ROADS MACHINERY CO., INC., Kennett Square, Pa., has published an illustrated general catalog of 48 pp. covering its line of road and street building machinery. The equipment, which is explained in detail, includes road graders with blades ranging in length from 5 to 10 ft., all-steel road drags of three types, including a two-blade, a three-blade and a three-way drag designed to cover a road 18 ft. wide, both stationary and portable rock crushing and screening equipment, road rollers, scarifiers, pressure distributors for bituminous materials, and heating kettles.

Pile Hammers — MCKIERNAN-TERRY DRILL CO., New York, in a 68-p. illustrated bulletin just published, makes an unusually complete presentation of the uses on various types of construction of its eight sizes of light and heavy double-acting pile hammer operated either by steam or compressed air. After a brief description of the design and operating features of this equipment and data on typical performances, the bulletin devotes 26 pp. to illustrations and descriptions of the pile hammers on jobs involving light and heavy sheetpiling (both timber and steel), round wooden piles, pipe piles, and batter or brace piles. These pages are replete with hints as to rigging for a wide range of conditions. There is a discussion, with sketches, of pile hammer ways and leads and the selection of he proper size of hammer. The booket concludes with detailed specificaions, lists of repair parts, and inforation on pile pulling with the IcKiernan-Terry hammers.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Car Shortage Relief in Quicker Moves and Heavier Loads

That the greatest transportation necessity today is the addition of improvements that will move freight cars faster, and action on the parts of shippers to utilize them to more nearly their full carrying capacity, is brought out in the following statement by Mr. M. J. Gormley, chairman of the Car Service Division of the American Railway Association, in his address before the Cincinnati Traffic Club, March 13:

There existed during the first eight months of 1922 an average daily surplus of equipment for the entire country of 270,750 cars. The severe shortage began about September 1 with a shortage of 58,670 cars and reached a peak of 179,239 on October 31.

From 1912 to 1922 this country experienced 30 months of car shortage with a maximum at any one time of 179,000 cars. During the same period there has been 90 months of surplus with the surplus reaching a maximum of 495,000 cars.

DIFFICULTY NOT LACK OF CARS

A great many people attribute the difficulties during 1922 to a lack of cars and make the statement that what is needed is additional cars and some new theoretical way of handling them. We believe the records will justify the statement that the shortage in 1922 was more largely made up of transportation shortage than car shortage. In substantiation of this statement, we have figures to indicate that if all of the cars of the country during the months of September, October and November, 1922, had moved at the rate of thirty miles per car per day instead of the average actually made of 25.9 miles per car per day it would in effect have resulted in adding 333,903 cars to the ownership. It is well recognized that thirty miles per car per day is an ideal figure and has been closely attained in the past, and without abnormal interference might have reached that point during the months mentioned. Generally speaking, it should be remembered that on the basis of the present car ownership of the country, the addition of one mile per car-per day in the movement has the effect of adding approximately 100,000 cars to the ownership.

Likewise if all the cars of the country had been loaded to an average of thirty tons per car, a figure attained in the past at different times, instead of the actual average of 27.7 tons per car, it would in effect have added 188,357 cars to the ownership.

Therefore, we are firmly of the opinion that the greatest necessity today is the adding of improvements that will move the car faster and action on part of all interested to utilize it to more nearly its carrying capacity. This involves locomotives, additional main lines, extension of yard facilities, enlarged shops, enlarged engine houses, and in our opinion, lastly comes the question of additional cars.

Business Briefs

Call money advanced to 6 per cent, March 26, for the fourth time this year, due to recall of funds by interior banks. Last week 5@6 per cent; year ago, 3½@6 per cent.

Time loans quiet at 5½ per cent, March 26. Last week, 5¼@5½ per cent for 60@90 days; year ago, 4½@5½ per cent.

Commercial-paper firm at 5@5¼ per cent; unchanged during week, with year ago rate, 4¾@5¼ per cent.

Bank debits, $10,188,000,000 for week ending March 23, against $9,355,000,000 for preceding week. Gain due chiefly to payment of first instalment of 1922 income taxes.

Foreign exchange shows strong recovery in French and Belgian francs. French franc, March 26, 6.61c.; week ago, 6.46c.; year ago, 8.94½c. Belgian, 5.71½c.; week ago, 5.56½c.; year ago, 8.32c. Mark at .48⅜c.; week ago, .48½c.; year ago, 30¼c.

Building permits for February valued at $216,748,197 in 149 cities, against $133,011,394 in same month last year, according to Bradstreet's.

Commercial failures (Dun's) totaled 391 for entire country, week ending March 22, against 544 during same week in 1922.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News pp. 177 to 191, are the following:

Office building, Philadelphia, Pa., for C. H. K. Curtis, $5,000,000.

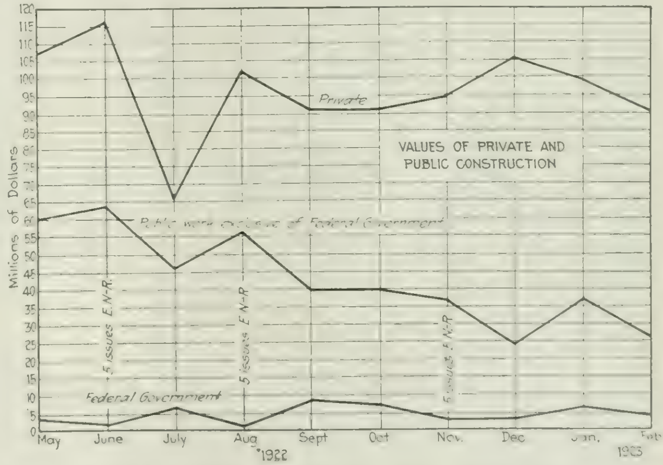
Bank, St. Louis, Mo., for Federal Reserve Bank of St. Louis, $2,500,000.

(Continued on p. 606)

If Government Postpones Letting Contracts

Federal Work Only 3 Per Cent of All Construction—Other Public Work 29 Per Cent

Mr. Hoover's advocacy of restricted federal construction at this time, in view of the economic situation in the industry, makes pertinent a brief inquiry into the probable effect of such a policy. Of the billion and a half of contracts reported last year in Construction News, only 2.8 per cent were for federal government projects. Since Jan. 1, this year, large contracts of all kinds totaled about $420,000,000, of which $12,000,000 or 2.9 per cent was federal, exclusive of government buildings.



VALUE OF LARGE PRIVATE AND PUBLIC CONSTRUCTION

Although stopping further contract-letting by the government would have little physical influence there would be a decided moral effect. Besides this there would always be the possibility that the states, counties and municipalities might follow the example of the federal government. Even the possibility of such united action should tend to steady prices. Contracts let last year for public improvements other than federal amounted to 29 per cent of the total value, or ten times the federal. Figures on large projects were as follows: water-works, $36,220,000; sewers, $43,584,000; bridges, $43,477,000; streets and roads, $[illegible].

The relative importance of private construction. and public work other than federal is shown by the chart. Here are given the monthly values of contracts reported in *Engineering News-Record*. The June, August and November figures are for five issues, instead of the usual four.

(Continued from p. 605)

Office building, Philadelphia, Pa., for Philadelphia Electric Co., $2,000,000.

Hotel, Asheville, N. C., for G. Vanderbilt and Battery Park Hotel Companies, $1,500,000.

School buildings, New York, N. Y., for Board of Education, 500 Park Ave., $1,915,000 and $1,400,000, respectively.

Store and office, Omaha, Neb., for C. & R. C. Cook of Chicago, $1,000,000.

Hotel, Madison, Wis., for Wisconsin Hotel Realty Co., 86 Michigan St., Milwaukee, $1,000,000.

Bridge, Blair, Neb., for Chicago and North Western R.R., $1,000,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 177 to 191, are the following large projects:

Railroad and telegraph system, 330 mi., between Casper and Miles City, Montana, to Peterson-Shirley and Gunther, Omaha, Neb., $12,000,000.

Office building, Los Angeles, Calif., to C. J. Kuback Co., $2,200,000.

Hotel, Chicago, Ill., to Shank and Co., $2,000,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of March 1; the next, on April 5.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.44	+$4.20	$4.50	$3.20	$3.45	$3.95	+$3.60	$4.00	$3.75
Structural rivets, 100 lb	4.00	+4.85	5.25	3.75	4.00	5.15	4.75	4.50	5.50
Reinforcing bars, ¾ in. up, 100 lb	3.34	+4.10	3.15	3.10	3.35	3.97½	+3.40	4.00	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	51%	+52%	45%	59½%	55-5%	38%	38.2@46.5%	45%	32.76
Cast-iron pipe, 6 in. and over, ton	+62.00	+55.00	57.00	—53.20	60.50	65.00	+60.00	58.00	55.00
Concreting Material:									
Cement without bags, bbl	2.70@2.80	2.90	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd	2.00	1.75	2.25	2.25	1.75	1.90	2.15	+1.25	1.50
Sand, cu.yd	1.00	1.24	1.87½	2.25	1.00	1.00	1.50	+1.25	1.25
Crushed stone, ¾ in., cu.yd	1.75	2.00	2.50	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	63.00	38.00	53.00	60.50	44.75	51.00	39.00	30.00	95.00
Lime, finishing, hydrated, ton	16.80@17.10	23.00	22.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	3.00@3.25	1.95	2.50	1.50	1.25	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	13.00	11.60	11.00	17@19	12.00	—15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.0859	.115	....	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1314	.0859	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal	+1.08	+1.17	1.16	+1.15	+1.22	1.25	+1.15	.86	1.17
Common Labor:									
Common labor, union, hour	.60	.35	.30@.50	......	....	.50@.55	.56¼	....	......
Common labor, non-union, hour	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.50	.30@.70	.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine casing. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.28). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Apparently reflecting an expectation of wage advances and consequent higher costs, steel mills are showing a disinclination to accept forward business.

With the pig-iron output at the heaviest point in several months, No. 2 foundry iron rose 50c.; bessemer, $1.50 and basic, $2 per gross ton at Pittsburgh, during week. Furnace coke also rose to the extent of 25c. per net ton, due to increased foreign demand.

Actual quotations on steel plates stood at $2.40@$2.65 per 100 lb., f.o.b. Pittsburgh, with $2.30, mentioned nominally. Plate mills are heavily booked and show a tendency to decline orders. Oil-tank plate inquiries show no let up and railroad car buying is heavier. Structural shapes and bars are $2.30@$2.60 per 100 lb. on current business, with $2.25 no longer quoted by the mills.

Atlanta warehouses advanced shapes, rivets and bars, 25c. per 100 lb., during week; San Francisco reports rise of 15c. on shapes and 10c. on reinforcing bars. Wrought steel pipe prices were advanced in Atlanta by a reduction of one point in the discount from list.

Consequent to the rise in coke and pig iron, cast iron pipe rose $2.50 in Atlanta; $3 in San Francisco and $4.80 per ton in New York.

Lumber prices remain very firm throughout the country, with no changes reported. Production is slightly above normal, with shipments 107 per cent and orders, 103 per cent of normal production, according to the National Lumber Trade Barometer of Mar. 23. The National Lumber Manufacturers' Association reports that orders, thus far this year, exceed production by about 640,000,000 ft., notwithstanding the great increase in output; and that shipments are less than 100,000,000 ft. under orders. This condition reflects improvement in transportation facilities and results of the campaign in the building trades to store materials in anticipation of needs as much as possible, in order to avoid transportation congestion in the peak months of Autumn.

Sand and gravel advanced 25c. per cu.yd. at bunkers in Seattle. Common brick, however, declined 50c. per. M. in San Francisco.

Linseed oil advanced 3c. in Chicago; 4c. in New York; 6c. in both Minneapolis and San Francisco and 12c. per gal. in Atlanta.

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DEVOTED TO CIVIL ENGINEERING
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E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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Demolition Risks

TWO fatal building accidents were added to the record in the past week, one occurring during construction and one during demolition. The former is still wrapped in mystery, but it is evidently an accident of quite exceptional character, whose teachings are likely to be concerned with the details of construction. The other accident, however, has a more general aspect, particularly important because little recognized in the past. Demolition has a fairly bad record; it has produced many accidents, and while few of them have been serious they all combine to show that safety receives less consideration in demolition than in construction of buildings. There are two obvious reasons for this: the low grade of competence and craftmanship engaged in much of the work, and the fact that the work is done as cheaply as possible and without any specification control. But at the root of the matter lies a failure to recognize that public safety is involved in demolition just as much as in erection. It is true that demolition is simpler work and does not require the same technical ability as construction; but unless both skill and caution are applied it will be unsafe work, so that experienced supervision and inspection are essential. When these requirements are fully taken account of in building practice and regulation, demolition accidents will not give much further trouble.

Enforcing a Code of Ethics

THANKS to an active publicity campaign the daily press is giving considerable space to the new code of ethics of the American Society of Mechanical Engineers. We read, for instance, that "the code is said to mark an advance in engineering ideals" and that "the society hopes it will ultimately apply to the entire engineering profession of the United States," just as though the mechanical engineers were here breaking new trails, leading a reluctant profession into the paths of righteousness. The facts are that the American Institute of Electrical Engineers has had a code of ethics since 1912, the American Society of Civil Engineers since 1914 and the mechanicals themselves a code, of which the current one is only a revision, since the latter year. What the mechanical engineers can do, and what their latest move promises that they will try to do, is to establish some active method of enforcing the code. In their new Committees on Professional Conduct, both the A. S. M. E. and the Am. Soc. C. E. have the making of a real ethical force which the engineering profession now lacks—bodies which not only interpret a code and thereby build up a common law of engineering conduct but which also take punitive action in specific cases. Engineering today has not the analogue of the lawyers' grievance committees, which on their own initiative or by complaint investigate individual lapses from the code and, if necessary, prosecute the guilty. There are just now one or two cases which cry out for some such procedure in the engineering profession, but they remain, as always, merely the subject of office and society gossip, with the dangerous and unfair connotations that gossip always involves. A code of ethics is only the first step toward professional integrity. Some way must be developed of enforcing the code.

A Prospective Power Czar

IF GOVERNOR SMITH'S water-power bill just introduced into the New York State Senate becomes law, New York will have in its service the most powerful engineer in the world. This bill as written constitutes a new officer, a commissioner of hydro-electric power, who *ex officio* is the state engineer and surveyor. This officer can take over, control and utilize the waters of the Niagara and the St. Lawrence. He can transmit the power developed from these rivers anywhere in the state. He can contract with any municipality for the sale of such power. He can purchase, lease or otherwise acquire any privately owned land, easements, interests, riparian rights, structures, etc., which appear to him to be necessary for the development of power. He can condemn real estate. He can build anything necessary for the development or transmission of power. He can sell any power at any rate he chooses without interference from public service or utility commission. Finally, he can exercise such other and further powers and authority "as may be necessary or incidental to the carrying out and accomplishment of the provisions and purposes of" the above sentences. For the present this autocrat is only to have $1,000,000 at his command, but the prospective activities of his office would soon require many hundred times that amount. Such a proposed law by its very absurdity demonstrates some of the difficulties of putting into cold type the state control of water power.

Crossing Rights

AN ECHO of old-time views—or perhaps it was more than an echo—made itself heard in a discussion of highway crossings at the recent meeting of the American Railway Engineering Association. The subject was a committee report dealing with revision of grades and alignment of highways at railway crossings, the alignment change being planned particularly to reduce the danger of accident. Several speakers in commenting upon the report took the attitude that the crossing should be made as difficult as possible for the road user, apparently on the ground that this would force him to be careful. It was urged that the road near the crossing should be laid out with sharp curves, and as much curvature as possible, so that road vehicles would have to slow down or stop. Whether this would conduce to safety is questionable. In fact one speaker at the meeting made the sensible remark that a crossing so built would cause the motorist to be more occupied with the difficulty of the curve and less with the possible approach of a train, so that safety would be reduced rather than increased. It is worth while recalling in the same connection the injunction given (by the railroad) at many crossing points, namely, to come to a full stop before crossing. Its intent is laudable, but its value is in doubt, at least when there is a curve in the railroad line and ample growth of brush at the crossing, as often happens. Similarly it is doubtful whether crossing safety is promoted by making the highway as troublesome as possible at the track intersection. Rough crossings, which compel a very abrupt checking of speed and often result in stalling, probably have more than one fatal accident to their credit. The road-crossing problem is not an easy one under the best of conditions, and it will continue to demand much study and conscientious planning. Its solution will not be promoted, however, by approaching it in the old-time spirit of antagonism between railway and highway interests. Railway men who approach the crossing problem in the antagonistic spirit of past days will probably find that they are working against the interests of the railway as much as against that of the highway. They hasten the day when universal abolition of grade crossings will be demanded.

Concrete Rock Borers

LITTLE marine bugs with unnatural appetites for stone have been known for many years, but they have had more of a biological than an engineering significance. Because some of them have recently been active in Southern California waters and around the Caribbean is no reason for alarm, even though they seem to have transferred their taste from natural to artificial stone. This is well emphasized in the current letter of Mr. Squire of the California State Harbor Commission. There is no indication that such borers are a serious menace to concrete in sea water. Certainly, their activities should not be confused in importance with the less lively but much more widespread and dangerous activity of the sea water in which they live.

Taking All the Credit

TOO frequently in engineering organizations is heard the complaint of the subordinate that the chief takes all the credit, to build up for himself a reputation which he can capitalize. For such self seeking engineers a paragraph in a recent letter from one of our most distinguished consulting engineers preaches a good sermon. "When I was starting professional work," he writes, "one of the older men who did a good deal to get me started in life told me that to succeed in professional relations it was necessary to let the other fellow have most of the credit. If a man could do the required work and get some fair share of the compensation that belonged to him, it was better to let the other fellow have some of the compensation and as much credit as he could get. Looking at it now, it is quite clear to me that my old friend was right. If a man gets too much credit for anything he does he is on the road to trouble." This is pragmatic and not ethical and should therefore appeal to the man who is in the habit of grabbing all the credit. His aim is to benefit himself and he is not to be influenced by considerations of what is right and proper. When, therefore, a successful engineer, who firmly believes in the essential rightness of a becoming modesty, testifies to the practical value of such modesty, his words take on a double significance. When a course is both right and profitable only a fool will not follow it.

Closed Specifications for Highways

FAITH in competition and fear of trusts are combined in about equal parts in the legislative and executive activities which have made the past winter notorious in highway history. In New Jersey a law compelling open specifications has been enacted, and vetoed by the Governor and passed again over the veto, and the highway department has been given power to build a plant and manufacture cement for state works. In Ohio a committee of senators is investigating the charge that the materials interests are subverting highway management and the Governor is refusing compensation for old contracts and approval of new contracts where "one kind of material only is specified," and has sent official notice to the highway commissioner that "in every case where you ask for bids on brick, concrete or other high-priced construction, I demand that you also ask for bids on cheaper types, such as macadam or gravel." Other states exhibit a less pronounced mania, but in general, throughout the country it is open season for closed specifications.

The manifest absurdity of some of the action which has been taken does not relieve the situation from serious aspects. Any disposition evinced by legislators and heads of government to usurp the technical functions of their state engineering departments is dangerous. Such usurpation is exactly what the orders of the Governor of Ohio amount to. The absurdity of his "demand" indicates the lengths to which interference by those not trained in engineering may proceed. The development of a state highway system best adapted to the traffic requirements of all the people, with a provident eye to the future, is a complex engineering problem. If the engineers appointed are not capable of the task other more capable engineers may be secured. Only failure will follow any attempt of governor or legislature to substitute as technical experts.

So much for general administration policy. It is this policy that should dictate practice in respect to closed or open specifications. The closed specification is not inherently vicious. It is absolutely sound engineering in certain instances to call for a specific road material which may be patented or otherwise privately controlled. The practice becomes vicious only when the selection is influenced by dishonest motives or when the ignorance or prejudice of the engineer make him incapable of sound decision. It is true also that sales managers have not always hesitated to play on the ignorance or prejudice or honesty of the engineer. There has been misuse of the closed specification. Commonly, however, this has been by township and county road departments. Very few state highway departments, if any at all, can be justly accused of employing closed specifications commonly or even frequently.

Altogether the closed specification offers little danger to the public purse or to the quality of highways secured if it is employed by competent and honest engineers. It is wise to be suspicious of its use exclusively because competent and honest engineering never finds one kind or type of road always best. It is of very doubtful efficacy to legislate against it because no law can be drawn which gives the road purchaser adequate power of selection which cannot also be evaded if the agent of the public finds it to his interest. Any danger which the closed specification invites or the open specification can possibly repel is one which can be overcome by responsible and honest engineering. In the end, whether specifications are open or closed, it is the engineer who picks the construction. The obvious duty of the legislature and governor is to pick good engineers and pay enough to get a good selection to pick from.

Closing the Chicago River

TWO proposals to close the Chicago River are now being considered seriously by different official organizations. The first involves the age-old controversy of fixed versus movable bridges. The second is an ambitious program of roofing the entire river within the downtown district to make a low-level boulevard. The first is in the hands of a committee of the City Council and the second has been brought to the consideration of the City Plan Commission.

To an engineer new to the city's problems it would seem an enormous economic waste not to close the river. When this engineer has lived in Chicago long enough to hear of the long litigation over closing the Ogden ditch, so narrow a historic stream that not even a rowboat could navigate it, and the recent controversies with Congress over filling up Bubbly Creek, he realizes the undue power accruing to vested interests and riparian property holders. But if this new engineer investigates the steep descending grade of shipping in the Chicago River since the 80's and 90's he will find that ultimate abandonment of the river for shipping is plainly indicated. Perhaps if he is a taxpayer the large sums required for new movable bridges will further intrigue his investigative turn of mind. It will lead him to search for the reason why an insignificant little creek which at best is only an elongated slip should continue to be a restrictive thong around the neck of one of the greatest downtown business districts in the world. Plenty of arguments will be found on both sides, but those for the shipping interests have rapidly diminished while those arising out of congested traffic conditions and expanding business requirements are steadily on the increase. For years the business building area has been restricted by the river to the north and west and by the railroad terminals to the south. The railroad situation has been worked over so much that it now resolves itself largely into financial bargaining among the various lines. The river barrier has been accepted as fixed and only recently has a start been made to build a few business structures to the west and along Michigan Ave. to the north.

Undoubtedly the time has been ripe for several years for someone seriously to propose river elimination. Angus Hibbard, a local consulting engineer, has recently seized the opportunity, which has arisen because of the objections to the plan to eliminate the South Water St. produce market and make of it a double-deck thoroughfare, to propose a double-deck river roof. His plan is being widely discussed. About the same time the City Council committee proposed to find out why, under present conditions, fixed bridges cannot be built. Both proposals which lead to the same result so far as shipping is concerned, call for a careful consideration of statistics bearing on the case, and then a clear statement of the whole situation in a campaign of education to be placed before the business interests of the city. Eventually, river elimination or closure in Chicago—and, for that matter, in Milwaukee and in Cleveland—will come about

No Royal Road in Sewage Treatment

THE growing tendency to give sewage a preliminary treatment before sending it through an activated-sludge plant, and in general the adoption, sooner or later, of supplementary processes in the case of every method brought out as new, self contained and yielding an effluent of high degree, is freshly illustrated by the sewage-works of Graham, Texas.

In its simplest original form the activated-sludge process consisted of the accumulation and activation of sludge, sedimentation, decantation of the clarified liquor and, eventually, periodic removal of surplus sludge. Soon it was found that separate sedimentation tanks were advantageous. Leaving out of account here the sludge-dewatering problem and trials of paddles in place of air for agitation, it may be noted that besides the supplementary or separate sedimentation, various preliminary methods of treating the sewage before activation were used until now some one of them seems to have become common practice.

At the Graham sewage-works the designer has adopted grit chambers and the septic tank for preliminary treatment. His claims for results, given elsewhere in this issue, can better be judged after more extensive and varied experience. It seems obvious that if money is spent for septic or other preliminary treatment there should be less air or power required for activation and a less volume of final sludge, or if not these then some other compensating advantages.

As to the name adopted for the combination (patented) in use at Graham—"sept-aer-sed"—it should be noted that it seems better designed for promotion purposes than for technical nomenclature. Activated-sludge plants from the start have combined aeration and sedimentation, whether or not septic treatment has ever been used as preliminary to activation.

The most daring and perhaps novel feature of the Graham plant is night storage of the septic tank effluent, brought about automatically when the air blowers for activation are shut down. One would suppose that this would upset the functioning of the filtros plates and the whole activation process.

As suggested at the outset, however promising any new and at first blush self-contained process of sewage treatment may be, provided it is designed to yield a high-grade effluent on the one hand and on the other to solve the final sludge problem, time and experience generally lead to the adoption of supplementary treatment —preliminary, final or both. In extreme cases we may see a combination with more than three elements.

Fortunately, local conditions do not always demand the highest possible degree of sewage treatment. In such cases, the choice of a treatment process may be several elements of one of the several possible combinations for highest results, range from one such element to two or three or more. There is as yet no single straight royal road through the sewage disposal field. It is rather a choice between various roads, none royal, and all more or less bewildering on the one hand and on the other between various humble paths. In all cases a guide is required. The wise city will choose as a guide a competent disinterested engineer rather than a person or company devoted to some proprietary process of sewage treatment, held up to laymen city officials as the only solution for any and every local sewage problem.

Concrete Frame and Exterior for High Tower Building

Medical Arts Building at Dallas, Tex., 255 Ft. Above Basement Floor, Laid Out in Cruciform Plan With Beam and Girder Floors to Insure Rigidity

By W. J. Knight
Consulting Engineer, St. Louis, Mo.

EXTREME height and a cruciform floor plan mark the new Medical Arts Building at Dallas, Tex., as a novel type of reinforced-concrete structure, in which both height and plan developed some unique problems of design. The building is intended for the exclusive use of the medical and dental professions and occupies a prominent corner location in the center of the city. The first three floors occupy the entire irregular shaped lot but to increase air and light all floors above the third assume the shape of a cross, 111 ft. 6 in. x 111 ft. 6 in., with window openings along the three faces of each wing. Each wing of the cross is 39 ft. 6 in. wide by 36 ft. 4½ in., and has a total height of 255 ft. from basement floor to the top of reinforced-concrete roof. Office suites located in the four wings have direct access to a central lobby, octagonal in shape, and four high speed elevators. The first floor is to be occupied by stores devoted to the exclusive sale of articles, drugs, etc., common to the medical profession. An octagonal well opening is located in the center of the lobby for the purpose of furnishing additional ventilation for this portion of the building. All floors of all offices consist of cement finish properly hardened to resist wear and dusting. The corridors and lobbies are finished with terrazzo.

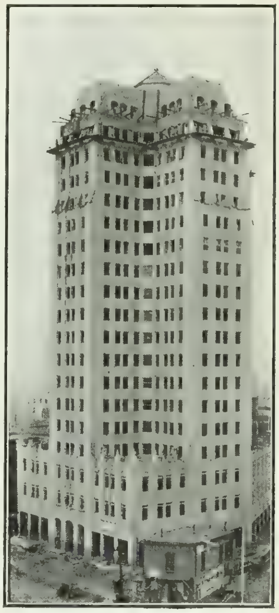


FIG. 1—THE MEDICAL ARTS BUILDING AT DALLAS, TEX., REINFORCED CONCRETE AND 255 FT. HIGH ABOVE BASEMENT FLOOR

The cost of a structural steel frame was also estimated for this building, but since the same amounted to about $75,000 in excess of reinforced concrete, the latter material was selected, not only for the frame but for the face.

Panels of all wings and center part of the building consist of reinforced-concrete ribs or joists 5 in. wide by 22 in. deep and 3 ft. 11 in. c. to c., extending in two directions. The top slab over joists is 2½ in. thick and reinforced with triangular mesh laid in two directions. Joists in elevation, Sec. A-A, Fig. 3, are reinforced with two 1-in. round rods, one straight with hooks at each end and the other bent up near the supports. Those in section in Sect. A-A are reinforced with two 1⅛-in. rods anchored at each end. This type of floor construction was adopted primarily to give increased rigidity to the structure, in the event of high winds, besides permitting the same form units to be used for each consecutive floor. Each floor, in addition, is circumscribed by sprandrel beams of unusual depth and cross-section.

The typical floor panels are designed for the following superimposed and dead-loads: Cement finish 9 lb.; partitions, 20 lb.; ceiling and plaster, 10 lb.; live-load, 50 lb.; dead-load of floor, 82 lb.; total, 171 lb. per square foot dead- and live-load. The first floor, which consists of flat-slab construction, is designed for a live-load of 150 lb. per square foot, having for its supports additional intermediate auxiliary columns extending from basement to first floor level.

Each of the four elevator shafts are inclosed by 12-in. concrete walls extending from basement to twelfth floor and 8-in. thick walls above the twelfth floor level. These walls are reinforced as individual stayed column units, each about 15 x 12 in. with longitudinal ⅝-in. round rods from basement to sixth floor and ½-in. round longitudinals above the sixth floor. The column stays are ¼ in. round spaced 12 in. c. to c. (Fig. 3.) All walls of elevator shaft were designed and utilized as columns to support their respective loads from floors above, and also to serve as stiffeners to aid in counteracting the overturning action of high winds. The reinforcement of each wall unit in each story was assembled and wired together on the ground and later hoisted into place. The walls inclosing stairway and stack are reinforced-concrete faced with brick veneering.

All column foundations rest on hard solid rock, with an assumed maximum safe bearing value of 18 tons per square foot. All foundation piers are tapered on four sides from first floor level to 1 ft. below basement floor, such that the areas of bases are sufficient to

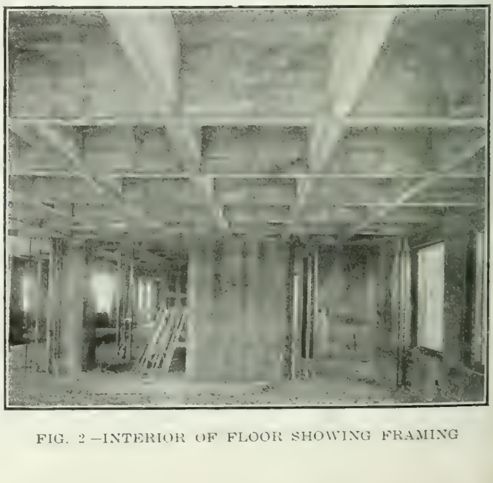


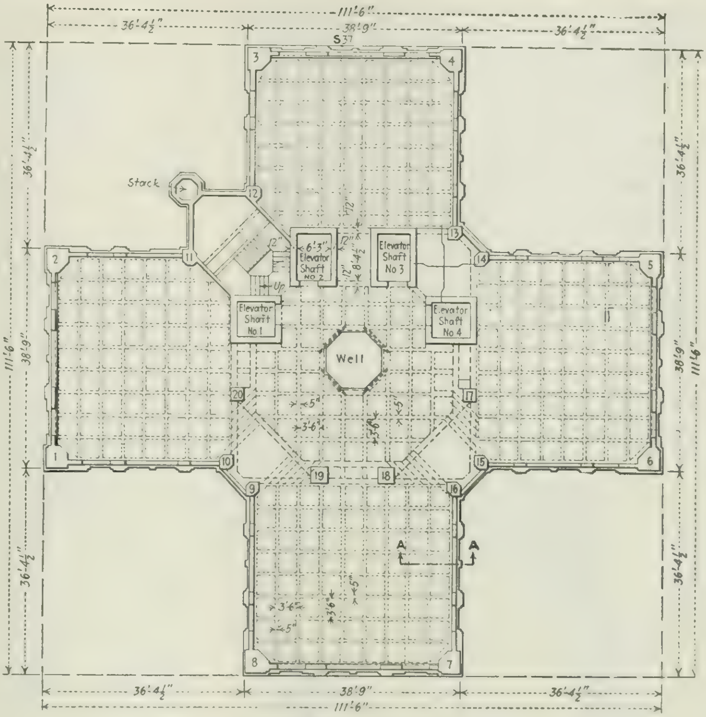
FIG. 2—INTERIOR OF FLOOR SHOWING FRAMING

satisfy the assumption of 18 tons per square foot or less as conditions required. (Fig. 4.)

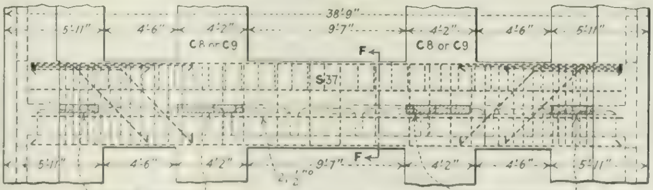
At the fifteenth and sixteenth floors it was necessary to offset Columns 1 to 8 inclusive for architectural reasons. This presented rather an awkward situation in the absence of supporting girders, which were deemed objectionable. Fig. 5 shows the design of offset for Column 8 at the fifteenth floor and the construction employed to transfer the load through vertical shear in the fourteenth story column to the column in the story beneath. The column in the fourteenth story, 31x60 in., is designed with two spiral column units and banded together with ½-in. round ties 12 in. c. to c. The column in the thirteenth story is 33x33 in. and reinforced as indicated. Any tendency of eccentric load from column in fifteenth story to cause bending in column of fourteenth story is opposed laterally by the floor construction at the fourteenth and fifteenth floors and also by the resistance offered by the deep spandrel beams which converge at this point.

Wind Stresses—The structure is designed for a wind pressure of 20 lb. per square foot of wall surface, without considering any reduction in the unit stresses resulting therefrom in the concrete and steel. All results were obtained from calculations made according to the "cantilever method." The distance from floor to floor for all stories from the fourth to and including the eighteenth floor and attic is 11 ft. 6 in. Consider, for example, the fifth story of Columns 7 and 8. The horizontal wind load at each floor above and including the fifth is equal to 11.5 × 17.33 × 20 = 4,000 lb. At attic the wind load is equal to 28.75 × 17.33 × 20 = 9,950 lb. The total moment from wind is:

4,000 × 971.75 = 3,887,000
9,950 × 155.25 = 1,544,738
Total moment, 5,431,738



Typical Floor Framing Plan
(5th to 14th Fl Incl)



Detail of Spandrel S-37

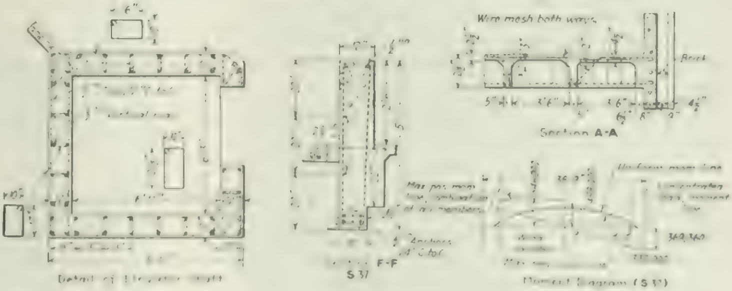


FIG. 6—TYPICAL FLOOR AND DETAILS OF BEAM FRAMING

Assuming 36 ft. as the average distance c. to c. of Columns 7 and 8 we have (18X × 18) + (18X × 18) = 5,431,736, or 648X = 5,431,736; X = 8,380. The direct stress in fifth story column is equal to 18X = 18 × 8,380 = 150,840 lb. The total horizontal shear in fifth story for the two columns is the sum of the wind loads above, or 62,000 lb. The total horizontal shear in fourth story is 66,000 lb. (Fig. 7.)

Referring to Fig. 7:

$$M_0 = 20{,}520 \times 18 = 369{,}360 \text{ ft.lb.}$$
$$M_1 = 33{,}000 \times 3.25 = 107{,}250 \text{ ft.lb.}$$
$$\text{The thrust} = 4{,}000/2 = 2{,}000 \text{ lb.}$$

Spandrel beams *S*37 (see details Fig. 3) are 12x60 in. The combined moments from wind, floor and masonry loads were computed. These beams are designed for a maximum positive moment of 546,000 ft.lb. or 6,552,000 in.lb. and a maximum negative moment at the face of each support due to wind, of 330,000 ft.lb. or 3,960,000 in.lb. Two intermediate concrete struts, 12 in. x 3 ft. $10\frac{7}{8}$ in., extending from fourth floor level to attic floor, were designed to furnish sufficient lateral stiffness for the rectangular compression flanges of all inverted spandrels.

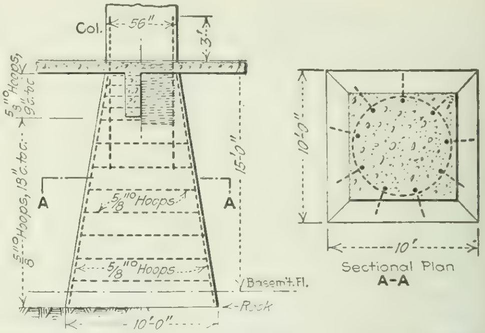


FIG. 4—FOUNDATION PIER SHOWING BATTERED DESIGN

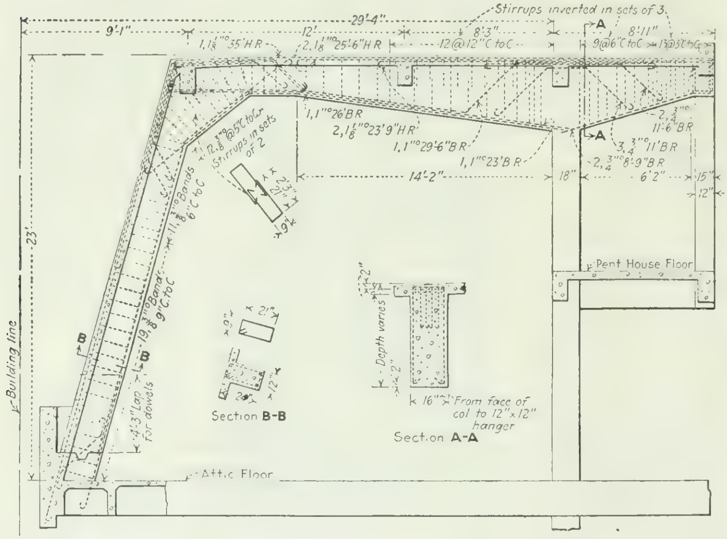


FIG. 6—DETAILS OF FRAME AT MANSARD ROOF

All rods of beams and panels at free bearing ends were hooked regardless of whether the theoretical calculations required anchorage, in order to insure a rigid frame.

The mansard roof construction is rather involved due especially to the necessity of suspending from the ends of reinforced-concrete cantilever beams, the loads from two house tanks located in the pent house story beneath the roof, and weighing 40,000 lb. each. (Fig. 6.)

The assumed principle of continuity and the effective rigidity of joints as applied to the design of reinforced-concrete frames of the roof, gave results somewhat in excess of calculations made in true accordance with the theory of rigid frame construction. Before the design of the roof frames was undertaken a close investigation was made of the tests performed by the University of Illinois, in 1918, of rigidly connected reinforced-concrete frames. The results of these tests were somewhat inconsistent with theoretical computations. The discrepancies ran up to 50 per cent and in some instances even greater. The area of roof being comparatively small, it was determined to make calculations on a more logical, practical and conservative basis, and then to check the results by utilizing theories applicable to this particular form of construction.

Viewed in the light of professional differences of opinion, which have created ominous forebodings in the mind of the average layman and others who are not versed in the art of design, it would appear that reinforced-concrete buildings should be limited within certain heights, implying that height and not unit stresses in the materials, is the dominant factor that should control whether the design is safe and in accordance with good practice. The term "good practice," as relates to reinforced-concrete design, is being frequently disturbed,

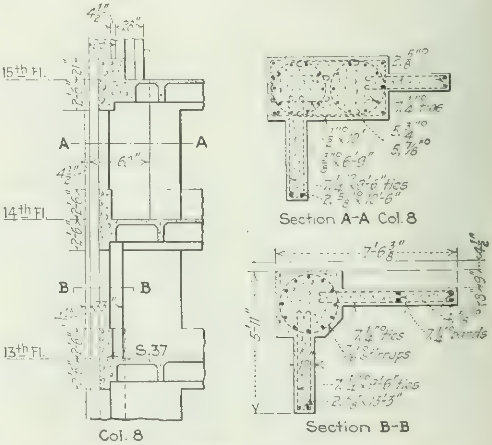


FIG. 5—OFFSET COLUMN AT FIFTEENTH FLOOR

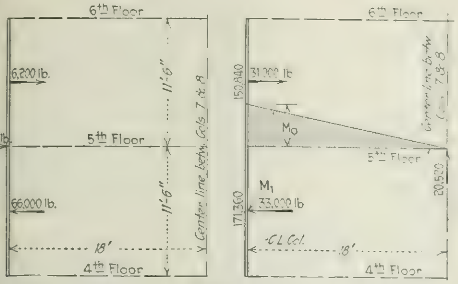


FIG. 7—METHOD OF FIGURING WIND STRESSES
See also wind stress diagram for spandrel beam on Fig. 3.

from time to time, by many engineers who are unwilling to accept conclusions based only on arbitrary selection, or from the mere fact that precedents fail to exist. Justification for a subsequent design may not always be exemplified by past experience.

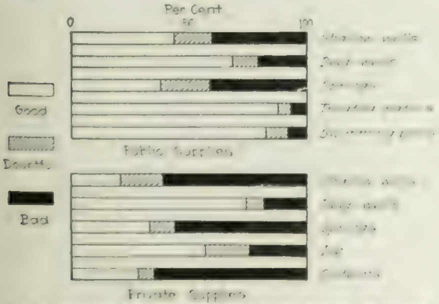
The height of any reinforced-concrete building depends entirely upon the limitating size permissible for the columns and the permissible proportion of members that furnish resistance to stresses induced by high winds and normal loads in combination.

Due to the position of the largest columns in the finished structure the unusual column sizes did not present a condition that was considered objectionable. Referring to Fig. 2, showing typical floor framing plan, Columns 1 to 8 inclusive are 56 x 56 in. in the first story and reinforced with twenty-five 1⅛-in. round longitudinal rods and ⁵⁄₁₆-in. round spirals having a pitch of 2 in. These columns, in the first story, are designed to support 2,580,000 lb., of which 180,000 is due to wind.

The structural design of the building was made by W. J. Knight, consulting engineer, St. Louis, Mo., M. F. Marks, principal assistant. C. E. Barglebaugh of Dallas, Texas, was architect and George W. Hewitt, of Dallas, was the general contractor. Cary-Schneider Investment Co. are the owners and S. W. Straus & Co. of New York and Chicago are underwriters.

Public and Private Water Supplies Compared

Comparison of public water supplies with private supplies in Iowa made by J. J. Hinman, Jr., at a recent meeting in Iowa Engineering Society indicated that the public supplies are the more sanitary. The diagram shows conditions as classified by analyses made in the Board of Health laboratory in the period from July 1, 1915 to July 1, 1922.



IOWA WATER SUPPLIES CLASSIFIED BY SOURCES

Moisture-Resistant Coatings for Wood

SHRINKING and swelling and internal stresses causing warping and checking are brought about in wood by changes in the moisture content. Such changes are occurring continually when wood is exposed to changing atmospheric conditions, and the only way to prevent or retard them is to protect the wood from the air with some moisture-resistant finish or coating. In order to determine the protection against moisture afforded by various coatings, a series of tests is being conducted by the U. S. Forest Service, at the Forest Products Laboratory, Madison, Wis.

Linseed oil, although it is probably recommended more frequently than most of the other materials for moisture-proofing wood, was found in the absorption tests to be quite ineffective. Five coats of hot oil followed by two coats of floor wax failed to give any great protection.

Oil paints form a film over wood which is very durable even in exterior locations. Laboratory tests show, however, that such a film, although it may be continuous, does not prevent moisture changes in wood. Graphite paints and spar varnish are about as effective as the ordinary oil paints with the heavier pigments.

Cellulose lacquers rank somewhat higher than the foregoing in moisture-resistance. Considerable improvement can probably be effected in them by the addition of solids. They have the advantages that they are fast drying and that the films they form over the wood are very elastic.

Rubbing varnishes afford considerably more protection against moisture than do spar or long oil varnishes. The larger amounts of gum solids present in rubbing varnish probably account for their greater moisture resistance.

Enamel coatings made by the addition of pigments, such as barytes, to ordinary varnish are about as effective as rubbing varnish.

A bronze coating composed of a cheap gloss oil and aluminum powder proved in tests to be superior in moisture-resistance to any of the coatings mentioned above. This mixture is very fast drying; three coats can be applied in the course of half an hour.

The aluminum-leaf coating developed at the Forest Products Laboratory particularly for the protection of airplane propellers, is highly efficient in preventing moisture changes in wood.

Some asphalt and pitch paints are highly moisture-resistant. They are rather cheap and may be applied almost any place where their color is not objectionable. Attempts to discover a means of covering asphalt and pitch paints with lighter-colored materials have met with little success.

For temporary protection against moisture changes, vaseline smeared over varnish is one of the most moisture-resistant coatings yet tested. Another temporary protection, a heavy coat of paraffine, is about as effective as rubbing varnish.

The following table gives the results of moisture absorption tests on panels coated with the different preparations. The percentages are based on average amounts of moisture absorbed per unit surface area by coated and uncoated panels subject to a humidity of 95-100 per cent for 14 days.

TREATMENT	Percentage Efficiency
Aluminum leaf process, asphalt paint base	98
Three coats spar varnish coated with vaseline	98
Three coats of asphalt paint	96
Aluminum leaf process, spar varnish base	95
Aluminum leaf process, cellulose lacquer base	94
Aluminum leaf process—oil paint base	93
Three coats of aluminum bronze [illegible]	92
A heavy coating of paraffine	91
Three coats of rubbing varnish	84
Three coats of enamel	88
Three coats of orange shellac	87
Three coats of cellulose lacquer	73
[illegible] applied to wood	68
Three coats of graphite paint	61
Three coats of spar varnish	60
Three coats of white lead oil	54
Five coats of linseed oil applied hot and two coats of wax	38
No coating	00

Flood Conditions and Land Filling at Cairo, Ill.

Proposed Raising Grade of Low Areas—Sand Boils in Leveed Area Caused by Underground Sources and Not by Rivers

THAT sand-boils and seep water inside the area protected by levees at Cairo, Ill., are fed by ground water and not by the adjacent rivers is an important conclusion presented in a recent report on flood protection for the city and an adjacent drainage district. A second important feature is that the report recommends raising the grade of all low areas of the city within the levees by means of a municipally operated suction dredging plant.

Owing to public apprehension during the long duration of the 1922 flood a special improvement commission was appointed by the city in co-operation with several civic organizations. This commission engaged the engineering firm of C. E. Smith & Co., St. Louis, Mo., to report on flood and drainage conditions in the city and in the drainage district. The investigation was made by W. C. Curd, consulting engineer, Chicago, who was at that time Chicago manager of the company. A brief abstract of his detailed report follows.

Flood Conditions—A difficult problem in flood protection by levees and pumping plants has been faced by the city of Cairo for many years, as the city is situated on a low and flat peninsula at the confluence of the Ohio and Mississippi rivers. Both of these streams are subject to periodical heavy floods, but fortunately the excessive stages in the two rivers do not occur at the same time. Porous sandy soil affords a poor foundation for the protective levees. The population of the city in 1920 was about 15,200.

From a 60-year record it appears that the greater number of floods has come from the Ohio, owing largely to climatic conditions. Of 53 floods since 1869, 22 occurred in April, 14 in March, and 8 in February, or 41.5, 26.4 and 15 per cent of the total. The Ohio drainage area of 203,900 square miles has an annual rainfall of 40 to 45 in., of which approximately 32 per cent is runoff. In the upper Mississippi valley, with 172,000 square miles of drainage area, the rainfall is 34 in. and the runoff 27 per cent, while in the Missouri drainage area of 527,000 square miles the rainfall is only 20 in. and the runoff only 12 per cent. In the Ohio valley the heaviest rainfall occurs during January, February and March, but in the Missouri and upper Mississippi valleys it is in May and June. Since the Ohio drainage area is the most southerly, it receives the effect of the storms from the Gulf while the other two drainage areas are still icebound.

Floods from all streams tributary to the Ohio and the Mississippi have never fully combined at Cairo and such an occurrence is a remote probability, according to the report. But should they combine, "a flood of twice the volume of any that has so far occurred may be expected." In some instances a great flood in one river has combined with an average stage in the other and this combination has produced record stages at Cairo, but as a rule the combined flood runout of the Ohio, Cumberland and Tennessee rivers comes first, then that of the upper Mississippi and lower Missouri, and finally that of the upper Missouri.

Levee work on the Mississippi below the mouth of the Ohio has increased flood heights and appears to have raised the stage of the 1922 flood at Cairo 2½ to 3 ft. above what it would have been with the natural bank overflows of ten years ago. But the city levees, with a crown elevation of 60 ft. on the Cairo gage, have still a freeboard of 5 ft. above the maximum stage of April 4, 1913. This stage was 54.8; next to this was 54 ft. on April 6, 1912, and 53.6 ft. on March 26, 1922. Beginning with 1862, there have been fifteen floods above the 50-ft. stage.

Cairo Levees—Since the first levee was built in 1828 there has been a gradual but intermittent growth in size and extent of the levees, marked in earlier days by occasional destruction resulting in disastrous flooding. At the present time a total of about $2,500,000 has been spent on the levees by the city, the drainage district and the U. S. Government, with the result, according to the report, that the people should now have "abundant faith in the security given their homes and property." A continuous levee system of about twenty miles surrounds Cairo and the Cairo drainage district and the enclosed area is divided by a cross levee near the north city limits. In case of a levee break in either section the other section can be shut off by flood gates in the cross levee. All the levees are reported to be in good condition.

Most of the levees are occupied by railway tracks, which is considered a favorable condition on account of the greater crown width and cross-section, the compacting of the material by traffic and the better maintenance by railway forces. In ordinary cases the larger cross-section required for railway use would cover the line of saturation, so that the usual banquette for high river levees could be omitted.

But at Cairo this saturation line is raised where seep water stands against the inner side of the levee and the base thus becomes saturated from both sides. As a result some sloughing of inside slopes has occurred and more may be expected unless the seepage is kept away from the levees either by pumping or by filling the land to a height sufficient to serve as a banquette. The report recommends the latter method as affording additional stability and safety and also reducing the objectionable standing water inside the protected area.

Three slides in the Ohio levee occurred in 1915, but were repaired by means of steel and wood sheeting and rock-filled cribs. The report states that undoubtedly these were caused by ground-water breaking through to the river after the flood of that year had receded. It is considered that the bank at each of these slides has fully settled and that no further trouble will occur. Caving of the right bank along the Ohio is occurring above the Illinois Central R.R. bridge, the current being thrown against this bank by a deflection dike built on the Kentucky side opposite Mound City, Ill., by the U. S. Government. Some revetment has been placed but the report advises the city to petition for further protection on account of the menace to the levees.

Sand Boils due to Ground Water—Both sand boils and seep water are experienced at Cairo during floods and cause considerable alarm. Along the lower Mississippi River it is the general belief that sand boils are formed by river water working through small channels under the levees. But the report states positively that sand boils at Cairo are fed by ground-water in the underlying sand and gravel formation and not from the river. This formation is about 375 ft. in thickness and is underlaid by rock. In regard to this question the report is quoted as follows:

> Seep water is underground water which, under pressure, works its way to the surface and spreads out over the low areas. Sand boils are small springs bubbling vertically out of the ground, the water being under sufficient hydrostatic pressure and velocity as to carry in suspension silt and sand from underlying strata which, on reaching the surface, settles out and builds up around the rim of the boil in the form of a frustum of a cone. Sand boils and seep water in Cairo are of the same origin, the one being a gradual increase in elevation of ground-water over a large area, whereas the other is a rise concentrated at some point of weakness in the formation where insufficient resistance is offered to prevent a rapid flow of ground-water to the surface.
>
> The popular belief throughout the Mississippi Valley is that sand boils and seep water are fed by the river, through small channels in or under the levee. It can be stated positively and authoritatively that the sand boils and seep water in Cairo are not in any manner connected with the rivers, but accompany floods only as a result of high pressure upon the underground flow. Cases are known where underground connections or channels have been developed between rivers and leveed areas, but such cases should more properly be classed as "blow outs" rather than sand boils, for they generally appear in locations where logs, stumps or roots in process of decay have not been removed in constructing the levee.
>
> The mineral content of water affords one of the most positive proofs of its source. In the analyses given in the accompanying table, it will be noted that there is no similarity between the water in the rivers and that from sand boils, the Bucher well or the seepage. These latter are all ground water. The Ohio water contains 8.98 grains of mineral salts per gallon, the Mississippi 12.46 grains, while the sand boils, seep water and well water vary from 28 to 42 grains, or three to four times that found in the river water.
>
> It will also be noted that the ground-water runs high in carbonates of calcium and magnesium. These salts come from limestone and are, unquestionably, taken into solution by rain water as it percolates from the ground surface downward through the limestone bluffs which line the Mississippi and Ohio valleys above Cairo. The mineral content must be in water before it reaches the sand and gravel under Cairo. There is nothing in that formation, in the way of mineral salts, that is soluble in water.

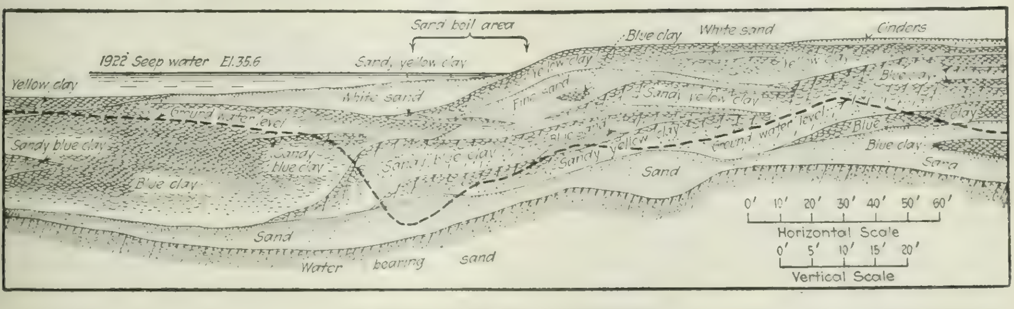
MINERAL ANALYSES OF WATERS AT CAIRO, ILL.

Mineral Salts	Rivers		Well at Bucher Plant, 63 ft. Deep	Seep Water 10th St. Pump	[illegible]	Sand Boil		
	Ohio	Miss.				[illegible]	[illegible]	[illegible]
Cal Carb	5 040	6 160	12 100	21 350	20 600	18 [illegible]	[illegible]	25 600
Sod Carb			1 840		0 036			
Mag Carb	0 478	1 100	6 080	1 420	7 350	[illegible]	[illegible]	[illegible]
Mag Sul	1 127	1 043		6 250		1 111	[illegible]	[illegible]
Sod Sul	1 248	3 070	0 746	4 240	1 080	2 306	4 450	[illegible]
Sod Chl	0 674	0 768	0 672	8 640	1 350	[illegible]	[illegible]	[illegible]
Sod Nit	0 422	0 422	0 139	0 099	0 072	[illegible]	[illegible]	[illegible]

Note: Samples of water were taken from sand boils [illegible] seepage from wells and the rivers. These samples were sent to the [illegible] Water Survey for analysis.

Borings made to determine why the sand boils were prevalent in certain areas indicated that the reason was a weakness in the surface formation, the ground-water under pressure passing up readily through the sand wherever the covering is thin. In the typical section given herewith the dotted line represents the ground water level at the time the borings were made. In each location bored this level is fairly uniform on either side of the boil but at the boil it drops down sharply into the water-bearing sand.

This condition indicates the influence of capillarity upon the height of water in a tight clay, but in the greater porosity of the sand formation at the boil, capillarity has little effect and the water is found at its true static level. At flood time, when the ground-water is under pressure, less resistance is offered in the sandy soil and the water rises quickly to the surface.



SECTION OF STRATA AT SAND BOIL

In this cross-section there will also be found an explanation of why the ground settles down at some boils and why it does not at others. It depends entirely upon the formation and whether there is sufficient velocity in the water through the boil to scour out enough material, at one point, to create a cavity that will break down. This is the disquieting fact about sand boils, for it can never be foretold what the formation is in that vicinity or what the velocity of the boil will be.

Sewers and Drainage Pumps—The city has an extensive sewerage system, but it appears that the seep water situation has imposed a condition on the sewers for which they were not designed. Radical changes are recommended including the division of the city into several sewer districts, each to have its own main sewer with a pumping station at the mouth. In this way the flow height of each district could be regulated in flood time to meet any conditions of storm water or seep water.

Four electrically operated pumping stations are maintained in Cairo to handle drainage and sewage at flood time, but a resetting of the pumps to give better head conditions is recommended as a means of securing less power consumption and greater pumping capacity. It is stated that in this way the present aggregate pumping capacity of 45,700 gal. per minute at minimum head and 38,500 at maximum head could be increased to 68,500 and 49,500 gals. respectively. It is also recommended that the pumps should be so operated that the sewers will not be under pressure but will flow not more than half full during storms. At present the low areas throughout the city are said to afford sufficient reservoir capacity when full to flood the entire city to a depth of nine inches. As these areas are filled or otherwise eliminated additional pumping facilities will be required, which facilities would be located with reference to the new sewers recommended.

Filling the Leveed Areas—Not only is filling recommended along the levees, to protect their bases from seep water, as noted above, but the report advocates filling all the low areas within the city to an elevation of 1 to 3 ft. above the present street grades as a means of preventing sand boils and seep water. The greater depth of fill would be to provide sufficient cover at sand boil areas or additional stability to the inner slopes of levees. The fills would be from 1 to 7 ft. deep in general, but would have depths of 12 to 17 ft in a few places. This filling would aggregate about 3,150,000 cu.yd. in the city and 1,250,750 cu.yd. in the drainage district, or a total of 4,400,750 cu.yd.

Suction-dredging is considered the only economical method of placing the material and for this work the fine sand of the Ohio, with variable percentages of silt and clay, is preferable to the coarse sand of the Mississippi. At certain points, however, the distance from the Ohio is too great and the dredge would have to work in the Mississippi. It is estimated that the discharge would have 12½ to 15 per cent of solids.

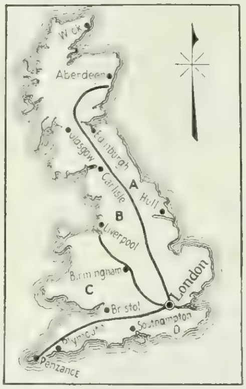
An interesting detail is a proposition to carry the discharge pipe along the Ohio River bridge, since the dredge would work over a bar on the Kentucky side, so that navigation would interfere with a floating line of pontoons. From the dredge there would be 1,000 ft. of floating line extending to the 16-in. riser of an 18-in. line about 3,300 ft. long, suspended from the bridge. The Cairo end of this pipe would be about 60 ft. above the general ground surface, thus affording gravity flow to long distances before a relay or booster pump would be required to reach remote areas.

A municipal electrically-operated dredging plant for the filling program is recommended, with a capacity of about 1,000,000 cu.yd. per year. Its operating cost is estimated at 7 to 8c. per cubic yard of material delivered, while interest, depreciation and other overhead expenses would make a total cost of about 12c. per yard. It is predicted that when the work is under way public opinion will favor a continuance of the filling beyond the quantity estimated and that when the work is finished it will not be difficult to sell the plant at a good price for similar work at other communities.

Under the plan proposed the city would purchase the plant by a bond issue and would take care of maintenance and overhead expenses by general taxation. The operating cost of 8c. per yard could be charged directly against the property filled and would amount to about $1.50 per front foot for a 5-ft. fill on an ordinary city lot. It is suggested also that the dredge, with its own generating plant on board, could furnish excess current for municipal uses and that during flood stages, when dredging must be stopped, current could be supplied to operate the drainage pumps which handle sewage and seep water. Furthermore, by this filling program, much of the low area which is now useless would be converted into good sites for factories and other industrial development.

England's Four Railway Systems

SINCE all the numerous large and small railways of England and Scotland (with a few exceptions not yet disposed of) are now amalgamated to form four great systems it is of interest to record particulars of the mileage, equipment and business of these systems. Their general geographical arrangement is shown in the accompanying cut, but they overlap and interlock to a considerable extent, so that there are still many competitive routes. The names of the new systems are as follows: London, Midland & Scottish Ry.; London & Northeastern Ry.; Great Western Ry.; Southern Ry. From statistics given in the *Railway Gazette*, London, the accompanying table has been prepared. Traffic and financial figures given in this table are the totals for 1921 for the several railways now combined in each of the new systems. The steamers listed are mainly for the cross-channel service maintaining direct communication with Ireland, France, Belgium and Holland.



GROUPING OF BRITISH RAILWAYS

Territories occupied are as follows: A, London & Northeastern Ry.; B, London, Midland & Scottish Ry.; C, Great Western Ry.; D, Southern Ry.

STATISTICS OF ENGLAND'S NEW RAILWAY SYSTEMS

	L. M. & S. Ry	L. & N. E. Ry.	Gt West Ry.	Southern Ry.
Area indicated by letter on map	B	A	C	D
Miles of line........	7,790	6,500	3,800	2,200
Miles of track including sidings	20,100	17,500	8,750	5,400
Locomotives	10,400	7,700	4,050	2,390
Passenger cars......	27,000	20,000	10,100	10,800
Freight cars.........	315,000	297,000	90,000	37,500
Company cars.......	22,300	16,500	9,700	2,280
Electric motor and trail cars and electric locomotives...	551	153	60	460
Rail motor cars......	32	10	70	14
Steamships	72	22	16	38
Motor vehicles; passenger	12	70	70	9
Motor vehicles; freight and parcels.	1,130	140	270	115
Canals, miles	350	295	213	4
Passengers carried...	338,687,000	232,000,000	112,321,000	171,470,000
Freight, tons........	19,300,000	19,000,000	8,000,000	4,000,000
Coal and minerals, tons	63,150,000	65,000,000	32,600,000	3,050,000
Cattle, head........	6,937,000	6,200,000	2,300,000	1,100,000
Trainmiles, passenger...............	61,000,000	46,000,000	28,000,000	31,000,000
Trainmiles, freight...	41,800,000	32,000,000	17,200,000	5,800,000
Trainmiles, electric..	3,831,000	730,000	330,000	4,711,000
Trainmiles, rail motor	384,500	.	611,000	
Engine miles, steam including switching	178,380,000	132,000,000	74,500,000	54,000,000
Gross receipts.......	$553,750,000	$450,000,000	$227,500,000	$165,000,000
Total operating expenditure.........	$473,000,000	$392,500,000	$192,500,000	$142,500,000

How to Get Better Engineering Contracts

To bring home to the individual engineer the necessity of the practical application of the principles of ethics in all of his relations with the public and with his fellow engineers, a committee of the Minnesota Surveyors and Engineers Society recommends a wider circulation of codes of ethics, and more particularly the approval or disapproval of forms of contracts for engineering services by engineering societies.

Effects of Grouting and Gravel Packing Around Tunnel

Excavation Over Tunnel Shows Grout Flow Through Fissures — Gravel Shooting Effective in Preventing Settlement

By W. E. Thompson
Assistant Engineer, New York Transit Commission, New York City

The recent removal of the material over and between a pair of cast-iron lined tunnels of the New York rapid transit subway for a length of approximately 350 ft. under Willoughby St., Brooklyn, in connection with the building of a station at Lawrence and Willoughby Sts. offered an opportunity to observe the results obtained by the separate injection of screened gravel packing and cement grout through the grout holes in the cast-iron lining at the time the tunnels were driven a few years ago. The excavation uncovered also a timbered drift, 60 ft. long, which had been driven between the tubes shortly after they were constructed, and disclosed the effect upon the surrounding soil of the grout injected through the poling boards of the roof. Fig. 1 shows a typical section through the excavation. The results noted are of particular interest as showing the extent to which the group penetrated and filled cracks and voids in the overlying material, at the same time failing to disclose a single instance of its having penetrated the interstices between the particles of bank sand. The action of the gravel packing is interesting, because it was in connection with the construction of the rapid transit subway tunnels that this material was used for the first time as a filling for the cavity left by the passage of a shield.

The Willoughby St. tubes were driven in 1915 and 1916, and the small timbered drift was excavated in 1918. The tubes connect with the Montague St.-Whitehall St.-East River Tunnel, now under operation by the N. Y. Consolidated R.R. (B. R. T.), and are of similar construction. The material through which they passed, where the recent excavation for the station was made, consisted of loose sand and gravel mixed with cobblestones. This was overlaid by a stratum of stiff sand and clay, containing many boulders, which extended from a few feet above the tops of the tubes to the surface of the ground. Numerous subsurface structures also were present in the street over the tunnels as shown in Fig. 1.

As the route of the railroad extended through narrow streets, lined with buildings and containing many subsurface structures in the form of water and gas mains, sewers and electric ducts, it was evident that the prevention of settlement necessarily must be a very important part of the work. In order to accomplish this purpose the contract, in addition to requiring the use of great care in driving the tunnels, provided for the injection of cement grout through the segments of the cast-iron lining for the purpose of filling all voids outside the tubes. This method was in accord with the best previous practice, but it has these disadvantages; it is difficult to confine the grout and prevent its return into the tail of the shield and it requires time for the grout to set before becoming effective, thereby causing delays which result in slow tunneling progress. To overcome these disadvantages, the contractors introduced the use of screened gravel as a filling for the annular cavity left by the passage of the shield, supplementing this by injecting grout as provided in the contract. The injection of gravel filling possessed the advantages that the gravel could be injected during the shove immediately behind the shield, and it became effective at once to support the surrounding material, thereby promoting rapid tunneling progress. It was found also that the grout would not readily penetrate through the gravel and leak into the tail of the shield and it was possible, therefore, to keep the grout closer to the shield than could otherwise have been done.

The gravel was of such size that it all passed a ¼-in. screen. It contained 33 per cent voids when packed, and was injected by means of an air blast at a pressure of 80 to 90 lb. per square inch. The gravel was fed into the discharge lines from two tanks mounted on a moving platform behind the shield and, to facilitate its passage through the discharge lines, the tanks were filled with water to the level of the top of the gravel. In the Willoughby St. tunnels, the best results were obtained by injecting gravel through the top segments while the shield was being shoved ahead, for the erection of the next ring, the length of the shove being 2 ft. 2 in. Before starting each shove the pipes and valves were set in place in the upper grout holes of the ring that was about to pass out of the tail of the shield, and connection was made to each of the pipes in turn. As many successive connections were made with each pipe as were possible, the gravel being injected to refusal each time. The time consumed by each shove was usually about fifteen minutes, and upon its completion, gravel was injected through the plates below the spring line, beginning at the lowest plate. On the approach sections of the river tunnels where the work was done under compressed air, it was the practice to inject the gravel first through the bottom plates, working up to the top of the tunnel as the shield advanced.

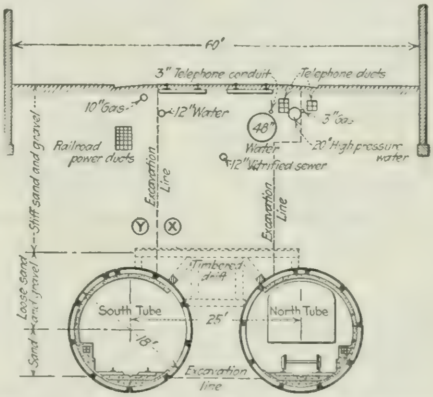


FIG. 1—CROSS-SECTION OF TUBES LOOKING WEST

Grout was found in pockets underneath the 48-in. water main to which it penetrated through fissures in the ground lying above the tunnels. Figs. 3 and 4 show the conditions at points marked Y and X respectively.

Grout, consisting of one part sand and one part natural cement, about the consistency of cream, was injected through the grout holes beginning at the bottom segment of each ring, then making a connection to each segment, moving upward to the top of the tunnel. The grout was injected at a pressure of 90 lb. per square inch, usually through the tenth ring back of the shield. Before grouting, it was necessary to open a passage for the grout by forcing a rod out through the gravel which lay over the grout hole, as it was found that in general the grout would not penetrate through the gravel. The arrangement of grout and gravel plant, as finally adopted is shown on Fig. 2. For a length of 3,758 feet of single-track tunnel under Willoughby, Fulton and Montague Sts., the average amount of gravel injected was 30.6 cu.ft. per ring, 2 ft. 2 in. in width, and the average amount of 1:1 natural cement grout injected was 32 bags per ring, equivalent to approximately 35 cu.ft. of set grout in place. The theoretic void outside the cast-iron lining, left by the passage of the shield was 31 cu.ft. per ring. The actual cavity, however, was somewhat larger, owing to the ploughing action of the shield and to the loss of some material at the face of the heading.

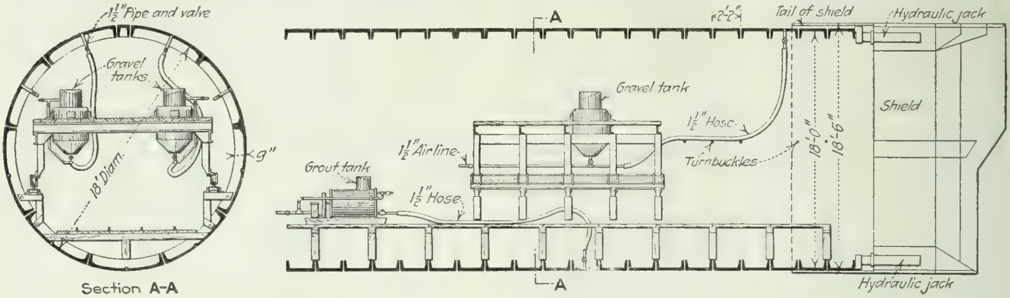


FIG. 2—ARRANGEMENT OF PLANT FOR PLACING GRAVEL PACKING AND GROUT

The results obtained by the injection of gravel packing and cement grout as described above were very satisfactory, a maximum weekly progress of 118 feet having been reached in one tunnel. There was practically no settlement of the buildings along Willoughby St. and the settlement at the middle of the street, amounting to an average of 2½ in. on the car tracks, after the passage of both tunnels, was insufficient to require any repairs to the roadway. When it is considered that the cover over the tunnels averaged only 34 ft., and that the vibration from trolley cars, which operated at frequent intervals on the surface could easily be detected in the tunnel heading, the results obtained were distinctly noteworthy.

The grout found in the excavation for the Lawrence St. station was in evidence through the ground overlying the tunnels for the whole length of the cut, to a point about the level of the bottom of the 48-in. water main, which is approximately 16 ft. above the top of the tubes, as indicated in Fig. 1. In the stiff stratum of sand and clay, there were many examples of the grout penetrating to a void through a small fissure caused by the caving of the soil and filling that void. Many of these pockets were from 3 to 5 cu.ft. in volume, but two, at least, contained about 10 cu.ft. Some of these voids did not appear to be the result of the tunneling operations but were apparently in the ground before the shields reached this point. They may have been caused by old excavations. For a length of about 35 ft. in one place, and for short distances elsewhere, the underside of the 48-in. water main was covered with grout, having a maximum thickness of 2½ in. where the grout had penetrated to a void under the main, caused by settlement of the underlying ground. As would be expected, there was considerably more grout in the soil over the timbered drift than in other parts of the cut. Although the grout penetrated freely through the smallest of fissures and cracks in the stiff stratum, there were no instances of grout mixed with the surrounding soil. Examples of the manner in which the grout penetrated this material are shown on Figs. 3 and 4. In these cases, as previously mentioned, the grout was injected at a pressure of 90 lb. per square inch. It is a matter of record also that thin neat grout, under the high pressure of 300 lb. per square inch would not impregnate undisturbed fine sand, when the attempt was made on one of the river tunnel contracts.

In the loose sand and gravel below the stiff stratum, about the level of the tops of the tubes, a smaller amount of grout was found, usually in the form of small rounded lumps or knobs, the largest of which was about two feet in diameter. These lumps were generally in contact with the iron lining, near a grout hole, and most of them contained a small air hole running up through the middle to the top. The appearance of the grout found in the loose material was quite different from that which was found in the stiff stratum, where the caving action was sufficiently slow to permit the grout to penetrate and fill the cracks and fissures. There were no seams of grout in the loose sand and gravel, and no grout whatever was found in the sand between the tubes, below the level of the upper quarter point, except next to the iron lining.

Where the cast-iron tubes were uncovered, scattered patches of grout were found adhering to the iron lining on the upper quarter of the circle. Below the spring line, a much larger amount of grout was found adhering to the iron, there being several instances observed of a continuous envelope of grout varying from one to four inches in thickness, extending for a length of 25 to 30 ft.

In only one place was gravel observed at any distance from the iron lining. In this particular instance, the gravel was found to have penetrated to a distance of four feet from the tunnel. Considerable gravel, mixed with sand, was found spread out over the upper quarter of the cast iron lining, and wherever grout was found in this area adhering to the iron, gravel was found on the side of the grout away from the iron. This may have been caused by settlement of the roof of the tube.

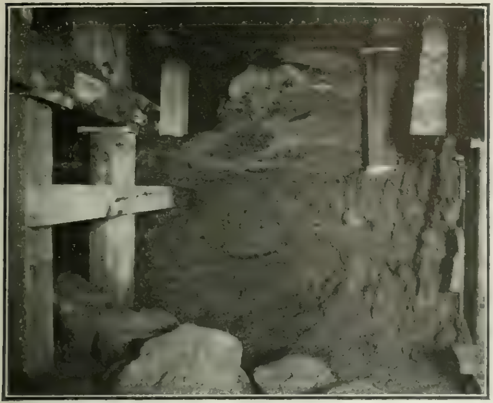


FIG. 3—PENETRATION OF GROUT INTO SOIL
Looking at south side of excavation over timbered drift, about 7 ft. above top of tunnels. The boulders in the foreground were encountered in the cut. The location of this photograph is indicated by the letter Y in Fig. 1.

which sometimes occurs, and the formation of voids into which the grout penetrated, by the arching action of the overlying gravel. Near the spring line, the gravel was usually found in pockets unmixed with sand. One example was noted of a pocket of gravel over a grout line about three feet below the spring line, the pocket being ten inches in diameter and about one foot in length. The gravel in this knob was so closely packed that it stuck out from the cast-iron lining unsupported when the surrounding soil had been removed. Below the lower quarter point the gravel showed a tendency to spread out under the iron lining, but it did not mix with the surrounding sand as in the case of the gravel observed over the top of the tunnel. This difference was probably due to the fact that the gravel was injected into an open space below the tunnel, whereas it was injected into falling sand above. In only a few cases was gravel found mixed with grout.

FIG. 4—ANOTHER VIEW SHOWING GROUT PENETRATION
Photograph taken looking westward at point [illegible] Fig. 1 about 7½ ft. west of that shown in Fig. 3. [illegible] shows how the grout has filled the cracks [illegible] stiff sand and clay.

The general conclusion may be drawn that the method of injecting gravel was excellent for the purpose for which it was intended, that is, to fill the cavity behind the shield with a material providing immediate support for the surrounding soil; the overlying cover, about 34 ft., being thick enough to eliminate danger from the release of air at the high pressure of 90 lb. per square inch, necessary to inject the gravel. The gravel was particularly effective in arresting settlement of the ground overlying the tunnels. Simultaneous injections of gravel through all the grout holes in the upper part of the tunnel during the shove probably would have been an improvement in method. Grout penetrated and filled all voids not reached by the gravel, reducing to a large extent the settlement that otherwise would have occurred at the surface. The lack of any examples to indicate that the grout had penetrated the interstices between the particles of bank sand, again demonstrates that it is practically impossible to accomplish this under the conditions described above. The grout penetrated to and filled all voids but would not impregnate undisturbed sand.

The tunnels were constructed by Booth & Flinn, Ltd., under the supervision of the engineers of the Public Service Commission.

Oldest County Concrete Highway in Iowa Promises Years of Service Still

DRIVING west of Mason City, Ia., on the old North Iowa Pike one passes on the second mile from the city over a mile of 16-ft. 6-in. reinforced-concrete pavement laid in 1913 by county day labor crews at a cost of 10,500, nearly $1 per square yard. The crown is 1¼ in. and the subgrade is a loose fluffy black soil which becomes mucky when wet. Reporting on pavement development in Iowa to the Iowa Engineering Society Raymond Zack, district engineer, Iowa Highway Commission, gave the following information as to this 10-year-old slab:

> No tests were run on cement or the sand and gravel. Unwashed material was used. The sand came from a pit on Willow Creek and contained a heavy percentage of red clay. Since then culverts have been built near this pit and material hauled from Mason City, because the local deposit is unfit for such use. The coarse aggregate consisted of soft limestone, strippings from the local cement plant and of unwashed gravel abounding in shale and lumps of clay. The material was dumped on the subgrade and shoveled into wheelbarrows and hauled to the mixer. Two-inch wooden forms were used and the riding qualities of the surface are about as poor as the concrete itself.
>
> This pavement has been in continuous service since laid. There are numerous transverse and longitudinal cracks which are, of course, kept filled with tar. During the last two summers several holes developed due to raveling of the concrete. Two on the west end of the mile near the center of the paving were filled with tar and gravel and cause no more trouble. One hole raveled out near the edge and a little later traffic broke through smashing out a triangular piece about 18 in. on a side. Another such piece broke out this last summer over an old wooden 1 x 1-ft box culvert, which had been left in and is now badly decayed.
>
> The action of the tires is causing some wear on this surface but by taking care of the places that ravel this pavement will serve for a good many more years. After it is unsatisfactory as a pavement it will be worth the original investment as a base for some more permanent type of resurfacing.

New System of Sewage Treatment at Graham, Texas

Septicization Precedes Activation—Storage Comes Automatically Into Use When Blower Shuts Off—Return Sludge Reduced—System Does Not Require Technically Skilled Operatives

By Henry E. Elrod
Consulting Engineer, Dallas, Tex., and Los Angeles, Calif.

SEPT-AER-SED is the name given to a new system of sewage treatment which was put into daily operation early in June, 1922, at Graham, Tex. As the name implies, the system comprises septic tanks, aeration chambers, and sedimentation chambers. The combination is the basis of patents issued Dec. 19, 1922.

The advantages of the Sept-aer-sed system of sewage treatment over the conventional activated-sludge process are: (1) The complete elimination of the troublesome excess activated sludge. (2) The small volume of air required for the production of a stable final effluent. (3) The lack of a necessity for technically skilled operatives. A plant of this type will treat 8 to 10 m.g.d. of strong municipal sewage per acre per day, with a volume of air less than that required for the usual activated-sludge plant, in the proportion that the reduction of suspended solids accomplished by the preliminary sedimentation in the septic tanks bears to the total suspended solids in the raw sewage. The operation of the plant produces no offense whatever and satisfactory operating results are obtained by intelligent, though not necessarily technically skilled, operatives. Considering the cost of the sludge conditioning and drying equipment and housing required in connection with the operation of the conventional activated-sludge plant, the cost of the Sept-aer-sed plant is materially less than that of the other type. With the elimination of sludge handling and drying costs, the reduction in the volume of air required, and the lack of a necessity for high-priced operatives, operating costs for the Sept-aer-sed system will also be very much less than those of the conventional activated-sludge process.

Studies at San Angelo, Tex.—The development of the Sept-aer-sed system of sewage treatment, as installed at Graham, is the result of studies and experiments carried on for several years at San Angelo, Tex., where an experimental plant of this type was installed in July, 1917, for the San Angelo Sewer Co. Conditions of topography in San Angelo were such that the only practicable location for a treatment plant was within a thousand feet of the business center of the city; there was no option, therefore, but to install an activated-sludge plant.

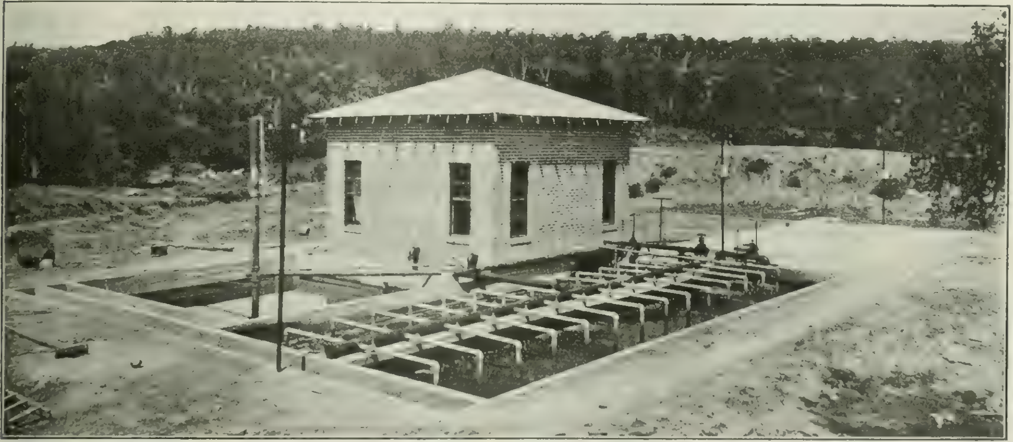
On the theory that the amount of air required for the oxidation of the suspended organic content of the sewage is proportional to the quantity of such organic matter in the sewage, a septic tank was provided for the reduction of a portion of the suspended solids and a proportional reduction of the air requirement was accomplished; it was not expected, however, that a greater reduction in the quantity of excess activated sludge would be produced than the proportional reduction of the suspended solids in the septic tank. The final effluent at San Angelo carried an average of 24 p.p.m. of solids; so when month after month no excess sludge was drawn off to be disposed of extraneously, it was thought that what excess sludge was being produced was passing off in the final effluent. Since these solids seemed to be inert, and caused no offense, no attention was paid to the matter until late in 1920, when analyses of the final effluent showed the solids to be cellulose-dissolved paper—which, being of lesser specific gravity than the sludge, floated out.

On discovering that the operation of the San Angelo plant produced no excess activated sludge, efforts were immediately made to ascertain the cause therefor. Until a better explanation of this phenomenon is advanced, the following one will stand: The amount of excess activated sludge produced by the aeration of raw sewage depends upon the amount and character of the suspended organic content of the sewage being aerated, the length of the period of aeration and the volume of air supplied, per unit of sewage.

Septicization Before Activation—In the ordinary activation-sludge process, raw sewage is admitted directly into the aeration chamber. This raw sewage contains fecal matter in large particles, together with greases, oils, and other trade wastes. Approximately 95 per cent of the air required for its aeration is effective only for the mechanical agitation of the sewage, to break up the larger particles of fecal matter and separate it from the greases, oils, trade wastes, etc. The remaining 5 per cent of the air is all that is necessary, ordinarily, for the oxidation of the finely comminuted organic content of the sewage. By placing a septic tank ahead of the aeration chamber, the reduction of a large portion of the solid content of the sewage is accomplished naturally; much of the suspended matter is changed, in the septic tank, to solids in solution, and practically all greases, oils, and trade wastes are retained in the tank. Those solids which do not settle out in the septic tank are very finely comminuted, anaerobically. Consequently, when the septic tank liquor enters the aeration chambers, practically the total volume of air supplied to it is effective as an oxidizing agent, very little being needed for mechanical agitation. This, in effect, is equivalent to reducing the suspended solid content of the raw sewage to a point where aeration, for a long period with a large volume of air, would produce biochemical oxidation to an extent which would eliminate the excess activated sludge.

Most of the difficulties, requiring constant attention and technical skill to overcome, encountered in the operation of the ordinary activated-sludge process are occasioned by the low stability of the sludge produced, the normal variations in the strength of the sewage, its variable rate of production, and trade wastes. In the Sept-aer-sed process, the sludge is quite stable, samples having stood in open and in closed containers, with and without water, for weeks without becoming septic. It dries readily and naturally without the least offense. The sludge is quite different, in practically all characteristics, from sludge produced by the aeration of raw sewage. Individual particles of the "floc" closely resemble small particles of sponge. Since practically all extraneous matter is retained in the septic tank, the sludge is clear and clean in appearance and is quite flocculent; its specific gravity is lower than that of the ordinary activated sludge; however, the sludge settles rapidly and completely, or sufficiently so for all practical purposes.

The effects of the variable strength of the sewage during different periods of the day are largely overcome in the septic tank, as the sewages of different strengths are mingled into a liquor of fairly uniform strength. By providing storage tanks in connection with the septic tanks, peak flows of sewage may be diverted thereinto, to be raised by lifts, operated by air from the aeration system during off-peak periods, thus smoothing out the peaks and valleys of the normal 24-hour production of sewage, so that a practically uniform volume of sewage of fairly uniform strength is charged into the aeration chambers continuously.



GENERAL VIEW OF SEWAGE-WORKS AT GRAHAM, TEXAS

Covered septic tank in right rear, with storage tank for receiving septic effluent for night storage back of it. Activation tank with compressed air supply pipes at front, backed by sedimentation tank. Pump and blower house in center.

The Graham Sept-aer-sed Plant was designed to treat 0.3 m.g.d., of rather strong domestic sewage, but at the present time the plant is handling only an average of 0.143 m.g. daily. Because of the small flow the plant is being operated only eleven hours each day. Automatic control devices have been installed, so that the plant may shut itself down at 6 p.m., or at any predetermined time; it is only necessary for the operator to start the plant each morning, after which he may leave it without further attention until the next morning; or, the plant may be run continuously with no more attention than is necessary to keep the motor and blower properly oiled. For the present, however, this plant has a regular attendant during the entire operating period, to protect it from possible interference from curious visitors, and from mischievous boys.

In general, the plant consists of a grit chamber, septic tank, night-flow storage tank, two-compartment aeration chamber, final sedimentation chamber and a blower house.

The Septic Tank is of the Cameron type, but of special design. Seals, constructed near the inlet and outlet ends of the tank, entrap the gases produced by the anaerobic decomposition of the settling solids, which gases may be readily burned if at any time they are found to create offense. A compartment at the inlet end of the tank serves as a grit chamber. Means are provided for clearing the septic tank of its sludge, if and when sufficient sludge has accumulated to make its removal desirable. (The septic tank of the San Angelo plant, which is of similar design and which has been in operation for more than five years, had not, at last report, accumulated sufficient sludge to require cleaning. In fact, on Oct. 25, 1921, after 4½ years operation, there was less than 9 in. of sludge on the floor of the tank.)

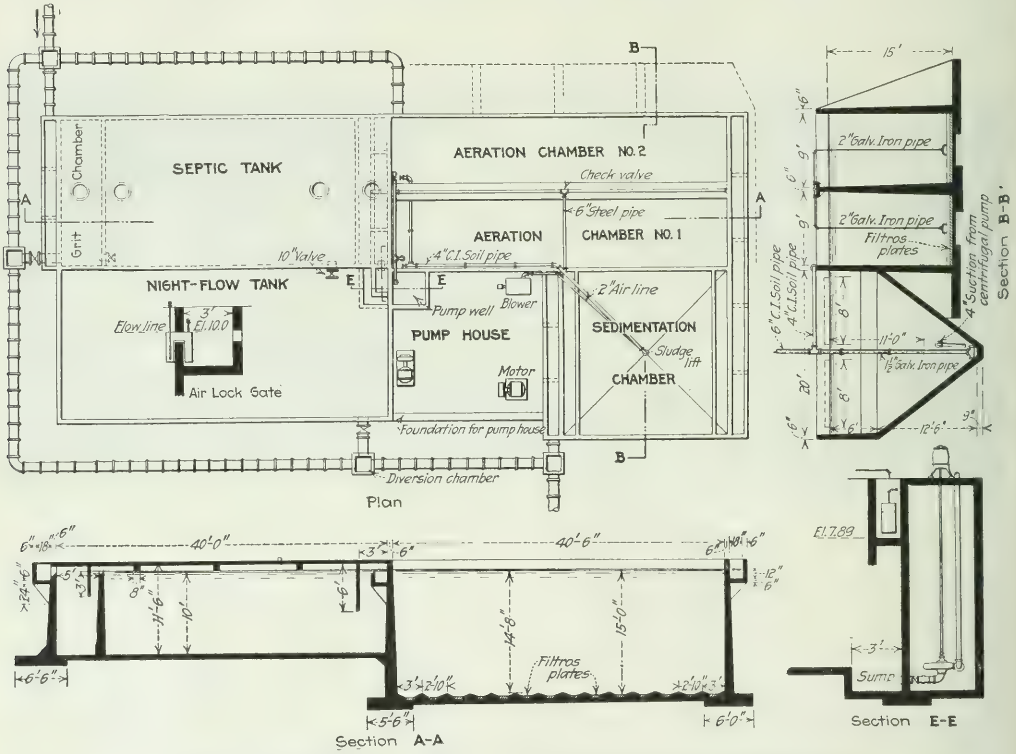
The Night-Flow Storage Tank is simply an open tank of sufficient capacity to contain the night flow of sewage (approximately 30 per cent of the day flow). During the day, the contents of this tank are transferred to the aeration chamber by means of a small centrifgual pump. In future plants of this type, which are intended to be operated during the day only, the sewage from the storage tank will be transferred to the aeration chamber by means of lifts, operated with air from the aeration system; if these lifts are controlled by floats, the liquor will be transferred in quantities varying with the normal day flow of raw sewage, thus smoothing out the peaks and valleys thereof.

The Aeration Chamber is like those common to the activated-sludge process, but does not need to be as large as those usually employed, as sufficient aeration of the septic tank liquor may be effected in three to four hours. Grade S filtros plates, set with neat cement in pre-cast concrete plate holders, are provided for air diffusion. No trouble has been experienced with the plates clogging on account of the intermittent operation of the plant. The diffusion of air is apparently perfect and since there are no coarse, heavy solids in the liquor being aerated, this condition should obtain indefinitely. The ratio of filtros area to aeration chamber surface area is as 1 to 4.5.

The Final Sedimentation Chamber is of the conventional hopper-bottom type. On account of the comparatively low specific gravity of the sludge produced by the aeration of septic tank effluent the settling tank was designed to handle only 750 gal. of liquor per square foot of tank surface area.

The Mechanical Equipment of the plant consists of:

(1) A No. 3 Nash Hytor positive-pressure, belt-driven blower, actuated by a 15-h.p., electric motor. This blower has a normal capacity of 324 cu.ft. of free air per minute, under 7.5 lb. pressure, at 600 r.p.m. At present, this blower is being operated at 483 r.p.m., at which speed it compresses about 180 cu.ft. of free air per minute, under 7.5 lb. pressure. (2) A Swaby vertical, direct-connected, motor-driven, centrifugal pump, of 500-g.p.m., capacity. This pump is cross connected to each chamber and compartment of the plant and to the final effluent channel, so that the contents of any chamber, or compartment, may be transferred to any other chamber, or compartment, or to the final effluent channel. (3) A 100-g.p.m., Swaby horizontal, direct-connected, motor-driven, centrifugal pump. This pump is utilized to transfer the liquor from the night flow storage tank to the aeration chamber. (4) Automatic control devices, operated by air pressure from the blower. (5) A Bristol recording sewage-flow gage.



PLAN AND SECTIONS OF "SEPT-AER-SED" SEWAGE-WORKS, GRAHAM, TEXAS

Operation Sequence—When the sewage-works are in use the septic tank effluent flows over weirs into the aeration chamber. When the plant is shut down the septic tank effluent is automatically sent to the storage tank. This is accomplished by means of an air-lock gate, set in the wall between the septic tank and the storage tank. As long as the blower is in operation, the gate is kept sealed by air therefrom. When the blower stops, the air in the "lock" is released through a channel cut in the seat of a valve in the connecting air line, and the liquor flows freely through the gate. On starting the blower, the gate is immediately sealed automatically, thus turning the flow of liquor into the aeration chamber again.

From the aeration chamber the liquor flows over weirs into the final sedimentation chamber, from which the clear effluent flows to a near-by water course. All of the settled sludge is continuously returned, from the hopper bottom of the chamber, to the inlet end of the aeration chamber, by means of an air lift.

Analytical Results—The accompanying table shows the results of analyses made by the Fort Worth Laboratories. Methylene blue stability tests of the final effluent were made at the plant from time to time, during the first few weeks of the operation of the plant. On account of the fact that there were many interruptions to the normal operation of the plant due to the "tuning up" of the machinery, etc., and of the fact that the septic tank had not been in operation sufficiently long to produce normal septic action, these tests were not uniformly satisfactory, but were not unsatisfactory during even short periods of operation when there were no disturbing conditions. Tests ordinarily showed color at room temperatures (80 deg. F. minimum to 102 deg. F. maximum) from 6 to 10 days and often for a much longer period.

Operation Cost—The present cost of operation of the Graham plant cannot be used as a fair criterion for that of other plants of this type, on account of the high cost of electric current and the comparatively small production of sewage at this time. Extensions to the city's sewer system of approximately 100 per cent, recently completed, will, it is expected, soon bring the production of sewage up to a volume approximating the normal capacity of the plant. For a plant of this type and size, operated at normal capacity, 560 kw.-hr. of current are required to treat 1,000,000 gal. of sewage with 0.66 cu.ft. of air per gallon of sewage treated. It is believed, however, that satisfactory results, under ordinary operating conditions, can be had with 0.5 cu.ft. of air per gallon of sewage treated. The blower in the Graham plant could not be economically operated at a rate of less than 0.66 cu.ft. of air per gallon of sewage, at which rate satisfactory results were produced.

ANALYSES OF RAW AND TREATED SEWAGE, GRAHAM, TEX.

(All in parts per million except as indicated)

	Raw Sewage*	Septic Tank Effluent	Final Effluent
Solids:			
Total	1,310	1,080	775
Suspended	460	375	11†
Alkalinity	376	..	..
Nitrogen:			
Free ammonia			1.6
Alb. ammonia			0.018
Nitrites			0.400
Nitrates			0.500
Oxygen consumed			12.000
Color			40.000
Odor, hot and cold			Musty
Turbidity			10.000
Stability, 4 days at 37° C			84%

*Sample of raw sewage collected at 8.30 a.m.
†Cellulose; mainly toilet paper; most settles in three hours.

Another set of samples, collected the same day, showed chlorine, B. Coli and total bacteria as follows:

	Chlorine P.P.M.	Bacteria B. Coli	Total per C.C.
Raw sewage	335	Present	2,400,000
Final effluent	225	Present in 0.01 c.c.	10,000
Creek above sewage-works outlet	465	Present in 0.0 c.c.	600
Creek below outlet	235	Present in 0.01 c.c.	35,000

Mr. Elrod states that "the greater bacterial count in the creek water below the outlet than in the final effluent is due to by-passing raw sewage into the creek shortly before the report was made in connection with 'tuning up' the plant."

The initial cost of the Graham plant was, in round figures, $16,000 exclusive of land. The plant has been approved for the Texas State Board of Health by V. M. Ehlers, state sanitary engineer. The plant was designed and the construction supervised by the Elrod Engineering Co., of Dallas, Tex., and the construction was done by the Janes Contracting Co., also of Dallas.

Assessment of Street Resurfacing Costs

Information gathered from 163 cities by the Civic Affairs Committee of the Indianapolis Chamber of Commerce discloses four standard practices: (1) Total cost of resurfacing paid by city; (2) property owners and city contribute equally; (3) two-thirds of cost paid by abutting property owners, the remaining one-third by the city; (4) total cost paid by abutting property owners. Of 163 cities, 93 assess some portion of the cost of resurfacing on the property benefited. Of these 93, 39 assess the entire cost against the property benefited; 60 assess in excess of two-thirds of the cost, and the amount assessed in the remaining cities ranges from 25 per cent to 50 per cent. Seventy cities make no assessment against abutting property for resurfacing.

Opportunities for Engineers in the U. S. Civil Service

FROM time to time, either organizations or educational institutions desire information as to the opportunities offered by the United States Civil Service Commission for engineers. Though no establishment of the government service has been charged with the collection of comprehensive data, a few figures are available which denote the range of engineering service.

In a letter from the United States Civil Service secretary to Prof. J. C. L. Fish, of the department of civil engineering, Stanford University, who had sought such information to convey to his civil engineering students, there were included the data herein given,

The secretary of the commission called attention to the disparity between salaries paid for the same engineering designations in different bureaus. His assertion is that "one of the outstanding complexities of the federal civil service is the lack of uniformity in pay for the same grade of work in different branches of the service." The reclassification bill passed at the last session of Congress, takes care of this wide disparity.

CIVIL ENGINEERING POSITIONS IN THE U. S. CIVIL SERVICE

(In most cases, employees at salaries of $2,500 or less, are allowed the increase of $20 a month granted by Congress.)

Engineering Designation	Department or Office	Bureau or Branch	No. of Employees	Salary Range From—	To—
Civil engr. and supt. of constr.	War	Quartermaster	15	$1,800	$3,600
Civil engr.			11	2,400	3,600
		Ordnance	4	2,400	2,600
	Treasury	Supervising Architect	9	1,200	2,500
	Interior	Reclamation	114	2,400	Up
	Interstate Com. Commission		125	1,320	9,000
	Agriculture	Forestry	1	2,000	
Asst. civ. engr.	War	Engineer	180	2,100	4,500
	Interior	Reclamation	84	1,500	2,280
Asso. civ. engr.	Commerce	Standards	2	2,200	2,400
Jr. civ. engr.	War	Engineer	265	1,500	3,000
Civ. eng. aid	Navy	Yards & Docks	8	day 10 00	14 [illegible]
Sr. highway engr.	Agriculture	Public Roads	86	2,500	3,600
Highway engr.			91	2,100	2,900
Sr. highway bridge engr.			11	3,000	3,500
Highway bridge engr.			9	2,100	3,000
Jr. highway bridge engr.			3	1,620	2,100
Sr. irrigation engr.			7	2,000	3,000
Irrigation engr.			6	1,800	2,220
Sr. drainage engr.			11	2,500	3,000
Drainage engr.			5	2,100	2,500
Jr. drainage engr.			1	1,680	
Junior engr. & deck officer	Commerce	Coast and Geod. Survey	70	2,000	*
Chief of road survey party	Agriculture	Public Roads	40	1,800	2,100
Supervisor of surveys	Interior	Land Office	1	mo. 300	
Asst. supervisor of surveys			10	mo. 250	
Cadastral engr.			63	mo. 155	200
Surveyor			37	mo. 125	150
"	War	Engineer	43	1,500	1,800
"	Agriculture	Forestry	27	1,400	2,200
Transitman	Interior	Land Office	30	mo. 100	120
	Agriculture	Public Roads	52	1,200	1,800
Topographic draftsman	War	Air	2	1,400	1,800
"		Quartermaster	1	1,800	
"	Interior	[illegible]	14	1,500	Up
"		Geological Survey	36	1,800	2,700
"		Land Office	57	1,000	2,340
"	Agriculture	[illegible]	13	1,200	1,800
"		Forestry	10	1,300	2,160
"	Commerce	Coast & Geod. Survey	34	1,200	[illegible]
"	Post Office		24	1,200	[illegible]
"	Navy		14	day 6 72	10 00
Highway draftsman	Agriculture	Public Roads	22	1,200	1,800
[illegible]	War	[illegible]	[illegible]	1,500	3,000

* [illegible]

Headwalls for Pipe Culverts

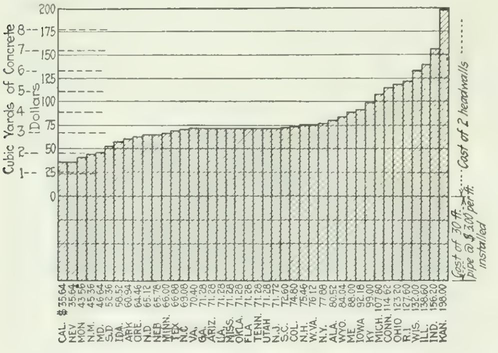
Wide Range in Designs—Light Walls Satisfactory in Warm and Cold Climates—Headwalls Not Always Necessary

By Howard See

President, Dixie Culvert & Metal Co., Atlanta, Ga.

FROM the very beginning of systematic road building, pipe culverts have been used extensively. While the culverts on any particular road job represent a relatively small percentage of the total cost of the job, yet in the aggregate the amount of money annually spent on culvert installations runs well into the millions, an item which justifies the necessary study to develop the most economical designs and practices.

An investigation of the headwall designs for pipe culverts as shown by the standard drawings of the various state highway departments produces some very interesting comparisons. The author obtained from each state highway department copies of its headwall designs, and tabulated the amount of concrete required for the various diameters of culverts according to the standards of the various states. The table shows great variations.



YARDAGE AND COST OF TWO HEADWALLS

Showing variation in practice of state highway departments. Cost computed at $22 per cu.yd. for concrete.

A 24-in. culvert may be considered of average size; comparisons made on it, which are typical of those that might be made of other sizes, have been charted in the accompanying diagram. According to the standards of California there is required for the two headwalls 1.62 cu.yd. of concrete. The amount required by Nevada is the same. This is the lightest headwall of any of the states. Georgia, Arizona, Louisiana, Mississippi, Oklahoma, Florida, Tennessee, Utah and New Jersey require 3.24 cu.yd., or twice as much; Indiana 7.1 cu.yd., and Kansas 9.0 cu.yd., over five times as much as California. This comparison is made on straight or flat headwalls, and the same relation would not exist between the yardages of the wing-wall type or the U type. However, the straight type is the one most generally used, the others being generally used only to meet some special condition.

At first sight it seems likely that the mild winters of California make possible a lighter headwall than is necessary in states having harder winters. But Idaho, South Dakota, North Dakota, and Montana use the lighter headwalls, and yet these are states in which the winters are most severe. It is a reasonable assumption that the lighter headwalls would be satisfactory in other states and that those states which have the heavier designs could make substantial savings by revising their standards accordingly.

Headwalls Not Always Necessary—A discussion of the design of headwalls for pipe culverts brings up the question of when headwalls are and when they are not necessary on a pipe culvert installation. It is general if not universal practice in all states to build headwalls on all pipe culverts. It has been a requirement on Federal Aid roads. Are these headwalls a real necessity in all cases? In many instances the cost of the headwalls is greater than the cost of the culvert pipe installed, so that the cost of the culvert installation would be reduced by at least half if the headwalls were omitted; even in those states in which the lighter headwalls are used the possible saving would be very substantial.

A study of this subject has brough the author to the conclusion that the headwall is not universally necessary, and that where it is not a necessity it should be omitted. The function of the headwall is, of course, to act as a retaining wall and to prevent the erosion of the fill or subgrade in which the culvert is installed. In a great many cases this could be done better and at the same time more economically by the substitution of additional length of pipe for the headwall. This would be particularly practical in the case of the downstream end, for here the important function is getting the water away from the toe of the fill as quickly as possible and with as little erosion as possible.

In railroad construction it is the practice to omit headwalls on pipe culverts except where some special local condition makes their use necessary. This is significant for the reason that railroad engineering is very much older than is highway engineering, and that economies of design have naturally been much more completely worked out. The chief engineers of several of the leading railroads of the country were consulted on this point, and in general they agreed that the headwall is not a universal necessity on pipe culvert installations and that the general practice should be not to build headwalls except where it is required by some local condition.

The omission of headwalls would not be equally practical on all types of pipe culverts. Those types which are installed in short lengths more definitely require headwalls than those which are installed in greater lengths, such as cast-iron pipe, or more particularly, corrugated pipe. The short-length pipe, not being mechanically bound together, would have a tendency to cause trouble by undercutting of the end section, which would cause it to disconnect itself from the adjacent section, after which the same action would be repeated. That type of culvert pipe which is mechanically a one-piece construction lends itself admirably to the omission of the headwall. This is particularly true on the downstream end, for long lengths of cast-iron pipe or corrugated pipe can be so installed that the end can act as a cantilever, overhanging the fill or bank by several feet if necessary. This permits the culvert to discharge its water well clear of the toe of the fill, thereby reducing erosion or undercutting to a minimum. Such construction as this is not particularly novel, being frequently used on railroad construction.

It is the aim of the author to direct the attention of highway engineers to two points: first, the desirability of revision of standards in many states in order that headwalls might be built of lighter design; second, the desirability of omitting headwalls where they are not necessary. The latter would mean that each individual installation would have to be analyzed on its merits and that the general policy of requiring headwalls in all instances should be abandoned. Instead, greater responsibility and discretion should be placed on the local engineer. He should determine where headwalls are necessary and where they are not necessary. There is no reason why this practice, general in railroad work, would not be applicable in highway construction.

Effective Joint Filling Methods in Brick Paving

By J. F. Gallagher
Asphalt Sales Department, The Texas Co., New York

Effective methods of applying asphalt joint filler in brick paving as exemplified in work done last year at Decatur, Ill., appear to have been developed by Walter C. Schwartz of Bloomington, Ill., a contractor specializing in this operation.

Having taken care of the preliminary features, such as sweeping the brick, the initial application of asphalt is made over an area of about 200 square yards. This partly fills the joints and leaves a thin film on the surface of the brick. After the asphalt has been given an opportunity to cool, it contracts so that the joints are only about half filled. Then follows a second application over the same area, which is intended to fill the joints flush and slightly increase the thickness of the surface coating on the brick. As applied the asphalt is flush but upon cooling it contracts and drops slightly below the general level. In order to bring this flush with the squeegee coat, a third application is made after which the pavement presents a smooth uniform appearance.

FILLING JOINTS WITH SQUEEGEE MACHINE
Applying asphalt filler to a brick pavement by a squeegee machine insures a more uniform and effective application

As will be found in almost any job of brick paving, there are usually a few brick the corners of which have been broken off in handling, or which may have been laid a little farther apart than the others. Of course, such places require a greater amount of filler in order to eliminate the holes or relatively open joints. To take care of such spots, they are "pointed up" by means of the old-fashioned cone-shaped pouring can. After "pointing up," dry torpedo sand is spread in the usual way, and while hot sand is to be preferred, good results have been obtained in warm weather from the use of dry torpedo sand or stone chips free from dust.

POINTING UP A BRICK PAVEMENT
The last of three steps in securing complete filling of the joints between the brick.

One might gain the impression that the successful procedure as above outlined would entail the use of considerably more filler and a greater labor cost than the ordinary single-application method. However, Mr. Schwartz states that from his experience he has proved he does not use any more material than the average contractor in a single application. This he attributes to his squeegee machine method of applying the filler which enables him to go over the area much more rapidly than by the hand squeegee method. The second and third applications require very little material, and for the reason that the machine must of necessity be pulled over the pavement at a rapid rate in making these applications, the labor cost is low.

The accompanying views illustrate the methods referred to as practiced at Decatur, where Mr. Schwartz was sub-contractor, the general contractor being File & Collins of Decatur. The asphalt used on this work was Texaco No. 39 paving filler.

Attention might be drawn to the type of squeegee machine used, which is regarded by the contractor as being largely responsible for the success he has had in filling brick pavements. It enables the operator to apply as much or as little material as desired, the amount spread being regulated by the speed with which it is drawn over the pavement. Also due to the fact that the hot material is spread as soon as it strikes the pavement, a very uniform finish can be obtained. In this respect the writer considers it far superior to the ordinary hand squeegee, as it eliminates to a large degree the possibility of a large amount of hot material being poured over the pavement before it can be squeegeed into the joints. Where this occurs the material chills quickly, forming a relatively thick mat on the surface of the pavement, and instead of filling the joints, simply bridges them.

Motor Maintenance in Detroit Water-Works

The seventy-eight automobiles owned by the Detroit Water Department traveled during the year ending June 30, 1922, 584,371 miles, used 71,493 gal. of gasoline and 4,787 gal. of oil at a total cost of $72,883. This figure includes maintenance, depreciation, interest on investment but not garage rental. Of the 78 cars 25 are passenger, 30 commercial and light delivery and 23 trucks of from 1 to [illegible] capacity.

Successful Malaria-Mosquito Work at Carbondale, Ill.

State, City and Railroad Combine to Drain Swamps, Clear Ditches and Oil Ponds—Control of Rain Barrels and Wells

COMPARATIVELY high death rates from malaria in southern Illinois (10 to 30 per 100,000 in different counties) have led the State Board of Health to undertake measures for eliminating the malaria mosquito. The methods employed at Carbondale, in Jackson County (death rate 11 to 15), were described recently in a paper before the Illinois Society of Engineers by Harry F. Ferguson, chief state sanitary engineer, and A. F. Dappert, assistant sanitary engineer. An abstract of this paper is given in the following paragraphs.

In Jackson county there are from 2,700 to 3,000 cases of malaria annually. Assuming the economic loss per case at $100, which would be a conservative figure and would include the cost of medicine, doctor bills and loss in productive earnings, the annual economic loss to the county is more than $250,000. That county could well afford, therefore, to spend a large sum yearly until mosquito breeding places have been eliminated. The eradication of mosquitoes is the most effective method of malaria control and drainage is the most effective anti-mosquito measure.

At Carbondale the campaign was directed against the malaria mosquito but included all species and was very successful. In 1921 there were 267 cases of malaria in the city, or 4.26 per cent of the population. At the end of the season's work a house-to-house canvass showed nineteen cases, or 0.3 per cent of the population affected during 1922. The doctors estimated fifty-four cases for 1922, but even so, the reduction in malaria has been great as a result of the first season's work. Mosquito breeding places included about 60 acres of cat-tail swamps on the north side, a 40-acre lake on the south side, a number of small ponds, and about six miles of ditches and streams, all within mosquito-flight-distance of the city. Further, there was an enormous number of rain barrels and open wells and cisterns. The Illinois Central R.R. provided for the drainage of the cat-tail swamps, while the International Health Board paid one-third and the Lions Club two-thirds of the remaining expenses, except the general supervision by state sanitary engineers.

For the drainage of the swamps the Illinois Central R.R. constructed 9,000 ft. of ditch by the dynamite process for about $1,200, or less than half of the estimated cost by hand labor. A crew of six men and one foreman completed the work in fifteen days. The ditch had an average cross-section of about 10 ft. top width, 2 ft. bottom width, and 3½ ft. depth; its cost was approximately 17c. per cu.yd.

The 40-acre lake on the south side was abundant with cat-tail growth and pond lilies in a number of small bays, and there was also a fine growth of grass around the edges of the lake, making it an ideal breeding place for mosquitos. The water level in the lake was dropped 18 in. by cutting the outlet wall, and a great reduction in breeding was at once apparent. The bays were cleared of the cat-tails and pond lilies, and portions of the surface and the edges were oiled throughout the season. A careful examination in September failed to find any breeding, when in May, before the work started, as many as 200 larvae could be secured in a single dip with a small dipper. Ditches and streams in the area were carefully regraded, cleared, and kept in proper condition for oiling. All ditches and other collections of water in the area were oiled once each week. Frequent inspections showed that almost perfect control was established on natural breeding places.

Control of rain barrels and other man-maintained breeding places was the most troublesome part of the campaign. In June, out of 664 open wells and cisterns, breeding was found in 391, and of these 584 were immediately stocked with Gambusia. A later inspection of sixty wells and cisterns showed that the fish were performing their duties well; only two cisterns were found breeding and the fish had apparently been removed from these. The control of rain barrels and tubs was accomplished by regular house-to-house inspections. In June the first inspection showed 1,030 containers, 831 being rain barrels and tubs which were found breeding mosquitoes. The second inspection in June caught 296 containers breeding. The third inspection 154, and the fourth inspection 206. For the fifth inspection every container holding water in the city was oiled. The next three inspections caught nineteen, seven and eleven containers breeding. By the height of the mosquito season, almost perfect control had been established.

The cost of work, not including the supervision by state sanitary engineers, or of the work done by the Illinois Central R.R., was $1,599, or about 25c. per capita. The total cost, including that of the railroad work and allowing for the State sanitary engineer's time and expenses, was about $4,260, or 68c. per capita. The work resulted in the prevention of at least 200 cases of malaria and relief from the mosquito nuisance. If each case of malaria is figured at $100 (and the Illinois Central R.R. was willing to spend $8,000 to prevent some 125 cases annually among its employees), the net saving to Carbondale from the reduction of malaria alone was at least $15,700. This charges off the entire cost of the ditching and other work of a permanent character against the first year's economic saving resulting from freedom from malaria. By less expenditures in future years, greater economic savings will thus prevail.

Moreover, the draining of the swamps and repairing of ditches and drainage channels has increased the value of the lands affected.

Leaching Action of Water on Zinc Chloride

ALTHOUGH zinc chloride is one of the most effective of wood preservatives· it will not give permanent protection. Under the action of water this preservative loses its strength in two ways. In time a considerable amount of the solution is leached out of the wood, and that remaining is not of sufficient strength to be effective. It has also been brought out in a study of preservatives at the Forest Products Laboratory that water eventually causes a chemical decomposition of zinc chloride by the removal of excess chlorine.

Samples of ties analyzed after service had a zinc content equivalent to 0.4 lb. of zinc chloride, with scarcely enough chlorine present for 0.08 lb. of zinc chloride per cubic foot. Treated blocks leached for a month at the laboratory lost about 90 per cent of their chlorine content and only 70 per cent of their zinc.

The disappearance of the chlorine from zinc chloride explains decay which has been found in treated ties and timbers which still have high zinc content. Although the zinc is the toxic or poisonous part of zinc chloride, it is not effective against the fungi which cause decay unless it is combined with some acid radical which makes it soluble. In consequence, in analyzing zinc-chloride-treated wood after service it is necessary to determine both the chlorine and zinc content in order to calculate the amount of preservative solution present in the wood.

Even then only a very rough estimate can be formed, for some of the chlorine which would be obtained in the analysis is in the wood in the form of an insoluble basic chloride of unknown composition.

Methods for Determining Street Pavement Crowns

New Crown Formula Presented—Symmetrical and Unsymmetrical Distribution Explained—Inverted Crowns for Alleys

By F. S. Besson
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DIFFERENT methods of procedure are followed in establishing street crowns where the street and its intersections are at the same level and where they are at different levels and also in the case of alley pavements where there are no curbs and gutters. In the following discussion a new and simple crown formula is suggested and crown distribution is considered (1) when distribution is symmetrical, (2) when distribution is unsymmetrical and (3) for alley pavements with inverted crowns.

New Crown Formula—There are many rules for determining roadway crowns, one of the best known being Dare's formula, which has been in use many years and gives excellent results:

$$C = \frac{W(100 - 4L)}{6{,}300 + 50L}$$

In this formula C = crown in inches; W = width of roadway in inches, and L = longitudinal grade expressed as a percentage. The crown decreases as the longitudinal grade increases. Some formulas require more crown for asphalt surfaces than for other types, while other rules require the opposite. In order to carry water quickly to the gutters, it is evident that more cross slope should be given a rough absorbent type of pavement than a smooth non-absorbent type. Steep cross slopes give a sidewise tilt to vehicles and make the effects of a slippery pavement felt more than do slight slopes. However, the pavements suitable for city use, are practically all in one class as far as smoothness is concerned and the question of cross slope may well be settled by the adoption of a single crown formula. One of simple application and a practicable mean of those in general use is as follows:

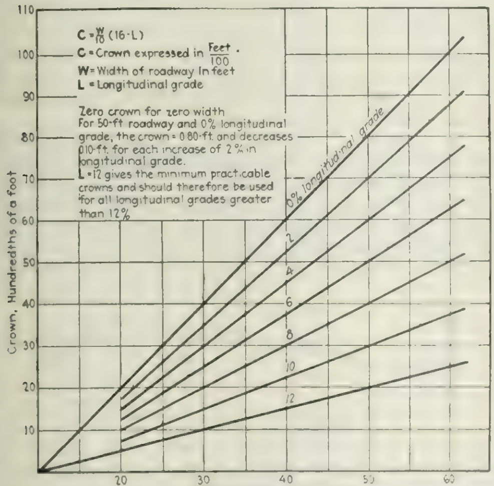


FIG. 1—CROWN DIAGRAM FOR STREET PAVEMENTS

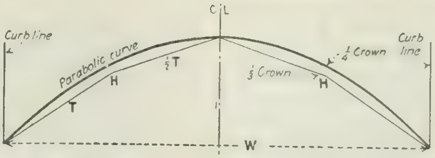


FIG. 2—COMPARISON OF PARABOLIC DISTRIBUTION OF CROWN WITH THAT BY FORMULA $T = 0.266\ (16 - L)$

$$C = \frac{W}{10}(16 - L)$$

For example, for a 50-ft. roadway and 4 per cent longitudinal grade

$$C = \frac{50}{10}(16 - 4) = 60$$

that is, 0.60 ft. since C = crown in $\frac{\text{ft.}}{100}$; W = width of roadway in ft.; L = longitudinal grade. The foot, since all field work is carried out with that unit, is used rather than the inch.

The diagram, Fig. 1, gives the crown in accordance with this formula, from below 24 ft. which width is a minimum suitable for residential local streets, to above 56 ft. which width is approximately the maximum necessary for a traffic highway. For a wide rapid transit street the width of the car tracks is omitted in applying the formula. For example, a 72-ft. roadway with 16 ft. subtracted for car tracks would require the same crown as a 56-ft. traffic highway. The transverse slopes are laid off from the outside rails toward the gutters while the entire track space is a tangent connecting the slopes. If extra slope is given the gutters, they should be considered separately from the roadway. The crown then should be computed from the top of the gutter slope and the roadway width taken exclusive of the gutters.

Symmetrical Distribution—The details of the following method for crown distribution are based upon the crown formula,

$$C = \frac{W}{10}(16 - L).$$

When the gutter lines are at equal elevations, the high point of the crown is at the center of the roadway. Other points on the cross-section are often determined

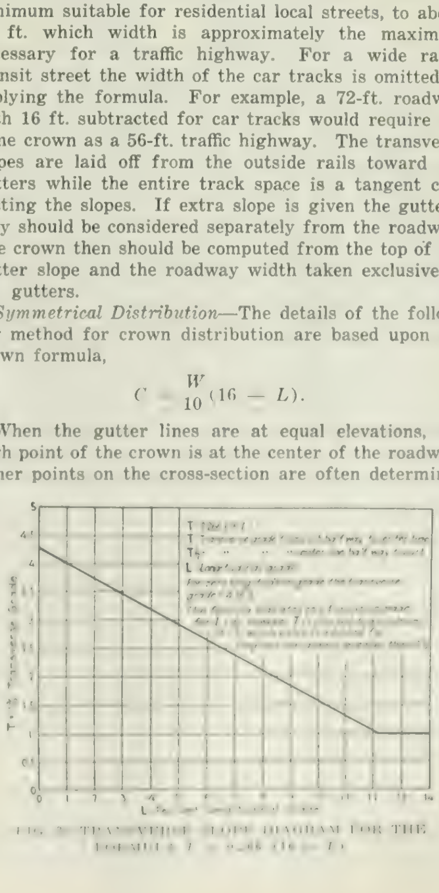


FIG. 3—TRANSVERSE SLOPE DIAGRAM FOR THE FORMULA $T = 0.266\ (16 - L)$

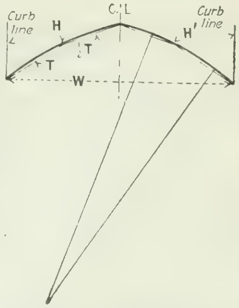


FIG. 4—PAVEMENT SURFACE REPRESENTED BY CIRCULAR ARCS THROUGH POINTS ESTABLISHED BY $T = 0.266\ (16 - L)$

by the parabolic formula, which gives a drop of one-fourth of the total crown at a point half way between the center line and the curb. A better distribution is obtained if a drop of one-third is made at the half-way points as shown at *H*, Fig. 2. The remaining two-thirds of the crown is then dropped between *H* and the curb. This plan gives a transverse grade percentage from *H* to the curb double that from the center line to *H*.

$$T = \text{per cent grade } H \text{ to curb} = \frac{\frac{2}{3}\text{ crown}}{\frac{1}{4}\text{ width}} = \frac{\frac{8}{3}C}{W}$$

$$\frac{T}{2} = \text{per cent grade center line to } H = \frac{\frac{1}{3}\text{ crown}}{\frac{1}{4}\text{ width}} = \frac{\frac{4}{3}C}{W}$$

From the preceding equations it is seen that

$$C = \frac{3}{8}TW$$

Substituting this value for *C* in the crown formula,

$$C = \frac{W}{10}(16 - L)$$

The following is obtained: $T = 0.266(16 - L)$. For example, with a 1 per cent longitudinal grade $T = 0.266 \times 15 = 4$ per cent. The transverse grade varies only with *L*, the longitudinal grade. Thus there is but one value of *T* for all widths of roadways as long as *L* is constant. The relationship of *T* and *L* is shown by the diagram, Fig. 3.

Having drawn in the transverse grades the actual cross-section of the finished roadway may be shown by drawing arcs of circles through the center line and the gutters as illustrated in Fig. 4, *T* and $\frac{1}{2}T$ being chords of the arcs. For work in the field, if the roadway width is less than 40 ft., in addition to laying out the gutters, only those elevations at the center line and at the greater points, that is between $\frac{1}{2}T$ and *T*, need be given. Workmen have no difficulty with a crown if grade pegs are at approximately 10-ft. intervals. If the roadway is wider than 40 ft., elevations may be scaled to the arc on the cross-section in order that intermediate grade pegs may be set.

In Figs. 2 and 4 the vertical scale is greatly exaggerated in order that it may be easily seen how the parabolic curve differs from the straight lines *T* and $\frac{1}{2}T$, and how closely the cross-section based upon $T = 0.266(16 - L)$ follows these lines. Compared to the parabolic curve, this cross-section on the drawing appears to give a sharp break at the center line which, in reality, however, is imperceptible in a roadway. While the departure from the parabolic curve is small, the *T* formula gives better crown distribution and great ease of application in actual practice. It may be noted that the crown formula,

$$C = \frac{W}{10}(16 - L)$$

is of secondary importance, since the transverse slope formula is sufficient for laying out cross-sections and in fact, for unsymmetrical roadways its use is the only satisfactory method.

Unsymmetrical Distribution—An unsymmetrical distribution of crown is necessary when land abutting one side of a street is higher than that on the other. This occurs whenever a street is built on the side of a slope. Cross streets cause the gutters at the intersections to be higher on the up-hill side than on the down-hill side. Between intersections, property on the up-hill side is above that on the lower side. Sidewalk and curb are also higher on the up-hill side; and, unless the accompanying gutter is placed higher than that on the down-hill side of the street, a very unsatisfactory appearance results.

Sometimes there is a mistaken idea that roadway cross-section must be symmetrical, with gutters on the two sides of a street at equal elevations; and, in order to attain this, steep slopes have been given sidewalks on the up-hill side. Also, curb has been set with extra height, above the gutter, showing as much as a foot whereas 0.55 ft. should be a maximum even in most exceptional cases. These expedients when made use of to a reasonable degree are helpful but they should not be applied to the extent of placing the up-hill gutter at the same elevation as the down-hill one. A difference in elevation is necessary in order to give a side slope street a good appearance. An unsymmetrical crown can be designed and constructed in the field just as easily as a symmetrical one.

The formula, $T = 0.266(16 - L)$ for the transverse grade, which has already been explained, is also used for unsymmetrical roadways; and, therefore, its value can be taken from the diagram, Fig. 3. The high point of the crown, however, is not in the center of the roadway. The cross-section may be laid out as in the following example. In Fig. 5, the elevation of the low gutter is 100 ft., that of the high gutter, 100.72 ft. The roadway is assumed to be on a 1 per cent longitudinal grade; and, therefore, from the diagram, Fig. 3, $T = 4$ per cent. Three per cent is the mean slope from *A* to *C* and is the same as that from *C* to *B*; but the rise *A* to *C* is 0.72 greater than the fall *C* to *B*. The distance *A* to *C* is greater than *C* to *B*, by a number of feet equal to 72 divided by the mean slope, or $\frac{72}{3} = 24$ ft. Suppose the roadway width to be 56 ft. then: $2CB + 24$ ft. $= 56$ ft., $CB = 16$ ft. and $AC = 40$ ft. Furthermore, it should be noted that the distance from the center line to *C* equals 12 ft. $= \frac{72}{6}$ or the difference in gutter elevations divided by $T + \frac{1}{2}T$. Elevations at the points *H*, *C*, and *H'* are easily computed, for example; $H = 100 + 4$ per cent of $20 = 100.80$ ft., $C = 101.20$ ft., $H' = 101.04$ ft.

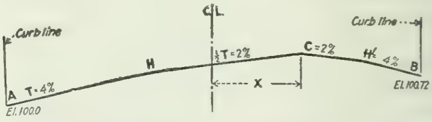


FIG. 5—UNSYMMETRICAL DISTRIBUTION OF CROWN

The increase in elevation to be given the high gutter above that of the low gutter is a matter of judgment and should be at least sufficient to give smooth connections at the street intersections. There is a limit to the extra elevation that may be given the high gutter. In Fig. 5, as the gutter at *B* is raised *C* approaches *B*

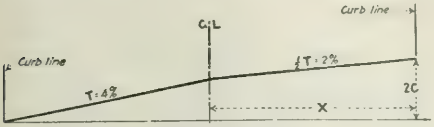


FIG. 6—MAXIMUM EXTRA ELEVATION FOR THE HIGH GUTTER

and coincides therewith when H is at the center line of the roadway. In such cases the cross-section is as in Fig. 6 and the limit of extra elevation of the high gutter equals twice the crown given by the formula

$$C = \frac{H}{10}(16 - L)$$

To sum up; for an unsymmetrical distribution of crown, where E = difference in elevation, stated in hundredths of a foot between the gutters, and X = the distance, in feet from the center line of the roadway to the high point of the crown:

$$T = 0.266(16 - L)$$

$$\frac{E}{1.5T} = X$$

For example, if $E = 0.72$ ft. and $T = 4$ per cent $X = \frac{72}{6} = 12$ ft.

Maximum value for $E = 2C$.

Where $C = \frac{W}{10}(16 - L)$.

Alley Crowns—Ordinarily no curb is used with alleys and this means that an inverted crown has to be used, that is, a dished cross-section with a longitudinal gutter in the center of the alley. The cross-section can be platted by using, as shown in Fig. 7-A, equal transverse slopes from the edges of the alley to the bottom of the gutter.

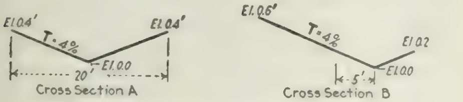


FIG. 7—ALLEY CROSS-SECTIONS

If an alley is on a side slope and it is desired to have one edge higher than the other, the cross-section may be platted as in Fig. 7-B. The horizontal distance from the low point of the gutter to the center line of the alley is obtained by the formula $X = \frac{E}{2T}$ where E = difference in elevation, stated in hundredths of a foot, between the edges of the alley, and X = the distance in feet from the center line to the low point of the gutter. For example, if $E = 0.4$ ft. and $T = 4$ per cent, then $X = \frac{40}{2 \times 4} = 5$ ft. The gutter should not be closer to the edge than the quarter point, therefore with an alley width of 15 ft. and $T = 4$ per cent, a value for E of as large as 0.4 ft. should not be used since with $X = 5$ ft. the low point of the gutter would be within 2½ ft. of the alley edge.

Where an alley entrance is from a street that is on a steep grade there may be considerable difference in elevation from the sidewalk at the up-hill edge of the alley to the down-hill edge. Some of this difference in elevation may be taken care of by providing a step or curb along the up-hill edge, between the sidewalk and alley paving.

Merging the grades of two portions of an alley at a change in direction or intersection is done in the same manner as for streets and being not nearly so difficult no explanation is necessary. At an alley exit the alley gutter should be gradually done away with so that the transverse grades of the alley will merge with the gutter grades of the street in an unbroken straight line, thus permitting the street water to flow properly in its gutter.

Using Divers and Compressed Air in Underpinning

Unusual Means Employed to Underpin Brick Party Wall, 10 Stories High, During Boston Bank Building Construction

AN UNUSUAL method for sinking small concrete caissons to underpin the wall of a heavy ten-story office building was recently devised and applied in Boston with great success.

In the construction of the new First National Bank building, Milk and Devonshire Sts., the party wall of the adjoining Massachusetts Trust building at the south end of the bank site had to be underpinned. This is a brick wall, ten stories high and 3 ft. thick in its lower portion, which is carried on an I-beam grillage, about 35 ft. below sidewalk grade. The grillage also carries the steel columns which support the floor system. At this point the hardpan, which is the original glacial till of hard packed sand and boulder clay, is found at approximately El. —37, or 57 ft. below sidewalk, and is overlaid by a stratum of very fine sand 8 to 10 ft. thick. Overlying this sand is blue clay. As the trust company building was occupied, any settlement, disturbance or cracking had to be avoided.

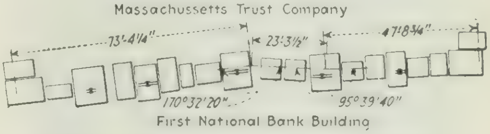


FIG. 1—PLAN OF UNDERPINNING CAISSONS

Experimental work developed the fact that the sand stratum was under sufficient hydraulic head to make necessary going through it by some method that would insure no loss of ground and at the same time form the new basement retaining wall and provide support for the new and existing loads along the property line. The depth under the existing grillage at which hazardous bottom conditions were found varied considerably from one end of the wall to the other. The methods by which the work was done are as follows:

The wall length was divided into conveniently short sections, and a caisson designed the width of each section. Prior to starting a caisson under any particular section, the load on this section was picked up by cantilever needling and transferred to the adjacent grillage areas to insure the safety of the old brick wall during construction, as it was not in good shape. Care was taken in opening up new sections not to overload the blue clay under the grillage.

A starting pit was then sunk directly in front of the grillage to a depth below its bottom sufficient for access. This was then enlarged by tunneling back under the grillage the proper width and depth for the caisson, and the hole was box-sheeted to prevent movement of the clay.

In this starting pit the first lift or working chamber of the concrete caisson was constructed, 4 ft. high, with a steel cutting edge around the outside perimeter. When this lift had set sufficiently, the inner forms were removed and sinking was started by mucking in the open from the inside, four 15-ton ratchet-jacks being used, with the grillage as a reaction, to force the shell down as rapidly as the soil was removed from the inside. When the top of this lift neared the bottom of the starting pit, a second lift was cast and the sinking resumed until by this process bottom conditions were reached which required a change in method.

At this stage, when the depth under the grillage exceeded 13 ft., steel diaphragm lockheads were set and bricked in the shaft, thus making an air lock, and the sinking continued through the quicksand under air, with pressures varying from 10 to 15 lb. per sq.in., until the cutting edge was firm in hardpan.

FIG. 2—DIVER ENTERING CAISSON

Where a minimum of 13 ft. was not reached, the caisson was allowed to fill with water to about El. —18, which was two or three feet below the grillage, and a diver was employed to continue the excavation to hardpan. While El. —18 was somewhat lower than the normal level of the groundwater, this head was found sufficient to prevent any boiling of the bottom. The method was necessarily slow and expensive, but it was unquestionably safe. When hardpan was reached the diver removed all overlying material and leveled the area within the cutting edge wherever this was possible without removing boulders, thus leaving a reasonably smooth surface for bearing.

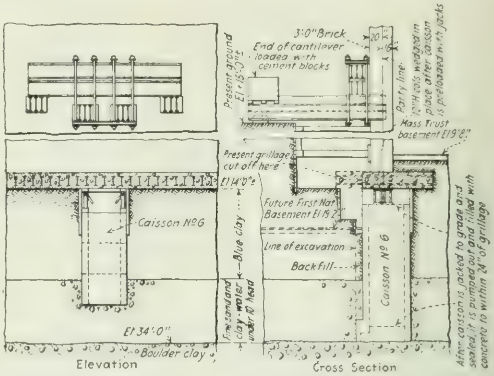

3'-0" Brick
20
16
End of cantilever loaded with cement blocks
Present ground El + 15'-3"
Party line
12"H cols wedged in place after caisson is preloaded with jacks
Mass Trust basement El 9'-8"
Present grillage cut off here
El 14'-0"
Caisson No. 6
Future First Nat. Basement El 19'-2"
Line of excavation
Backfill
Blue clay
Fine sand and clay - water under 10' head
Caisson No. 6
El 34'-0"
Boulder clay
After caisson is jacked to grade and sealed, it is pumped out and filled with concrete to within 24" of grillage
Elevation
Cross Section

FIG. 3—TYPICAL SECTION OF UNDERPINNING CAISSON

A concrete seal about 4 ft. thick was then placed. Where air was used for sinking, this concrete was passed through the lock and the pressure maintained long enough for proper set. Where a diver was used, the concrete was passed down to him in heavy canvas bags which he emptied and distributed over the bottom, the normal head of water being maintained until the seal had properly set. The lockheads were now removed or the caisson unwatered, dependent on which method had been used, and the rest of the concreting was done in the open.

After allowing the completed caisson to set three or four days, hydraulic jacks were applied, using the grillage as a reaction, to produce a test load as nearly 25 per cent in excess of the designed load as the confined space and the weight of the reaction would permit. This test load was then caught by inserting short steel struts with top and bottom bearing plates and driving them tight with steel wedges, thus eliminating future settlement as far as possible. As a further precaution, however, the jack load was again applied after a few hours' time. and the wedges once more driven tight. The section was then completed by concreting in these struts.

This, the most important underpinning work executed to date in Boston, is now practically complete, with no measurable settlement.

The First National Bank employed Stone & Webster as general contractors, for whom the Chas. R. Gow Co., New England agents of the Raymond Concrete Pile Co., devised the methods used and carried out the work as foundation sub-contractors. York & Sawyer of New York are the architects for the bank, Mr. H. G. Balcom is their consulting engineer. Chas. T. Main is consulting engineer for the Massachusetts Trust Co.

French Bill Offers Housing Remedy

In order to make it attractive to landlords to rent apartments and dwellings to families wiht children, a bill has been introduced in the French Chamber of Deputies providing for reduced taxation on real estate ranging from 25 to 50 per cent. A 25 per cent reduction is allowed where the ratio of children to the number of apartments is 3 to 1; 40 per cent reduction when the ratio is 4 to 1; and 50 per cent reduction when the ratio is 5 to 1, or higher.

Initial Failure and Automatic Relief of Stress

Some Cases of Readjustment of Relations of Parts of Structures Tending to Affect Safety

By David C. Coyle
Structural Engineer, Gunvald Aus Co., New York City

It is a familiar process of thought, among engineers, when the action of a structure under load is obscure or disputed, to picture what would happen in case of complete failure. The imagined deformations of the doubtful members give to the mind's eye an indication of the stresses they are called on to carry. Sometimes we find that a certain member cannot take an exaggerated deformation; should it start to fail, some other part amply strong would come into play and prevent further failure, the weaker part is said to be "fetching up" on the stronger. This idea of the automatic relief of stress is quite simple under some conditions. At other times, however, it may be used unconsciously, concealed under some assumption where it may or may not be applicable, a dangerous process. The purpose of this article is to examine the action of fetching up as it occurs in various everyday cases, so as to bring out the extent and limitations of its usefulness.

There are various plain cases which will serve to illustrate the idea in its simple form. A telegraph key or a swing bridge, starting to deflect under load, fetches up on a rigid support before reaching its elastic limit. A window lintel starting to sag when touched by fire does not fail because the wall fetches up as an arch, and only a few bricks are able to follow the lintel downward. A grillage beam on a hard support, such as concrete or rock, starts to bend under load, but this action throws the pressure toward the center, relieving the ends, and failure in bending cannot proceed.

Whenever we assume that a structure is more determinate than it theoretically is, we are applying the idea of the automatic relief of stress more or less unconsciously, and there is a chance for dangerous error. Let us examine some cases of this kind more in detail.

Rivet Groups—A group of rivets is statically indeterminate, since it is theoretically possible for one rivet to take all the load. However, we assume that as the load increases the tightest rivet will start to fail, and the slight motion will bring others into action until enough are working to carry the load. The essential feature which justifies the assumption is that the motion necessary to bring the whole group into action is usually so slight that no rivet is seriously damaged by shearing before the group fetches up as a whole. We therefore avoid very long lines of rivets with the pull applied at one end, because the stretch of the member might shear off the first rivet before stressing the last one, and so rip off the connection.

Continuous Beam Figured as Simple—Again, where a structure though actually continuous is figured without regard to continuity, the assumption is implied that the connections can deform without damage sufficiently to permit the members to act as they are figured. For instance, steel girders framing into opposite sides of a column are actually continuous over the support under light loads; but the rivets in the upper part of the connection are usually incapable of carrying the full-load tensile stress across the column. They must therefore start to fail, but before they have pulled apart the girder has deflected and comes into action as a simple beam. The top rivets may be standing under their ultimate tensile stress, but the system has fetched up so that no further stretching occurs and they do not fail.

Sometimes it is necessary to support a smaller steel beam in the middle by a strut down to a heavier beam below. We usually cut the upper beam in two, on the ground that it is improper to figure the two beams as working together, since the strut may be fabricated slightly too long or too short. Yet in the light of our common practice with steelwork it would seem fair to figure both beams as working in proportion to their moments of inertia, since they can take up any initial inaccuracy by a preliminary overstrain and initial failure of one of them. Experience with steel caps in mine timbering indicates that a beam can be bent beyond its elastic limit and yet be practically as strong as before.

Concrete Beams—With concrete somewhat different considerations enter. A pair of beams framing into a column cannot be figured as simply supported. Under load they will pull part at the top over the column, and will not, like a riveted connection, remain just as good as new. The crack in the concrete may destroy its shearing strength and cause the beam to fail. On the other hand, in some cases, such as that of a long span next to a short one, the long span may be figured for $w/8$ as a precaution against uneven settlement. A small quantity of steel may be placed over the support to prevent cracking. It is important to note that the purpose of this steel is not to carry a load but to make the concrete act as do the top rivets in a girder connection, i.e., stretch without losing its shearing strength. Most of the authorities, noting that this steel over the support is overstressed, condemn the whole arrangement as unsafe, but the defense, if one wishes to use this system, is that even though stretched beyond its elastic limit the top steel will not pull apart because the beam fetches up as a simple beam.

Effects of Settlement—The relation between settlement of footings and the strains in the structure overhead is often very complicated. It is important to have a clear idea of which deformations will limit themselves by fetching up, and which will continue indefinitely and cause a failure.

The difference should be kept in mind between a fluid bearing substance and a compressible one. Pile footings or spread footings in mud are often dependent on friction for support, and as the load is increased they will continue to settle, while in earth or sand the bearing resistance increases rapidly and limits the settlement. In the first case the footing will never fetch up until it strikes hardpan, and the structure must be able to develop within itself the necessary resistance to a permanent unbalanced load.

Where the subsoil is such that an overload footing will ultimately fetch up, the nature of the stresses in the structure may be illuminated by considering the possible automatic relief of stress. An interior column whose footing is too large for it, so that it settles less than those around it, will receive an overload and will shorten; this shortening tends to relieve the overload, except that if the elastic limit has been passed the chances are that there will be enough eccentricity to start a buckle, seriously weakening the column. The equilibrium between the resisting strength of the column and its load is unstable, in the sense that once it is upset the column fails. A line of beams, on the contrary, may survive a considerable disalignment. When we design a concrete beam for $wl/8$ on the ground that its supports may settle unevenly, we do so only to be on the safe side. Actually the chances are that after an unequal settlement the reinforcing metal will stretch enough to allow the negative steel to come into action if the loads require its help—provided, of course, that the displacements involved are so small that none of the steel has been stretched to necking.

Local Overstress—Tests show that in most steel structures there are joints where local stresses are far beyond the working limits. Why are there so few failures? The answer doubtless involves the ductility of steel. A part will carry say 32,000 lb. stress, under conditions which limit its motion under stress. Suppose that in a storm the wind loads, going beyond any it has yet experienced, stress it to 50,000 lb: it stretches and takes a permanent set at the new length and 32,000 lb. stress. The wind stops, its stress drops to 22,000 lb. and will never reach 32,000 lb. again until the big wind is repeated. In this way a properly designed building will gradually adjust itself through the years until it has eased its local stresses somewhat below the elastic limits. It is a similar process that occurs in aging a violin. Failure occurs in a steel structure when there is some local secondary stress (like that in the fatal gusset in the Washington theater) which is in unstable equilibrium; it has nothing to fetch up on except the ground below, and finally finds its resting place there.

General Principles—In conclusion one may outline some general principles which apply to the automatic relief of stress. There are two cases, (a) a member starting to fail may fetch up before it is strained beyond its elastic limit, or (b) the member may be strained beyond the elastic limit before it fetches up. For safety the following conditions are necessary:

1. In all cases the body which supplies the needed strength must have a fixed strength of its own. No secure fetching up can occur on mud or any semi-fluid except up to the limit of its capacity in buoyancy.

2. The equilibrium must be stable. Initial failure of the part in question must automatically reduce the load or increase the strength so that the cause of failure is unable to follow the member through to complete collapse.

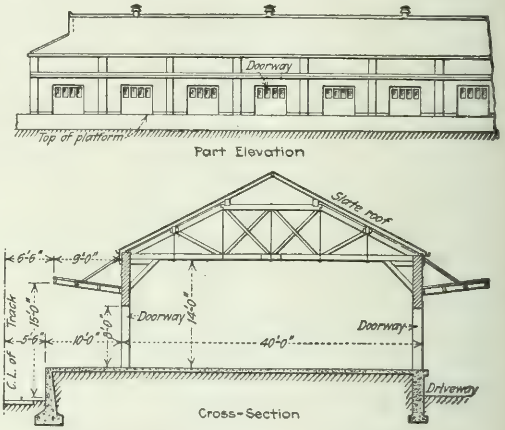
3. If the geometrical arrangement of parts does not prevent the member from being deformed beyond its elastic limit, the member so deformed must be ductile enough to remain practically unhurt in its new shape. For concrete this ductility may be obtained by reinforcement which brings about an even distribution of the stretch.

Under all conditions the vital essential is that if we are neglecting some load or stress because we feel it will be taken care of by the self-adjustment of the structure, we should think clearly, and be sure of just what we mean in each case. Our general ideas should represent the sum of definite thoughts, not a mere vague hopefulness that all will be well. The cases cited in the preceding may stimulate clearness of thought in a direction where it is not always evident.

Improving Daylight Conditions in Railway Freighthouses

Alternatives of Adequate Daylight Light or Supplementary Electric Light—Roofs, Windows and Skylights

In ONE-STORY freighthouses of the flat-roof and gable-roof types which are widely used the distribution of daylight lighting is frequently inefficient, since the light enters only at side windows and doorways, the area of which may be obstructed more or less by cars or wagons on the track and driveway sides respectively. Canopy roofs which are placed just above the doorway level, to protect freight when being handled to and from the house, also tend to obstruct the light. Furthermore, the stacking of freight on the floor of the building is likely to interfere with the distribution or diffusion of interior light from the sides. A typical freighthouse is shown in the accompanying drawing.



TYPICAL SECTION OF RAILWAY FREIGHTHOUSE

Monitor roofs which admit light directly over the middle of the floor have been provided in many cases. But sawtooth or pond-truss roof construction to give increased light has been used very little in buildings of this class, one reason assigned for this being the narrow width of the building, usually 30 to 50 ft. It appears probable that under average conditions freighthouse business is hampered more or less by inadaquate lighting, which may cause delay or inaccuracy in billing and in reading scale weights and the marks and addresses on tags and packages.

Inquiry as to the relation between freighthouse work and freighthouse design in regard to lighting facilities has developed opinions of three classes: (1) The present system which provides only wall openings for interior lighting is satisfactory; (2) This present system is so unsatisfactory that extensive use is made of artificial light during the day, but no steps have been taken toward improving or altering the design in order to give greater daylight efficiency; (3) Some arrangement of roof lighting is employed and is very desirable. There is a rather general objection to skylights on the ground of the chances of leakage and consequent damage to freight.

Opinions expressed on the subject depend largely upon geographic and climatic conditions. Thus a Canadian engineer considers that a flat roof from which snow will be swept by the wind is decidedly preferable to any irregular shape of roof on which snow might accumulate. An engineer on a large railway system extending mainly through the Southern states is well satisfied with buildings having a solid sloping roof and sidewalls in which the only openings are doorways 8x8 ft. separated by 10-ft. panels of blank wall, as shown in the drawing. The upper half of each door is glazed, but a canopy 9 to 12 ft. wide extends along each side of the house, just over the doorways, thus preventing much direct light from reaching the middle of the floor. The freight scales are placed adjacent to the 10-ft. stretches of solid wall. It is stated, however, that freight is so stacked as to provide passageways for trucking, and that even with the doors closed there is sufficient interior light to permit the work to be carried on without delay.

In other designs there are side windows alternating with the doorways, while some modern freighthouses have both sides composed entirely of sliding doors which form the panels between the columns supporting the roof. In some cases also a line of shallow windows is placed above the doorways, an arrangement which should improve the interior lighting materially. In general the lighting requirements are similar to those of factory and industrial buildings, but as a rule these later buildings are wider than freighthouses and have a much larger area of window space, while one-story manufacturing buildings usually have some provision for lighing through the roof. Nevertheless, the present tendency in the design of such buildings is to increase the window area, even to the extent of using curtain walls composed almost entirely of glass.

Present unsatisfactory conditions in the lighting of freighthouses together with the possibility of improvement in these conditions, were noted in *Engineering News-Record* of March 9, 1922, p. 393. This article showed that even in a freighthouse 35 ft. wide and having a monitor roof the lighting was inefficient, leaving many dark or gloomy areas. By means of larger windows the glazed area was increased 260 per cent. Much depends upon environment and maintenance. As to environment, a lighting area which is ample for a freighthouse in a country town may prove quite inadequate for a city building in a smoky atmosphere and surrounded by tall buildings. As to maintenance, the lighting efficiency will be higher where the walls are whitewashed or painted a light color and where the walls and windows are kept clean. Freight should not be stacked close to walls and windows, a broad passageway being kept clear along the sides of the building.

Reference has been made to the daylight use of electric light in freighthouses. In advocacy of this practice it has been urged that electric light is now so cheap as to warrant its use in this way in order to facilitate the work of the freighthouse, thus effecting some economy in operation. For such industrial lighting it is essential to provide lamps of proper type, position and spacing in order to give a general diffusion of light and to avoid alternations of light patches and deep shadows. For the interior electric lighting of freighthouses the following recommendation is made in a bulletin on "Modern Practice in Railroad Lighting," issued by the National Lamp Works, Cleveland, Ohio.

"A direct lighting system should be installed which should provide an intensity of from three to six foot-candles. Reflectors should be used and they should be mounted high enough to insure sufficient intensity in the vertical plane to enable package markings to be easily read."

But even if artificial lighting is cheap, daylight is cheaper, and it seems evident that in many cases it is practicable to improve daylighting conditions very materially. Two points may be noted as calling for consideration in the design of new freighthouses and the improvement of existing freighthouses: (1) Can adequate daylight lighting be provided for economic operation of the business under average conditions, leaving electric light for use on dark days and for night work; (2) if electric light is considered essential to supplement daylight in regular day work, how can it be arranged so as best to combine economy and efficiency.

Municipal Waste Disposal in Iowa

IOWA, a state of small towns, has comparatively few municipally-owned garbage and waste disposal systems. While the problem is essentially engineering, little attention is paid to it by municipal engineers according to Earle L. Waterman, associate professor of sanitary engineering, State University of Iowa, in a paper presented recently to the Iowa Engineering Society. Information from cities of more than 7,000 population was given, mostly obtained from the city clerks. The costs per capita shown in the table are computed on the basis of the 1921 expenditures and population of the 1920 census.

In thirteen of the largest cities, all over 16,000, the collection is done by city employees or by a contractor for the city. In only one city of less than 16,000 population is the collection handled as a community problem.

As to area covered by the collection system the replies to a questionnaire were as follows: Des Moines, less than one-half but all of the thickly settled portions; Sioux City and Cedar Rapids, 75 per cent; Clinton, 66 per cent; Waterloo, Council Bluffs, Burlington, Ottumwa and Mason City practically the whole area.

Professor Waterman noted the following with reference to methods of disposal:

Feeding to Hogs—In most instances where the municipal garbage is fed to hogs the hogs are owned by private parties who are either contractors collecting the garbage or individuals who receive it from the collectors. In Waterloo and Fort Dodge private companies collect the garbage and use it for hog-feeding. Sioux City is the only municipality in the list which owns its own hogs and hog farm.

Sanitary Fill—In some Iowa cities, both garbage and refuse are used for filling in low land. This method is economical and satisfactory where it is properly done, but a cause of many complaints when it is not carefully planned and executed. It is reported as being satisfactory at Davenport where low land along the Mississippi River is being reclaimed. Here piles of ashes and dirt are spaced along the top of the embankment so that there is just room for the garbage wagons to back in between the piles and discharge their load of garbage on the face of the bank. As soon as the wagon is pulled out, men with long handled shovels cover the garbage with 8 to 10 in. of earth and ashes. Approximately 2 cu.yd. of covering are required for each 14 cu.yd. of garbage. It is occasionally necessary to obtain cover material from outside sources.

Incineration—In Council Bluffs, Mason City and Ottumwa incinerators are used for the disposal of municipal wastes. This method has also been used in Des Moines but it is reported that "the operation of the incinerator has been abandoned because of excessive costs." Cost of operation as reported for Mason City and Ottumwa do not appear to be excessive. In Council Bluffs the service is paid for by the people for whom rendered and not by a tax levy as is the case at Mason City and Ottumwa. The city clerk at Council Bluffs states that the incinerator in that city has been in operation for several years and that as far as the garbage problem is concerned they consider that it is satisfactorily solved. The state sanitary engineer makes the following comment on the Council Bluffs incinerator: "All the garbage and refuse, except ashes and tins, is hauled to an incinerator and burned. From 65 to 75 lb. of coal is used per ton of garbage and the officials have no trouble. The incinerator is located near the residential district and it is so clean and so free form odor that you would not know it was there unless you saw it."

TABLE I—COSTS AND METHODS OF MUNICIPAL REFUSE DISPOSAL IN IOWA CITIES

City	1920 Pop.	Collection By	Wastes Collected	Method of Disposal			Costs per Capita for 1921	Paid By
				Garbage	Refuse	Ashes		
Des Moines	126,468	City	Garbage	Burn on dump	...	...	$0.54	Tax
Sioux City	71,227	City	All	Hogs	Dump	Dump	.71	Tax
Davenport	56,727	City	All	Sanitary Fill			.....	......
Cedar Rapids	45,566	City	Garbage and refuse	Sanitary Fill			.38	Tax
Dubuque	39,141	Contract	All	Dump	Dump	Dump	.....	Tax
Waterloo	36,230	Contract	All	Hogs	Dump	Dump	.60	Tax
Council Bluffs	36,162	City	Garbage and refuse	Incinerator		..	...	Indiv.
Clinton	24,151	City	Garbage	San Fill	.....	..	*.13	Tax
Burlington	24,057	Contract	Garbage	Buried	.	.	†.29	Tax
Ottumwa	23,003	City	Garbage and refuse	Incinerator		Fill	.35	Tax
Mason City	20,065	City	Garbage	Incinerator		...	.35	Tax
Ft. Dodge	19,347	Priv. Col.	Garbage and refuse	Hogs	Dump		....	Indiv.
Muscatine	16,068	City and Contract	All	Hogs	San. Fill		†.26	Tax
Keokuk	14,423	Private collection	Garbage	Hogs			.....	....
Boone	12,451	Private collection	Garbage	...			...	Indiv.
Iowa City	11,267	Contract	Garbage	Hogs		.	.14	Tax
Oskaloosa	9,427	Private collection	Garbage	Hogs			...	Indiv.
Creston	8,034	Private collection	Garbage	......			...	Indiv.

* Five months. † Six months.

Wharf Construction Details to Protect Against Marine Borers

ADDITIONAL details concerning wharf construction to protect against marine borer depredations were given in the report of the wharf construction section of the San Francisco Bay Marine Piling Committee at the recent meeting of the American Wood Preservers Association. Last year's recommendations (see *Engineering News-Record,* March 2, 1922, p. 358) have been widely approved but the following points have been added by a special subcommittee, W. H. Kirkbride, engineer maintenance of way and structures, Southern Pacific Co., and Ralph A. Beebee, city harbor engineer, Oakland.

Bracing—Wharf structures built on creosoted piling should not be braced by means of lateral braces or any method which requires framing below the high tide line. Batter piles having their connections above high tide line, form a satisfactory method of bracing such structures.

Fender Lines—Full length fender piles should be creosoted to increase their life against marine borers and be protected from the mechanical wear which ordinarily limits their life. This protection can be satisfactorily accomplished by using untreated stubs, spaced alternately with the fender piles and set out so as to absorb the shock from ships. For California ports Eucalyptus is available and might be suitable for fender stubs, since it has the necessary hardness and toughness. It is already being used to some extent for this purpose by the Board of State Harbor Commissioners.

The flooring system, by its importance, deserves more attention than has previously been given to it. The following recommendations are devoted to that phase.

Cutoffs, Corbels and Caps—The recommendations of last year for placing these above high tide level and for painting them with hot creosote where the latter is not possible, are heartily concurred in. For corbels and caps a light pressure treatment of 6 lb. of creosote per cubic foot, previous to placement in the structure, is recommended.

Timbers for Flooring Systems should in all cases be as heavy as can be used within economical cost. It should also be given a light creosote treatment (6 lb.) after it has been framed, etc., whenever that is possible. This recommendation of framing (including bolt holes) before treatment, is the one most often objected to as impracticable, impossible or too costly. Actual and continued trial has proved it practicable on most ordinary simple construction on San Francisco Bay, where, except for one company, all creosoting must be obtained from a long distance. In ordinarily simple construction bents can usually be sprung enough to make such framing fit. This procedure adds somewhat to the construction cost, but its results are believed to justify its cost. The recommendations of last year's report in respect to boring drift bolt holes the same size as the bolts should hold for floor system timbers, as well as for bracing, etc.; where machine bolts are used, however, the holes should be bored $\frac{1}{16}$ in. larger than the diameter of the bolt. Holes which must be bored in timbers after they are treated should be filled with hot creosote, if possible, before the bolt is inserted. Deck planking can be spiked to creosoted stringers without damaging the creosote protection if care is taken that the creosoted timber is not split by the spiking.

If it is not desired to use creosoted timber for the floor system in a deck, care should be used to ventilate contact surfaces or to give them as thorough a treatment with creosote as possible. Hot creosote swabbed on plentifully during construction is the best treatment available under such circumstances.

It is very desirable to place a watertight covering, such as a 2-in. surface coating of asphalt, over the deck of wharf structures. Such a coating makes a satisfactory floor surface, gives additional fire protection and keeps surface water from seeping into the wooden floor system.

London's Rapid Transit Traffic

Rapid transit traffic on five of the electric underground and suburban surface lines of London, but exclusive of the electric street railways, amounted to 325,000,000 in 1922 as compared with 329,000,000 in 1921, but this loss was more than made good by an increase of 85,000,000 in the number of passengers carried by omnibuses. These figures were given at a joint meeting of the Metropolitan District Railway Co., London Electric Railway Co., Central London Railway Co., City & South London Railway Co. and London General Omnibus Co. The decline in local railway traffic was attributed to the general depression, while the growth of omnibus traffic was attributed to the increased number of large modern omnibuses. To help in solving the problem of unemployment, arrangements were made in 1922 to build certain extensions and to enlarge the tunnels of the City & South London Ry. so as to accommodate the rolling stock of other underground lines. These works are now well advanced.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

More Machinery, Not More Immigration, Seen as Country's Need

Sir: There are those who advocate letting down the bars on immigration while discussing the recent Immigration Bill which failed of passage. The basis of argument used is that it is necessary to obtain cheap labor.

That cheap labor is one necessity for our return to normalcy is admitted, but it would appear that there are several disadvantages connected with the method advocated for obtaining it.

On the basis of the experience of this country from 1914 on, I believe the results have shown that it is absolutely desirable to put the bars higher than ever on immigration, if we are to retain the distinctive characteristics which made us the nation we are and not become submerged by undesirable European hordes. In all our great cities today we have the foreign quarters with high percentages of illiteracy and inability to read anything which might tend to Americanize them or convey American ideals to the newcomers. They have their own newspapers, they think and understand only those things which it is absolutely necessary they understand—as,, for instance, our money system and a few other things. It is unnecessary to point out the dangers of having vast numbers of unassimilated people in our midst who can be controlled for good or evil by an individual of a mentality only slightly in advance of their own mentalities.

Furthermore, the type of immigrant we are obtaining today is not to be compared with the type we formerly received. The European countries themselves are not so foolish as to let their most desirable citizens emigrate. Furthermore, the preponderance of immigration today comes from the southern European nations, and is not nearly so desirable as that of the northern European countries (including the Scandinavian). The latter are assets to this nation or become so within a few years. The former gather together in their cliques and remain "sores" in our large American cities. In some of our cities, one could walk for miles and wonder whether he were in Europe or America, the particular part of Europe being determined from the particular foreign quarter. What is needed first in this country, today, is to digest thoroughly the immigrants we have already received and to change them from liabilities into assets. Glance over the nationality of the names of those interested in the I.W.W., bolshevik, communistic and allied movements, and the proof of the above argument will be evident. Allow me to invite your attention to one of your contemporary magazines, *Industrial Management* for November, 1922, which states that "the crude labor shortage argument makes a plausible peg on which to hang price increases in steel, and on which to combat decreased freight charges. A preponderance of crude labor, like a preponderance of wheelbarrows, shovels, and other inefficient and primitive tools in a modern factory is an admission of managerial inferiority. It is an acknowledgment of inability to cope with the industrial situation with the God-given weapon of invention. . . . The sooner our big industries become aware that there there is to be a perpetular shortage of unskilled labor, the sooner our inventors will get to work and devise mechanisms that will do the work many times better and faster. Machinery and not immigration is the answer."

R. E. Bassler,
Lieut., Civil Engineer Corps,
U. S. Navy.

Washington, D. C.
March 13, 1923.

Direct Oxidation Official Comments on Mr. Potts' Letter to Gov. Silzer

Sir—On p. 507 of your issue of March 15 appears a letter addressed to Governor Silzer of New Jersey by Clyde Potts, in which, in reply to my charge against him, which I am prepared to sustain, he brings up the old Phillipsburg indictment, with the idea that it will reflect discredit upon me.

Mr. Potts well knows that no responsible person has ever imputed to me any personal culpability in this matter. The indictments were instigated by a business competitor of a sub-contractor and are based on the foolish assumption that all work done on or near the site of the plant should have been done under the contract, and that some extra grading, a retaining wall, etc., not even contemplated when the contract was let, were improperly allowed as extras.

No official of Phillipsburg had any part in the bringing of these indictments, and the Direct Oxidation Disposal Corporation is now operating the plant under a monthly contract.

My sole connection with the matter was that the orders of the town engineer for extra work passed over my desk as president of the Municipal Disposal Co., which had the general contract, on their way to the sub-contractor, who did the work and got the money. I had no choice in the matter as under the terms of the contract the authority of the town engineer to order extra work was absolute.

Mr. Potts' insinuation thus comes with bad grace, and is quite obviously designed to divert attention from himself at a critical time.

It is perhaps needless to say that the Direct Oxidation Disposal Corporation, as well as myself, would welcome any investigation which Governor Silzer or any other responsible person may desire to make. Such investigation would reveal only that the company is a reputable and responsible business organization, which has a pardonable reluctance to be made the victim of the private revenge of a public official.

Philadelphia, March 22. H. Jerome Hirst.

[A synopsis of the indictment mentioned and of preceding events appeared in *Engineering News-Record*, April 27, 1922, p. 710.—Editor.]

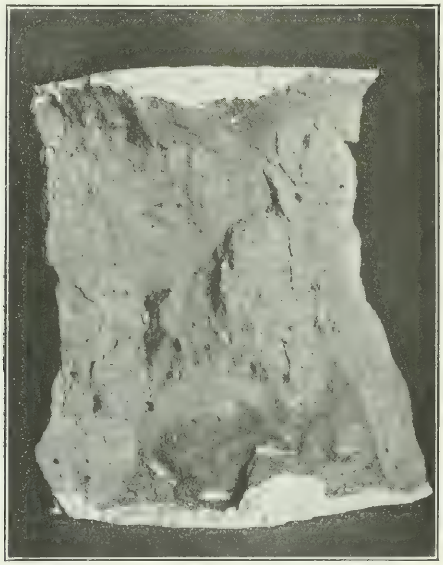
Rock Borers in Concrete Exaggerated

Sir—Under the caption "Rock Boring Mollusks Attack Concrete Pile Jackets," *Engineering News-Record*, March 15, 1923, p. 499, publishes a report by biologists of the San Francisco Bay Marine Piling Committee on the discovery of boring mollusks in so-called concrete pile jackets of Los Angeles Harbor.

The writer protests the term "concrete" used in describing the material in which these borers were found, and also takes exception to the inferences drawn in the latter portion of the report as being premature and not warranted by the data or information now at hand.

Specimens of the jackets penetrated were submitted to the laboratory of the Board of State Harbor Commissioners for inspection and analysis. None of the specimens submitted was "concrete"; all were inferior grades of cement mortar made up of a beach sand so fine that approximately 93 per cent passed the 50 mesh screen. The poorer specimens were little better than laitance and sand and were about as hard as chalk. The best specimen was selected for testing and gave a crushing strength of 1,726 lb. per square inch. The accompanying photograph of the fracture not only shows the excessively fine grading of the aggregate, but also the variable distribution of cement through the aggregate. The report calls this material a "medium grade of mortar concrete" and states that "service in sea water over a period of fourteen years indicates a composition as good as that of much of the concrete used for such purposes." Our laboratory analysis and test indicates a material such as no engineer would employ as concrete anywhere, and particularly not in sea water exposed structures. The fact that material of this nature gave service for fourteen years is only indicative of the indefinitely longer life of real concrete properly proportioned and placed.

A search was made for pholad borers in the concretes of San Francisco Harbor, some of which have given service without appreciable deterioration for thirty years. Piles jacketed by setting forms in the water similarly to the Los Angeles pile coatings were pulled and carefully inspected without evidence of borer attack being found. Some of these piles were located at the inner end of the Golden Gate within a mile of locations where rock borers are known to exist in rock suitable for their habitat. The inference would seem to be not that the concretes of the harbor had not been exposed, but that the rock aggregates used in these concretes as contrasted with the extremely fine aggregates in which the borers were found, do not constitute a desirable habitat for rock borers. At any rate if over a period of thirty years, the pholad borers of the Golden Gate have not been tempted to seek new quarters in concrete structures, future attack is improbable.


FINE GRAINED "CONCRETE" WHICH BORERS ATTACKED

These borers appear to favor sedimentary rocks such as shales and calcareous sand stones, some of which are harder than the mortar in which they were found at Los Angeles, but many of which tend to weather and soften on exposure to sea water. The mortar in which they were found was itself of such quality that softening in sea water would ordinarily be expected and the relation of sea water disintegration to the borer attack should be considered. No borers have been reported in igneous or metamorphic rocks which are suitable for aggregate in concretes exposed to sea water, and it is extremely doubtful if borers could enter the interstices between the aggregate in dense concrete required for resisting sea water disintegration.

For this reason it would seem that the occurrence of borers in low grade cement mortar is more interesting from the biological view point than it is alarming from the engineering view point. Marine concrete structures are in little danger of being riddled by pholads and the concluding speculation of the report is unwarranted especially in a scientific report. Engineers will do well to concentrate their efforts on meeting the more pressing problems of sea water exposed concrete construction: the problems of protecting reinforcing steel and of producing non-absorbent concrete. In doing this they will indirectly solve such problems as might arise from the possible attack of rock-boring mollusks.

Harry Edwin Squire,
Asst. Harbor Engineer.

San Francisco, Calif., March 21, 1923.

Winter Track Work: Pere Marquette Ry.

Sir—I read with interest your article in *Engineering News-Record* of March 8 on "Development in Railway Maintenance-of-Way Methods." Under the heading "Permanent Section Forces" I note that one road in a cold and mountainous district considered it would be practical to find work for section forces throughout the winter and that one road in the eastern, one in the central and one in the northwest district use the minimum permanent gangs the year round. I note also that twenty-four railroads approve of the system of permanent forces and that fourteen are using it.

This winter we have, for the first time, carried extra gangs on our road, allowing them to lay rail when the weather permitted. The most of this work, fortunately, was under contract, where the railroad did not suffer by reason of short hours put in. I have personally been a strong believer in reducing the forces to a minimum when the fall work was cleaned up and only carry over through the winter the actual forces needed to take care of track shimming and inspection and the small work incident to keeping the track in order through the winter. I have felt the same in connection with our bridge gangs; that the work accomplished in the winter is small and that the risk of accident is great. I am basing my views upon my experience. I realize that the man problem is quite different now and it may be necessary for me to change my views.

Frank H. Alfred,
President and General Manager
Pere Marquette Ry.

Detroit, Mich.
March 16, 1923.

Announce Bidding Prices for Building Work When Award Is Made

Sir—Attention is invited to a growing practice in building contracting that merits comment.

There was a time when a bidder was considered to be entitled to know what were the figures of his competitors—this in the spirit of fair competition. This custom seems to have fallen into disuse, except in the award of public contracts. Architects make awards without even the courtesy of notice to bidders that contracts have been closed, and many corporate interests, acting through their employees, do likewise. What can be the reason for shrouding the bids in mystery?

The preparation of a bid, the sum of which runs into hundreds of thousands of dollars, calls for some expense and certainly entitles the maker to know at least the figure of the successful bidder.

Few reputable architects will enter an open competition. In this connection the writer recalls an experience while practicing architecture some ten years ago. After a considerable outlay in preparation of plans, a postal card was received; I give you the wording: "What do you want done with your plans?"

I recently prepared a bid for work amounting to over $350,000. The cost of preparation, I figure at about $300. Notice that award has been made—a most extraordinary thing these days—has reached me, but why omit the amount of the award?

It is my belief, after many talks with prominent builders that unless the game is to be played above, rather than under the table, the invested capital in building contracting will be placed elsewhere. No one will risk his money in such a perilous business.

New York, March 24, 1923. **Clarence S. Howell.**

Small Sewage Works for New Prague, Minn.

An Imhoff tank of 80,000 gal. capacity of the return-flow type and also a shed-covered sludge drying bed have been built for New Prague, Minn. The cost of the tank, sludge drying bed, sludge pumps and motor, piping, outfall sewer and all accessories was $10,489.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The City Manager Plan was recently adopted by Knoxville, Tenn., the popular vote being 3,774 for to 1,861 against.

Formal Decision of the Indiana Engineering Society to enter the Federated American Engineering Societies has been announced by the president, W. H. Elliott, city engineer of Indianapolis.

Warrenton, Ore., Has Chosen a business woman, Mrs. R. E. Barrett, as city manager. Mrs. Barrett, who is prominent in real estate and development work on the Coast, was chosen from a list of 20 applicants.

During the Spring Meeting of the American Society of Mechanical Engineers which is to be held in Montreal, Quebec, May 28-31, a special railroad session has been arranged for the morning of May 29. Two interesting papers, one on modern methods of car construction and the other on railroad motor cars, have been prepared.

By the Annual Financial Statement of the Canadian Pacific Ry. gross earnings of $186,675,035 and working expenses including taxes amounting to $150,373,344 are shown. Deducting fixed charges of $13,348,905 left a surplus of $22,952,785. Gross earnings were less than those of 1921 by $6,346,818, but net earnings showed an increase of $2,099,950.

During the Week May 14-20 commercial associations and trade organizations in New York City and State will unite in an effort to make known to all citizens benefits to be derived by the use of arbitration in settlement of business differences. The week is to be known as "arbitration education week," and the drive is being fostered by the Arbitration Society of America.

Application Has Been Made by the Central Pacific Railway Co. for a certificate of public convenience and necessity for authority to construct a 118-mile link from near Kirk, in Klamath County, Ore., to Oak Ridge, in Lane County. The purpose of the new line will be to develop timber and agricultural resources and to provide direct railroad connection to the Willamette valley and Portland.

The Bill to Create the Kennebec Reservoir Co., which sought to construct an immense storage reservoir in the Dead River region for the purpose of regulating water supply to mills on the Kennebec River, was vetoed by Governor Baxter of Maine last week. Governor Baxter said in a special message to the Legislature that such a potential water supply should be retained by the state until the people of the state are given an opportunity to decide whether it shall be developed by them in their interests.

Road Construction Contracts in California May Be Cancelled

In accordance with a policy of economy and retrenchment inaugurated by the new Governor of California, the Highway Commission proposed to cancel contracts on several jobs not considered by the newly appointed Highway Commission as necessary parts of the main trunk highway. Before any action was taken on this plan, however, legal advisers of the State pointed out objections. Question is raised, for example, as to the legality of taking funds voted for road building with which to pay contractors for losses on abruptly terminated contracts. Meantime work is progressing on the contracts in question.

Double Tracking for Santa Fe Ry.

An extensive work now in progress on the Atchison, Topeka & Santa Fe. Ry. is the double tracking of its main line from Albuquerque, N. M., to Barstow, Calif., a distance of about 750 miles, thus greatly reducing the amount of single track between Chicago and San Francisco. Some sections of the work are already under construction. This improvement has been adopted in order to increase the traffic capacity on a line through rough country and having relatively heavy grades which affect operation. East of Winslow the easier grades permit of heavier trains so that the traffic capacity of single-track is greater. Grade reduction is included in the improvement; in some cases by building a double-track relocation and in others by building the second track on a new location. The maximum grade on this 750-mile district will be 1.42 per cent, as against 1.82 per cent at present.

This work is under the direction of C. F. W. Felt, chief engineer of the Atchison, Topeka & Santa Fe Railway System and R. B. Ball, chief engineer of the Pacific Coast lines (A., T. & S. F. Ry.)

Paving Brick Committee Acts on Varieties

Annual Meeting of Simplification Committee Co-operating with Department of Commerce

As reported in the last issue of *Engineering News-Record*, the Standing Committee on Simplification of Varieties of Paving Brick, which is cooperating with the Department of Commerce, at its meeting in Washington, March 27, eliminated from the "recognized" types and sizes the repressed hillside brick, 4 x 3½ x 8½ in.

As a basis of this year's deliberations the committee had at its disposal a survey of the production of brick in 1922, made at the request of the Department of Commerce by the National Paving Brick Manufacturers Association. The report showed a total shipment in 1922 of 419,640,000 brick. Of this total 352,000,000 brick or 84 per cent were of the seven "recognized" types and sizes adopted by the Standing Committee, March 27, 1922. The remaining volume was distributed between more than 35 varieties.

The following table shows the shipments and the percentage which each variety bears to the total shipments.

The committee eliminated as a "recognized" variety the repressed hillside brick, 4 x 3½ x 8½ in., because it regarded this variety as, essentially, a special brick, and because the shipments had amounted to only 4.1 per cent of the total.

The two wire-cut-lug brick varieties, 3 x 3½ x 8½ in. and 3½ x 3½ x 8½ in., representing 2.1 per cent each of the total shipments, were retained after discussion. It was pointed out that these sizes are much used in the Southern States.

A suggestion that the vertical fibre lug brick, 3 x 4 x 8½ in., constituting 5.1 per cent of the total shipments, be designated a "recognized" variety failed to receive the approval of the committee, it being the consensus of opinion

SHIPMENTS IN 1922 OF SEVEN RECOGNIZED VARIETIES AND FOUR ELIMINATED VARIETIES OF PAVING BRICK. (TOTAL SHIPMENTS FOR YEAR, 419,640,000)

	No.	Per Cent
SEVEN RECOGNIZED VARIETIES (Adopted by the Committee, March 27, 1922.)		
Plain wire-cut brick (vertical fibre lugless)		
3 x 4 x 8½ in	145,221,623	34.4
3½ x 4 x 8½ in	48,010,783	11.5
Repressed lug brick		
4 x 3½ x 8½ in	82,362,675	19.6
Wire-cut lug brick (Dunn)		
3 x 3½ x 8½ in	8,804,440	2.1
3½ x 3½ x 8½ in	8,707,359	2.1
4 x 3½ x 8½ in	42,738,399	10.2
Hillside brick (repressed)		
4 x 3½ x 8½ in	16,681,375	4.1
Total (seven recognized varieties)	352,526,654	84.0
FOUR VARIETIES ELIMINATED (By Committee, March 27, 1922)		
Repressed lug brick		
3½ x 3½ x 8½ in	7,552,755	1.8
Vertical fibre lug brick		
3 x 4 x 8½ in	21,038,699	5.1
3½ x 4 x 8½ in	2,417,865	0.6
Hillside brick (Dunn)		
4 x 3½ x 8½ in	1,821,630	0.4
Total (four varieties eliminated)	32,830,949	7.9

that the use of this variety is local and that it is undesirable to encourage its spread nationally.

Frank B. Dunn, of the Dunn Wire-Cut Lug Brick Co., had requested the committee to restore as a "recognized" variety wire-cut lug hillside brick, 4 x 3½ x 8½ in. This variety constituted only 0.4 per cent of the shipments for the year and the restoration vote was lost due to its failure to receive the unanimous vote, which is necessary for the designation of a "recognized" variety.

The committee then re-affirmed its action of March 27, 1922 and designated as "recognized" varieties the first six bricks in the preceding table. For the current year, therefore, there are only six "recognized" varieties instead of seven as heretofore.

The committee decided to request the American Engineering Standards Committee to arrange for an investigation of the service rendered by different types of paving brick. This resolution was carried after it was brought out that engineers desire to know the merits of different types of paving brick and especially the relative merits of the lug and lugless types.

The committee voted to hold its next meeting in March, 1924. The members of the committee and the organizations they represent are as follows: **P. H. Bates**, Bureau of Standards; **Will P. Blair**, American Society for Testing Materials; **R. Keith Compton**, American Society of Civil Engineers; **E. E. Duff, Jr.**, National Paving Brick Manufacturers Association; **W. A. Durgin**, Department of Commerce; **G. F. Fisk**, American Society for Municipal Improvements; **L. C. Herrick**, American Association of State Highway Officials (absent); **E. W. McCullough**, U. S. Chamber of Commerce; **E. J. Mehren**, *Engineering News-Record* (Chairman); **O. W. Renkert**, American Ceramic Society; **P. St.J. Wilson**, Bureau of Public Roads.

Fatal Collapse During Demolition of Building

One workman was killed and many others injured in the collapse of several floors of a building in course of demolition at 39 Eldridge St., New York City, on March 30. Material accumulated on one of the floors overloaded it so that it broke when temporary shores under the joists were removed, and fell through two floors below to the cellar.

Pennsylvania R.R. Distributes $67,921,961.37 in Relief

The report for 1922 of the voluntary relief department of the Pennsylvania R.R. system, which has just been compiled, shows that during 1922 $3,639,131.90 was received in benefits by employees and their families. Since the relief plan was inaugurated, 37 years ago, the benefits received have totaled $67,921,961.37.

Extra allowances paid last year to pensioned employees who were members of the fund at the time of their retirement, amounted to $443,274.91. Altogether, since the establishment of the plan, $2,988,386.21 has been distributed in this way.

The companies comprising the Pennsylvania Railroad System contribute the entire cost of operating the Relief Department, which in 1922 amounted to $825,411.64.

Index Ready April 15

Numerous inquiries received as to when the consolidated index of 1917-1922 would be issued, leads *Engineering News-Record* to make the announcement that the index is yet in the printer's hands. It is hoped the first copies will be ready for distribution by April 15. Copies will be sent out according to priority of receipt of the order.

Baltimore Chosen for Conference on City Planning

Baltimore has been chosen as the meeting place for the fifteenth National Conference on City Planning and the date has been fixed as Apr. 30 to May 2. The headquarters will be in the Hotel Southern. The Baltimore Zoning Commission will place on exhibit what is described as "a remarkable set of maps and data on existing structures" and a variety of city planning information. The main subjects for discussion at the conference will be regional planning, inter- and intra-urban transit and traffic, zoning, water supply, park systems, port development, automobile parking, and the major street system. Joseph W. Shirley, City Hall, Baltimore, is chairman of the Baltimore committee in charge of the conference, and J. C. Grinnalds, City Hall, Baltimore, is assistant chairman. A detailed program of the conference may be obtained from Flavell Shurtleff, secretary, 130 E. 22nd St., New York City.

North Carolina Authorizes $15,000,000 for Roads

The North Carolina State legislature now in session has authorized an additional bond issue of $15,000,000 to be used by the state highway commission for the construction of roads and bridges. This, together with the $50,000,000 authorized by the 1921 legislature, makes available $65,000,000 for the construction of the state highway system. To this sum may be added the state's federal aid from the U. S. Bureau of Public Roads.

A feature of the new act provides a tax of 3 cents per gallon on gasoline and other motor vehicle fuels to take care of the interest on bonds, sinking fund, etc. The remainder, together with the proceeds of the motor vehicle licenses is to be used for maintenance purposes. This last sum will amount to around $5,500,000.

Motor Vehicle Registration Gains

In 1922 motor vehicle registrations more than maintained the rate of rapid increase which has caused the total registration to grow from 3,500,000 in 1916 to 12,238,375 motor cars and trucks at the end of 1922, according to the U. S. Bureau of Public Roads. Last year the increase amounted to 1,775,080 registrations as compared with an average yearly rate of approximately 1,390,000 for the preceding 5 years.

The total gross registration revenue amounted $152,047,823, of which $117,093,116 was applied to road work under the supervision of the state highway departments. Eighteen states taxed gasoline, deriving a revenue of $11,923,442, not all of the states reporting for a full twelve-month period.

Last Word in F. A. E. S. Expenditures

Answering the charge made by Richard L. Humphrey and Arthur P. Davis in *Engineering News-Record*, March 29, 1923, p. 599, that he misstated the traveling expenses of the Federated American Engineering Societies in 1922, C. M. Holland has written to Messrs. Humphrey and Davis a letter which includes the following:

"In answer to your statement, I submit the following which is an exact copy of Secretary Wallace's financial statement, showing the expenditure for travel for the year 1922 was $8,417.65, as stated in my communication to Gardner S. Williams [See *Eng. News-Record*, March 1, 1923, p. 412.—Ed.]

STATEMENT OF EXPENDITURES FOR TRAVEL BY THE FEDERATED AMERICAN ENGINEERING SOCIETIES

January 1, 1922, to January 1, 1923

Members of Executive Board	$3,936.16
Representatives on National Board Jurisdictional Awards	153.39
Members of Committee on Procedure	272.38
Publicity Director Attendance Upon Meetings of Executive Board and Council	309.18
Executive Secretary and Members of Staff	1,983.28
Members of American Engineering Council	1,763.26
Total	$8,417.65

(Signed) L. W. WALLACE,
Executive Secretary.

"I think that the above completely answers your criticism and shows that my statement was correct."

The figure given by Messrs. Humphrey and Davis was $7,682.70. It will be noted that this is the sum of the first, fifth and sixth items in the above tabulation.

Fabricators' Committee Recommends Higher Steel Stresses

A board of engineers retained by the American Institute of Steel Construction, an organization of steel fabrication concerns, to report on the subject of working stresses for steel framework of buildings has just reported in favor of a basic stress of 18,000 lb. per sq.in. This recommendation, however, is restricted to steel of bridge grade in place of the generally used building grade. which latter is of lower strength. Other specifications for material methods of design and workmanship were also fixed by the board in its report. It is expected that the specification will shortly be published. The board consisted of Prof. George F. Swain, Prof. M. S. Ketchum, E. R. Graham, W. J. Watson and W. J. Thomas. A similar recommendation for raising the present 16,000 lb. working stress in building practice to 18,000 lb. was made two years ago by another fabricators' organization.

Glens Falls Dam Closed

The large power reinforced-concrete dam built for the International Paper Co. across the Hudson River at Sherman Island, just above Glens Falls, N. Y., was finally closed on March 29, before the usual spring rise in the river. The dam holds back about 50 ft. of water and is part of a hydro-electric development now nearing completion under the Parklap Construction Co., New York City.

Water-Works Operators Meet at Decatur, Ill.

Many Varied Topics Consume Discussion at State Section Meeting

Local financing of water-works by customer ownership, water softening status, the fuel problem, electrolysis, meter and filtration difficulties were the principal topics of discussion March 21 and 22 at the meeting in Decatur of the Illinois section of the American Water Works Association.

For the first time in many years optimistic financial statements emanated from the operators of privately-owned systems. They have discovered that their own customers have money and are willing to put it into the local water business. F. C. Ambary, manager of the Champaign and Urbana Water Co., outlined a successful sale of 7 per cent preferred stock to the home folks. Wilson M. Bering, secretary of the Decatur Water Supply Co., detailed the procedure of selling more than a million dollars worth of preferred stock to citizens of Decatur for the purpose of acquiring an impounding storage reservoir financially beyond the debt limit of the city. (See *Engineering News-Record*, Feb. 16, 1921, p. 299). Preferred stock is to be retired by a sinking fund leaving the plant to the city which owns the common stock. H. E. Jordan, Indianapolis Water Co., stated in discussion that their 7 per cent preferred stock was being refunded by 5½ per cent bonds at 95. W. S. Cramer, chief engineer, Water Works Co., Lexington, Ky., spoke of selling at home a 6 per cent issue of preferred stock within 3 days. In each case the company undertakes to sustain the market price by taking the stock back.

C. M. Roos, secretary, Cairo Water Co., described a strenuous and somewhat dangerous search in the Kentucky field by automobile for coal during the miners' strike. Finally, after an experience in the operation of a wood lot with gasoline saw rigs, a small mine was purchased.

The water witch still has some followers in Illinois. Alex Van Praag, consulting engineer, Decatur, had to extend the number of test holes drilled at Mt. Pulaski to satisfy the believers in the occult. If this town had made tests 26 years ago it would have saved, he said, two sets of pumps and wells both outgrown because wrongly located.

E. R. Shepard, consulting electrical engineer, Chicago, stated in his paper on "Status of Electrolysis" that there is much less damage now than formerly. He described the tests being undertaken by the U. S. Bureau of Standards to learn soil corrosion and electrolysis effects on several thousand samples of pipes buried over the country.

Illustrated descriptions of the recently completed storage dam and the sewage treatment works at Decatur were given by S. A. Greeley, consulting engineer, Chicago, and F. D. Holbrook, consulting engineer, Decatur.

After a luncheon at the Country Club of the H. Mueller Manufacturing Co., and a trip through the company's factory, excursions were made to the water and sewage works which are costing this city of 45,000 people a total of about $55 per capita.

Municipal water softening status in the state was outlined by A. M. Buswell, chief, State Water Survey. He brought out that the hardness range in most Illinois waters begins at the point (200 p.p.m.) where the hardest waters in New England leave off. Fifty-eight supplies have total solids in excess of 1000 p.p.m.

H. F. Ferguson, sanitary engineer, State Department of Health, has been making a survey of Illinois filter plants and factors affecting operation for the committee of the parent society on permissible loading of filters. The tabulated results are available in blueprint form.

Howard Ely, superintendent, Danville Water Co., in leading a round-table discussion on filter problems noted the successful removal of tastes and odors by means of copper sulphate in the manner described in *Engineering News-Record*, July 13, 1922, p. 70.

The newly elected officers are as follows: Chairman, C. M. Roos; vice-chairman, A. M. Buswell; treasurer, H. E. Keeler; trustee, W. E. Lautz.

A. A. E. Nominates Four For President

Four geographical sections of the country are represented in the four nominees for president of the American Association of Engineers, biographies of whom are given herewith. The annual meeting of the Association is to be held in Norfolk, Va., May 7-9, though the ballot for officers will be taken before, the polls closing April 27.

Webster L. Benham

Webster L. Benham is a graduate of Columbia University from which institution he received a C.E. degree in 1905. His early professional career was with the New Jersey Zinc Co., in private engineering work in Oklahoma City and as assistant city engineer of Oklahoma City, Okla. From 1909 to 1918 he was president of the Benham Engineering Co. of Oklahoma City, joining the army at that time and becoming a major in the Construction Division. At the present time he is owner and chief engineer of the Benham Engineering Co. of Kansas City and Oklahoma City, consulting engineers engaged in general municipal and industrial engineering work. He is a member of various technical societies and has served the American Association of Engineers both in committee work and as national director.

Frank T. Payne

After his graduation from the University of Alabama, Frank T. Payne was engaged for ten years in railroad engineering work for the Southern Pacific, Atlantic System, National Railways of Mexico, and the Illinois Central R.R., working his way from rodman to assistant engineer. Five years thereafter he was in general engineering practice, including municipal work and construction of industrial plants. Later he served as city engineer of Gretna, La. Since 1904 he has been chief engineer of the Department of Conservation of the State of Louisiana. He was the first president of the New Orleans Chapter of the A.A.E. and has been active in committee work, having served as chairman of the committee on resolutions at the eighth annual convention.

Robert I. Randolph

Robert Isham Randolph, who is secretary of the Randolph-Perkins Co., engineers and managers of Chicago, was educated at Cornell. After graduation he was employed by the Sanitary District of Chicago and placed in charge of construction of a bascule bridge across the Chicago River at Dearborn and 22nd Sts. Later he was secretary of the Internal Improvement Commission of Illinois and secretary of the Rivers and Lakes Commission of the same state. Still later he became a junior partner of Isham Randolph & Co., consulting engineers of Chicago and Jacksonville, Fla. During the war he served two years in the service as major of engineers, commanding the 535th Engineers. He is a member of various technical and social clubs of Chicago and is past president of the Chicago Chapter of the Association.

George E. Taylor

George E. Taylor, since 1920 junior partner in the consulting engineering firm of Anderson & Taylor, of Morganville, W. Va., received his technical education in that state. Upon his graduation he was made assistant engineer of the Public Service Commission of West Virginia. He then became chief engineer of the Public Service Commission and a silent partner of the George R. Clarke Co. of Clarksburg, W. Va. His company is employed in valuation and rate cases by large public utility corporations in the West and South. Besides being a member of various technical societies, he has contributed both to the technical press and to technical literature. He is secretary of the State Board of Registration for Engineers in West Virginia. He has served the Association as president of the Charleston Chapter and vice-president of the national Association.

Water Tank Above Stair Tower Fails at Hartford

Nine Dead Include Contractor—Tank Filled Three Weeks Ago—Load Carried By Brick Walls

Collapse of the tower supporting a 50,000-gal. water tank caused the death of nine men at the new plant of the Fuller Brush Co., Windsor Ave., Hartford, Conn., on Mar. 31. Among the dead was J. F. Bent, vice-president of the R. G. Bent Co., general contractors for the tower. Thirty-four persons were in the tower just before the collapse, and it is remarkable that so many escaped; four were seriously injured. The accident occurred at 11:35 a.m., shortly before the men would have stopped work. The steel tank was placed in the top of a 40-ft. square tower 160 ft. high, at the center of the front face of the building. The tank was supported by four inclined steel posts about 20 ft. long, the bottom ends of which were embedded in a heavy reinforced-concrete floor. The thrust was carried by clevis rods, also embedded in the floor. This supporting floor was carried by the four brick walls without steel columns.

The main entrance to the building was through the tower, which also contained elevators and stairs to serve the four floors of the building. The tower was nearly completed, and the sprinkler system served by the tank was in operation, the tank having been filled three weeks previously. Because of the rescue work, much of the evidence required in placing the blame was soon destroyed by dynamite, oxyacetylene torches, and steam shovel. Several investigations are being made, among them being those made by the coronor and the states attorney; by H. G. Balcom, consulting engineer, representing both the Fuller Brush Co. and the firm of Buck & Sheldon, architects and engineers for the tower; by the Hartford superintendent of buildings, with the aid of A. S. Lynch, consulting engineer; by E. H. McClintoch, of McClintoch & Craig, architects and engineers, representing the Holyoke Valve & Hydrant Co. of Holyoke, Mass., subcontractors for the tank and sprinkler system; and by James Bush and others, representing the Aetna Insurance Co., whose liability loss was about $50,000. The property loss was about the same.

No reliable attempt can be made to determine the cause of the disaster until the reports of these several investigations are rendered. All parties concerned in the design and construction of the tank have enviable reputations, and no expense had been spared to make the tower as strong as seemed necessary.

The masonry tower will be rebuilt to provide for elevators and stairs, but a new tank, independently supported, will be placed in the rear.

New Labor Contract in Chicago on Landis Award Basis

The Chicago Building Trades Council has recognized the principles of the Landis Award for three years in an agreement signed recently with the Building Construction Employers Association. Working conditions laid down in the Landis Award are to be the basis for all negotiations between the unions and the contractors' association.

Contract for 330-Mile Railway Let in West

The Wyoming North & South R.R. has awarded a contract to Peterson, Shirley & Gunther, Omaha, Neb., for the construction of its line from Casper, Wyo., through Sheridan to Miles City, Mont., a distance of 330 miles. The contractors have commenced work at Casper and have established headquarters at Sheridan, Wyo. It is expected to complete the line in 1924.

Suit Against St. John Cantilever

The attorney general of the Province of New Brunswick has instituted suit against the Canadian Pacific Ry. demanding an injunction to compel the company to remove its new steel cantilever bridge over the mouth of the St. John river at St. John, N. B., on the claim that the bridge is a menace to navigation. Shipping interests allege that unless the bridge is raised 7 ft. it will be an impediment to navigation up the St. John river from St. John harbor and the Bay of Fundy, and that schooners bound up the river to load lumber have lost topmasts while passing under the bridge. Similar claims were laid before the Canadian Railway Commission last year, but the change demanded was denied. The company claims that the attorney general of New Brunswick has not the proper jurisdiction to seek an injunction, and that only the minister of justice (attorney general) of Canada has jurisdiction over matters affecting navigation. It is likely that testimony, argument and judgment on the demand will consume several months.

Pinchot Highway Conference Well Attended

Delegates from over a score of states attended the conference of highway officials called by Governor Pinchot at Harrisburg, Pa., March 23 and 24. Papers were presented by Thomas H. MacDonald on highway construction and maintenance from the national standpoint; by Frederick Stuart Greene on experience by the states in road construction; by Charles J. Bennett on experience of the states in traffic regulation; and by H. G. Shirley on experience of the states in road maintenance. The papers were brief summaries of existing practice and made no attempt to offer new information or to suggest policies for future practice.

Discussion was active and at times frankly critical of the attitude of state administrations toward highway development. Playing politics in highway affairs was bluntly condemned. Two other facts on which stress was laid were: that selection of road types is an engineering problem to be solved differently as traffic requirements and natural conditions differ and that traffic surveys conducted comprehensively and in a uniform manner are essential to the economic selection, design and classification of highways.

On Friday evening the official delegates were entertained at dinner by Governor Pinchot and on Saturday there was a luncheon and round table discussion with Commissioner P. D. Wright, Pennsylvania Highway Department, presiding.

Feiker Again Joins Secretary of Commerce Staff

At the request of Secretary Hoover, of the U. S. Department of Commerce, F. M. Feiker, Assistant to the President of the McGraw-Hill Co., Inc., has again been granted leave of absence to undertake the organization and general direction of the world surveys of raw material supplies, rubber, sisal hemp, nitrates, etc., for which Congress recently made an emergency appropriation of $500,000. Mr. Feiker served as assistant to the Secretary of Commerce during the first year of Mr. Hoover's administration, acting as general assistant in organizing the personnel and industrial trade contact committees in relation to the Bureau of Census, the Bureau of Standards, and the Bureau of Foreign and Domestic Commerce.

River and Harbor Expenditures Not Yet Allocated

Washington Correspondence

Some confusion has resulted from what turns out to be a false report circulated by a Washington newspaper to the effect that Secretary of War Weeks was going to allocate most of the $56,000,000 appropriated for river and harbor work by the last Congress to the Ohio and the Monongahela Rivers. The day following the publication of the report Secretary Weeks told the reporters that there was no basis for such a statement, that the department had not yet attempted to allocate the appropriation to specific projects, and that certainly it would not give so disproportionate an amount to the rivers mentioned.

He further explained that while the War Department, through the Chief of Engineers, had submitted to Congress a detailed report in which the amount which could profitably be spent on various rivers was given for each river and while the sum of these amounts formed the basis for the $56,000,000 appropriated, there was no law requiring the Secretary of War to allocate the money appropriated according to any such system. In other words, the Secretary could designate the amount to be spent on any project regardless of the preliminary report of the Chief of Engineers.

It will be remembered that the federal budget called for only $27,000,000 for river and harbor work, but that Congress raised it to the higher sum noted over the protest of the President.

Trenton Sewage-Works Controversy Begets Suit and Protest

As a continuation of the campaign to force Trenton to build sewage-works and the State Board of Health to act on the plans for the direct-oxidation process submitted for approval last December, the city commission of Bordentown has adopted a resolution of protest against the delay in which it alleges that its health and prosperity are threatened. In addition, John R. Thropp filed a suit in Federal District Court at Trenton on March 29 for $100,000 damages alleged to have been caused to his property at Morrisville, Pa., by the discharge of untreated Trenton sewage into the Delaware River.

Engineering Societies

Calendar

Annual Meetings

- NATIONAL CONFERENCE ON CITY PLANNING, New York; Fifteenth Conference, Baltimore, April 30-May 2.
- AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.
- AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Spring Meeting, New Orleans, La., April 18-20.
- NATIONAL FIRE PROTECTION ASSOCIATION; Boston; Annual Meeting, Chicago, May 8-10.
- AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Detroit, Mich., May 21-25.
- AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

Tri-State Water & Light Association will hold its annual convention at Birmingham, Ala., Apr. 17-20. The headquarters, including the exhibit, will be at Hotel Hillman. Invitations to join the association have been extended to water-works men in Alabama, Florida, and eastern Tennessee. The president of the association is J. E. Gibson, manager and engineer, Water Department, Charleston, S. C., and the secretary is W. F. Stieglitz, Columbia, S. C.

The Society of Safety Engineers of California at the annual meeting in San Francisco on March 22 elected officers for the ensuing year as follows: president, William S. Wollner, Northwestern Pacific R.R.; vice-president, E. W. Bullard, safety engineer; secretary, H. M. Wolfin, superintendent of safety, State Industrial Accident Commission.

The County Surveyors Association of California at the annual meeting in Sacramento, Calif., on March 12 and 13 elected officers for the ensuing year as follows: President, H. H. Hume, county engineer of Butte County; and secretary, Lloyd Bowman, county surveyor of Santa Cruz County.

Personal Notes

George W. Saathoof, chief engineer for the Cities Service Corp., accompanied by **S. W. McPhee**, engineer also connected with the Cities Service New York office are in Denver, Colo., making preliminary plans to start the erection of a $4,000,000 power plant for the Cities Service, at a point near Boulder, Colo.

F. P. Shearwood has been elected to succeed Walter J. Francis as vice-president of the Engineering Institute of Canada. Mr. Francis was, as noted in these pages last week, elevated to the presidency of the Institute upon the death of Arthur St. Laurent.

E. H. McGovern has been appointed office engineer of the Cleveland, Cincinnati, Chicago & St. Louis Ry., with headquarters at Cincinnati, Ohio. He succeeds **F. H. Plaisted**, who has resigned.

Charles W. Staniford, civil and consulting engineer, of New York City, has been appointed consulting engineer for the city of San Diego, Calif., in planning the future development of the port of that city. Mr. Staniford has left for the coast to undertake this new work.

F. M. Faude has been appointed chief hydraulic engineer of the Railroad Commission succeeding **C. I. Rhodes**, resigned. Mr. Faude has been with the commission for five years as assistant hydraulic engineer and during a six months' period, in the absence of the head of the division, served as acting chief engineer.

Fred Davenport has entered consulting engineering work under the firm name of Davenport Engineering Co., and is located at Fort Wayne, Ind., having formerly done consulting work in the city of Kokomo, Ind.

W. A. Mueller has recently entered the engineering service of the City of Louisville, Ky., being employed as senior inspector in the Department of Sewers. He has but recently left the Illinois Highway Department where he was employed as resident engineer.

E. F. Bankston, former assistant bridge engineer for the county engineer of Nez Perce County, Idaho, has become associated with the Missouri Highway Department where he is employed as project engineer.

William P. Grass is now chief engineer of the Pacific Phenols Co., Guerneville, Calif. He was formerly resident engineer with the Santa Cruz County Highway Commission.

Ernest W. Seemann has severed his connection with the Elgin, Joliet and Eastern Ry Co., where he was employed in the chief engineer's office as designing draftsman, to become associated as civil engineer with Cowin and Co., Inc., Minneapolis, fabricators of reinforcing bars.

R. O. Parsons, formerly assistant engineer with the Georgia State Highway Department, has become resident engineer with the Kentucky State Department of Roads.

Ben T. Sanders, formerly county engineer of Pickens County, Ala., has accepted a position as superintendent of construction with the Batson-Cook Co. of West Point, Ga. He is located at Beaufort, N. C.

Herbert Phillips, engineer in charge of construction of hydro-electric stations for the New Brunswick government, has resigned from the St. John Electric Commission.

Gen. W. H. Rose has resigned as manager of the New York branch of Lockwood, Greene & Co., engineers and managers, to become associated with the American Machine & Foundry Co., of New York City. General Rose became connected with Lockwood, Greene & Co. in New York after his resignation from the army in 1919. During the war he was a brigadier-general in charge of the Division of Purchase, Storage and Traffic. Prior to the war, as a major of Engineers, he was in responsible charge of all electrical design, construction, and operation and maintenance for the Panama Canal.

J. Rowland Bibbins, former manager of the Department of Transportation of the U. S. Chamber of Commerce, has established a consulting office in Washington, D. C. He will engage in work having to do with transportation development, including complete surveys and economic studies adapting traffic, transit, railroad and port terminals, motor transport and city plans and valuation.

Howard J. Williams, formerly assistant engineer with the Maine Water Power Commission, has resigned to accept a position with the Vaughan Engineers of Boston.

Joseph Harber, formerly construction engineer with P. Roberts & Co., and later with the Wolf Contracting Co., both of New York City, has formed a contracting corporation under the name of the Harber Contracting Co., Inc., with offices and shops at 244 W. 30th Street, New York City. The company will do all kinds of general contracting and building work including alterations.

Obituary

George F. Kessler, one of the best-known American city planners and landscape artists, and who was consultant in city planning to both the Kansas Citys, as well as adviser to many other cities, died in Indianapolis March 19. He had been connected with park development in Kansas City, Mo., for 30 years.

Michael Skiff, aged 53, prominent contractor of Pueblo, Colo., was killed March 21, when the auto truck in which he was riding skidded and turned over.

Ernest J. Hynes, Denver contractor of the firm of Grier and Hynes, died in that city March 6.

Barton F. Howe, junior engineer in the Water Resources Branch of the United States Geological Survey, was drowned March [illegible] while making a discharge measurement at the Delaware River at Milford, Pa. He had endeavored to make measurements while the river was ice covered and the ice gave way, the swift current pulling him underneath it. He was a graduate of the engineering college of the University of Vermont. During the war he was an officer in the aviation service, having served overseas for several months. He had been connected with the Albany, N. Y., office of the U. S. Geological Survey since September, 1919.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Conference Reports on Business Cycles

Results of Study of Unemployment, Booms and Depressions Issued by Dept. of Commerce

EIGHTEEN months ago the President's Conference on Unemployment met in Washington under the auspices of the Department of Commerce and Secretary Hoover. It was called primarily to consider relief for the four to five million unemployed which had then resulted from the business slump of 1921. At that time it formulated emergency measures which probably had a good deal to do with alleviating the unemployment situation, but since then it has been making a further study which has resulted in a report entitled "Business Cycles and Unemployment," just issued by the U. S. Department of Commerce.

In this report the committee analyzes the economic phenomena of periodic booms and depressions, and its conclusions are that preventive measures lie in the better handling of business in times of prosperity, because depressions are due to over-expansion, inflation, loss of efficiency, waste and extravagance in the boom periods. It is felt, therefore, that the first point of attack on the problem must be more informed action by business men in periods of rising markets in order that excessive expansion may be prevented and the extent of the decline reduced. In other words, the committee feels that there is such a thing as a business cycle and that business executives generally should keep informed regarding it.

To Prevent Inflation

Suggestions for curbing excessive expansion include recommendations as to the control of credit by individual banks, possible control of inflation by the Federal Reserve system, control by individual business men of expansion in their own business, and the retardation in boom times of governmental and large utility building and construction. It is interesting to observe that the last recommendation has just been carried out by Secretary Hoover to meet the rising costs of construction.

The committee, however, considers that before any constructive action can be taken there must be gathered and constantly disseminated fundamental information from which trends in business can be properly adjudged by individual business men, and it strongly recommends the recruiting of enlarged and more systematic statistical information by the Department of Commerce and its wider dissemination. It points out that the construction industries are to some extent, at least, the balance-wheel on the ebb and flow of boom and depression, because construction is more readily controllable than the demand for consumable goods. Other suggestions are that the Federal Reserve Bank may earmark a special reserve of gold as against probable future gold shipments from the United States and "thus accomplish the double object of preventing both temptation to inflation of credits on the basis of this surplus gold supply and at the same time the great embarrassment of possible financial credit difficulties that would arise if foreign drafts were made upon the gold which had been used as a credit basis."

Engineers Queried

In a final questionnaire to various businesses and professions the section addressed to engineers is as follows:

"To what extent can improvements in methods of production and organization of marketing in each industry relieve the business cycle? What are the difficulties now in the way of making these improvements, and how can the difficulties be removed?"

An exhaustive report on the subject has been prepared at the request of the committee by the National Bureau of Economic Research.

Brick Association Elects Officers

At a meeting of the board of governors of the National Paving Brick Manufacturers' Association, held in Cleveland, March 22, the following officers were elected: Chairman of the board, O. W. Renkert, president, Metropolitan Paving Brick Co., Canton, O., succeeding Spencer M. Duty, president, Medal Paving Brick Co., Cleveland, O.; president, R. T. Hutchins, vice-president and sales manager, Mack Manufacturing Co., Wheeling, W. Va., succeeding O. W. Renkert.

R. T. HUTCHINS

The following officers were re-elected: W. P. Blair, Cleveland, first vice-president; C. C. Barr, president, Barr Clay Co., Streator, Ill., treasurer; Edward E. Duff, Jr., Cleveland, executive secretary and Stanley A. Knisely, Cleveland, assistant secretary.

Agree on Lumber Sizes

At a meeting of the Standardization Committee of the National Lumber Manufacturers Association, held in New Orleans, March 24, in connection with the annual meeting of the association, an agreement was reached among the representatives of all constituent associations of the national body, except one which was not represented when the action was taken, upon standard finished sizes of lumber, as follows: That 25/32 in. shall be the standard finished size, surfaced two sides, of all grades of 1-in. lumber, kiln dry basis, and 1⅝ in. as the surfaced thickness of small dimension.

Plan to Curb Inflation in Construction Industry

General Feeling Among Manufacturers and Contractors Favors Conference to Spread Work

Washington Correspondence

ORDERS for construction materials are pouring in upon manufacturers in such volume and the program of private building during 1923 has reached such proportions that many representatives of the industries affected have suggested that a conference be held to forestall a runaway market for both labor and material.

Estimates from the headquarters in Washington of the Associated General Contractors indicate a building and general construction program, including highways, of $6,000,000,000 under contract or contemplated for 1923; this is $1,500,000,000 in excess of the total for 1922. Reports to the association, as of March 1, indicated stocks of materials lower than on the same date last year, with producing plants having orders on hand to the limit of their capacity for several months to come. At the same time, reports from practically all sections of the country showed demand for labor strong, with a tendency toward wage advances.

The Associated General Contractors sent a letter to 250 organizations and large manufacturers, representing all lines of production interested in construction work, calling attention to the situation. Replies from more than 200 have been received, indicating a general feeling in favor of a conference of contractors, material men and labor to find a means of spreading out the work.

Ryerson Buys Plant of Cincinnati Iron & Steel Co.

Joseph T. Ryerson & Son, Inc., with main plant and offices in Chicago, have purchased the plant, stock and good will of the Cincinnati Iron & Steel Co., Cincinnati, Ohio. The Ryerson company will now have six steel-service plants, at Chicago, St. Louis, Detroit, Buffalo, New York and Cincinnati.

L. E. SKINNER

The newly acquired plant occupies a full city block with about 110,000 sq.ft. of floor space. The stock contains iron and steel products, including bars, shapes, plates, sheets, tubes, rivets, bolts, nuts, pipe, etc. Modern cutting equipment and handling facilities will be improved to make possible a 24-hr. shipping schedule.

Lewis E. Skinner, who has served 18 years with the Ryerson company is in charge of the Cincinnati plant. He will be assisted by C. A. Parnell, former assistant to Arthur Allshul, at the Ryerson plant at Buffalo.

Lime Association to Meet

The fifth annual convention of the National Lime Association will be held at the Hotel Commodore, New York City, June 13-15.

Record Runs May Mislead Equipment Users

Unusual Performances Mean Little Without Full Details of Local Conditions

Supplementing the discussion in last week's issue (p. 602) other manufacturers this week state the policies of their organizations. One of them makes some pertinent comment on the solicited testimonial.—EDITOR.

By HAROLD E. SMITH
President, The T. L. Smith Co., Milwaukee

THERE is no denying the fact that it would be unfair and poor policy for any reputable manufacturer to use any language in his advertising which would give a wrong impression to any reader. It is also quite possible that the publication of figures representing record runs made with machines over short periods of time might be misleading not only as to the amount of work which can be done on any job in one year, but also as to the particular value of the performance of that machine on that job.

There are a great many jobs which it would not pay to organize for high daily capacity and the fact that large records were not made on these jobs should not be held against the contractor or any of the contractors' machinery. It is equally true that where a job is highly organized and equipped the contractor has a right to expect frequent large daily output and large average output and the fact that he secures it should not be considered anything unusual for advertising purposes.

But there are a great many jobs where the daily production has been unusually high—not for short periods of time, but over an extended period—and the cost unusually low. In such cases all of the credit should go to the contractor. Often, however, he admits that his record was partly due, at least, to the sturdiness, speed and dependability of certain units of machinery which he used, and that other competing machines lack the qualities necessary to have equalled this performance. In a case of this kind there is justification for an advertisement featuring the record performance by the manufacturer of the machinery; the manufacturer has rendered a service to his industry and is rendering a further service by letting other contractors benefit by the knowledge of this performance.

There is considerable difference in the design, cost, and quality of competing types of contractors' machinery. Some are better, faster, and more reliable than others. The manufacturer who pays more for the manufacturing of his machine and sells it at a higher price because of this quality can hardly submit to a policy of advertising which would prevent him from claiming superior speed and productive capacity for his machine. In the case of concrete mixers there are a great many elements of speed other than the speed of mixing. The mixing time is practically always fixed and should be rigidly adhered to by the contractor. But if one machine can consistently load, discharge and distribute faster than another make, and can consistently work day after day with less interruption and delay from breakdowns and troubles than another machine, then the manufacturer can justly claim greater speed without misleading the public and without, in any way, working at variance with the aims of the engineers and the road officials in securing the best possible mixture of concrete.

To summarize, it would be unfair to the manufacturer of the fast, dependable unit if he could not make some truthful and carefully-worded statements in his advertising regarding what his machine has done or can do in regard to steady record performance.

By HARVEY T. GRACELY
Advertising Manager,
Marion Steam Shovel Co., Marion, Ohio

THE publishing of record runs had far better be left to the editor of a publication than to the ad writer. Local conditions and the elements have so much to do with cost and output that it is very unfair to publish unusual experiences and then, by inference, leave the reader to draw the conclusion that such performance can be expected under his particular working conditions, regardless of what they may be. We are now and always have been opposed to such a policy and I believe a review of our advertising matter will fully substantiate this attitude.

We would like to go a step farther, however, and object to the procedure of certain manufacturers in soliciting testimonials. The practice of obtaining statements from users by intensive solicitation, involving in many cases compensation for exaggerated statements, is so decidedly unethical that no conservative and well-meaning manufacturer should countenance it in any way. Such things do happen, however, and are still believed by some of the more unscrupulous to be a fair way of getting business.

Frankly, the Marion Steam Shovel Co. has always believed in conservative statements on output and costs, and has been a consistent believer in advertising its products strictly on the merits of construction and performance. We use testimonial advertising only where we think the data and information are helpful to the user. We avoid direct solicitation, feeling that the genuine, sincere expression of endorsement is far more to be preferred than any self-written, signature-requested statement.

(To be continued)

Business Notes

COL. WALTER J. RILEY, president of the O. F. Jordan Co., East Chicago, Ind., manufacturers of spreaders and other railway specialties, is home after a tour of South America.

HENRY H. ASHLEY, president, Hazard Manufacturing Co., Wilkes-Barre, Pa., makers of wire rope, died Jan. 20.

BECKWITH MACHINERY CO., Pittsburgh, which has an office and warehouse in Cleveland, has moved to a new and more centrally located office and warehouse in the latter city at 1259-61 Central Ave. Growth of the business and the need for larger warehouse facilities is given as the reason for the change.

JOHN B. WIGHT, for many years manager of the New York office of the Alpha Portland Cement Co., until his retirement a year or so ago, and a commissioner of the District of Columbia from 1897 to 1900, died at his home in Montclair, N. J., March 31.

HAROLD L. BOND and his son Harold C. Bond have resigned as president and secretary, respectively, of Waldo Bros. & Bond Co., Boston, dealers in contractors' equipment. Their future plans have not yet been announced.

WILLIAM H. SCHUTTE, who has been identified for a long time with the Chicago selling force of the Blaw-Knox Co., has been promoted to the managership of its Chicago office.

THOMAS J. DOLAN, Chicago, dealer in contractors' railway supplies and equipment, announces the organization of a new company under the name Dolan-Tucker-Smith Equipment & Supply Co.

GIBB INSTRUMENT CO., Bay City, Mich., manufacturers of electric welding equipment, has opened a sales office in Cleveland, Ohio, at 2104 East Superior Ave., in charge of W. O. Little.

FREDERIC E. WHEELER, formerly president, Finlay-Wheeler, Inc., contractors' equipment dealers of Buffalo and Rochester, N. Y., has joined the Chicago sales staff of Blaw-Knox Co., Pittsburgh.

CONCRETE STEEL CO., New York, producer of Havemeyer steel bars for reinforcing concrete, elected the following officers at its recent annual meeting: Chairman, J. F. Havemeyer; president, W. H. Pouch; secretary and treasurer, H. T. Bahr.

HARDWOOD MANUFACTURERS INSTITUTE, Chicago, announces its first annual convention for May 10 and 11 at the Blackstone Hotel, Chicago.

CALIFORNIA GLAZED CEMENT PIPE CO. announces the change of its firm name to the Bent Concrete Pipe Co., Los Angeles. The company, during thirteen years, has manufactured machine-made concrete pipe. The Bent Concrete Pipe Co. has taken over the reinforced-concrete pipe business of Bent Bros., contractors. The officers and owners of the company are Ernest F. Bent, president and manager; W. L. Jencks, treasurer and assistant manager; B. J. Primmer, secretary and general superintendent; Arthur S. Bent, of the contracting company bearing his name, and H. Stanley Bent, both of Los Angeles.

SHUNK MANUFACTURING CO., Bucyrus, Ohio, has closed a contract with S. Franklin Henderson, owner of patents on a motor truck hoist and body, for the exclusive manufacture of this equipment. The Henderson hoist is the same product that the Ohio Crane Co., of Bucyrus, had planned to produce. Hoist and body have been approved by the Packard, White, General Motors and Garford companies. Harvey Hopkins, of Cleveland, has been appointed superintendent in charge of production of the hoists and bodies at the Shunk plant. The equipment is suitable for trucks varying in capacity from 2 to 10 tons.

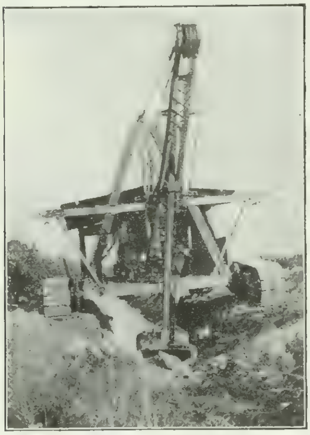
Equipment and Materials

New ½-Bag Tilting Mixer

To its line of concrete mixers the T. L. Smith Co., Milwaukee, has just added a new ½-bag tilting unit with a capacity per batch of mixed concrete of 3¾ ft. The machine, called the Smith 375, has a double-cone drum and is designed for speedy discharge. Two types of mounting are furnished, the first a two-wheel pneumatic-tired trailer with 30 x 3½-in. Ford tires, and the second, a frame carried on four metal wheels.

Crawler Dredge Digs Ditches Between Fruit-Bearing Trees

For ditching between rows of fruit-bearing trees only 30 ft. apart in the orange and grape-fruit groves of the Fort Myers Grove Co. in Florida, a 1-yd. crawler dredge with special features has been designed by the Bay City Dredge Works, Bay City, Mich.



The work involved both the cleaning out of old ditches and the excavation of new ones in an existing grove of 800 acres and the development of 1,000 to 2,000 additional acres. It was essential, in the ditching operations, that the trees should not be damaged.

The material to be excavated consists of hard water-sand overlying lime rock. The ditches are from 3 to 4 ft. wide at the bottom and 8 to 12 ft. wide at the top. The hard character of the material led to the selection of a dipper rather than a drag-line for the excavation. Furthermore, a full circle machine could not be employed on account of the close spacing of the rows of trees, preventing a machine from operating at the side of the ditch. The crawler dredge, therefore, was designed to straddle the ditch; it has a clear span between crawlers of 14 ft. and an overall width of 20 ft. The outfit is mounted on four crawler treads, each 2 ft. wide and 8 ft. long. The gross weight of the equipment is 64,800 lb. On this type of work it has been found that the crawled traction is desirable because, on account of the comparatively small yardage of earth to be taken out, the machine must be able to move rapidly to work at capacity.

Power is furnished by a two-cylinder opposed type 45-hp. kerosene engine manufactured by the Reliable Tractor & Engine Co., Portsmouth, Ohio. The dipper, with a capacity of 1 cu.yd., is made of heavier plates than standard design and has a manganese steel lip and teeth.

Corrugated Culverts Marked With a Date Tag

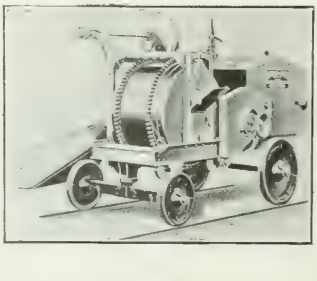
A triangular metal date tag is now being attached to all corrugated culverts of Armco ingot iron manufactured by the American Rolling Mill Company, Middletown, Ohio, and sold by distributors in the United States and Canada for cross-drain structures under highways and railroads. This tag, which is riveted to the interior of the culvert on the upstream end, is intended to prove the manufacturer's claim of long life for these culvert pipes. This tag is intended not only to give the manufacturer and distributor definite information regarding the life of the metal culvert, but to save the engineer in checking the durability of the material he specifies.

New Tracing Paper Is Strong, Transparent and Color Fast

A tracing paper for which a number of advantages, such as strength, transparency and color-fastness, are claimed by its maker, the New York Blue Print Paper Co., New York City, has been placed upon the market under the trade name of Vellux. In the matter of strength the company claims that this paper is the next best thing to tracing cloth and stands erasing well and takes ink readily. Its transparency is said to excel that of any other paper and the fact that it does not yellow with age makes it a fast paper to use in running off blueprints.

Mixer Mounted on Flanged Wheels for Railroad Use

For railroad work the Koehring Co., Milwaukee, has mounted its small Dandie concrete mixer on flanged wheels, the idea being to haul the unit on the tracks with a gasoline motor car. The outfit is supplied in sizes of 4 and 7 cu. ft. of mixed concrete per batch. This machine is designed for handling odd jobs along the right-of-way, including culvert work, signal bases, culverts, station platforms, and small retaining walls. It may be removed from the rails without the necessity of laying track. The drum has a double-gear drive and the discharge chute may be controlled from either side. The equipment may be had with low-charging platform or power charging skip, automatic water-measuring tank and light-duty hoist.



Publications from the Construction Industry

Scientific Street Lighting — HOLOPHANE GLASS CO., INC., New York, has embodied in a 22-p. illustrated booklet a guide to good practice in street lighting. In its engineering aspect the trend is said to be toward the extension of ornamental lighting, closer spacing in non-ornamental lighting, greater mounting height, and higher intensity values. Each of these phases of the subject is discussed and details are given regarding the Holophane refractor designed to distribute light from lamps to best advantage.

Ancient and Modern Construction—KOEHRING CO., Milwaukee, has issued a 31-p. booklet, illustrated with etchings in color, which presents in text and picture examples of notable ancient and modern construction embodying the element of permanency. The volume is entitled "Built to Endure." The subjects range from the Colosseum, Rome, to the new baseball stadium for the New York "Yankees."

Building Construction — THOMPSON-STARRETT CO., New York, reproduces in an attractively illustrated volume extracts of letters of commendation from its clients for whom buildings of all types—residences, offices, institutional structures, theaters and industrial plants—have been erected. The frontispiece shows New York's skyline with 15 structures marked to indicate Thompson-Starrett work. The policy of the company is expressed in a foreword by President L. J. Horowitz, who says: "After all, a contract for a building is secondary in importance to a clean bill of health when the work is done."

Brick Paving Filler — THE TEXAS CO., New York, has added to its literature on paving a booklet outlining recommended practice in the use of asphalt filler for brick and vitrified block pavements. The new publication is illustrated and consists of 28 p., dealing with such subjects as the process of production, shipping, preparation of the filler for use, and methods and equipment for its application. Under the latter head are detailed nine steps covering the preparation of the surface and the application of the filler.

Natural Cement—THE CARNEY CO., Mankato, Minn., in a 22-p. illustrated booklet describes the characteristics and uses of its product, made from natural rock, for mortar in building operations. It is usually mixed in the proportions of 1 part natural cement to 4 parts sand. There is a list of several hundred structures in which the Carney product has been used.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

March Contracts Heaviest on Record

Average Weekly Value of Construction Awards 30 Per Cent Heavier Than Same Month in 1920

March contracts awarded in the five issues of *Engineering News-Record* totaled $240,349,000, against $123,742,000 in the four issues of February. This represent an average weekly value of $48,000,000 for March, compared with $31,000,000 during the preceding month.

The number of awards totaled 912 during March, with an average value of $263,000, against 483 in February, averaging $257,000 per contract.

The weekly average, $48,000,000 for March of the current year, represents an advance of 30 per cent over the average of $37,000,000 per week for lettings valued at $148,000,000 in the four issues of *Engineering News-Record*, March 1920.

Minimum costs observed in Construction News on each class of construction are as follows: Waterworks, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings $150,000.

Engineering News-Record
Construction Cost
Index Number

April, 1923	213.50
March, 1923	205.25
April, 1922	164.72
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number advanced 8.25 points since last month, due to higher steel prices and stiffening in labor rates. Steel rose to $2.50 from $2.25 per 100 lb., Pittsburgh mill. The average rate for common labor is now 50c. Thus, general construction cost is 30 per cent higher than one year ago and 22 per cent under the peak; it is 113 per cent above the 1913 level.

Engineering News-Record
Construction Volume
Index Number

Monthly		
March, 1923	(*5 issues of E. N.-R.*)	195
February, 1923	(*4 issues of E. N.-R.*)	105
March, 1922	(*5 issues of E. N.-R.*)	202
1913		100
Yearly		
1922 (entire year)		130
1921 (entire year)		88
1920 (entire year)		91
1913		100

Engineering News-Record's Construction Volume Index Number is 195 for the month of March, and 130 for the whole of 1922, as against 100 for 1913. This means that the actual volume of construction in 1922 (not the mere money-value of the contracts let that year) is 30 per cent above the volume of construction for 1913. Our monthly volume number, 195 for March, 1923, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING MARCH, 1923

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Canada	Total
Waterworks	$264,000	$10,595,000	$130,000	$2,618,000	$1,166,000	$137,000	$239,000	$15,149,000
Sewers	...	721,000	7,000	2,522,000	803,000	257,000	167,000	4,477,000
Bridges	25,000	3,001,000	482,000	292,000	1,735,000	186,000	58,000	5,779,000
Excavation, drainage and irrigation	...	304,000		100,000	514,000	28,075,000	...	28,993,000
Streets and roads	153,000	5,439,000	7,837,000	7,695,000	12,860,000	3,538,000	184,000	37,706,000
Industrial works	3,235,000	4,773,000	1,983,000	12,062,000	3,810,000	2,784,000	695,000	29,342,000
Buildings	7,167,000	26,775,000	4,004,000	22,073,000	10,844,000	9,673,000	4,493,000	85,029,000
Federal government		241,000	1,216,000	2,292,000	532,000	1,406,000		5,687,000
Miscellaneous	..	671,000	75,000	1,719,000	18,384,000	2,620,000	4,718,000	28,187,000
Total	$10,844,000	$52,520,000	$15,734,000	$51,373,000	$50,648,000	$48,676,000	$10,554,000	$240,349,000

Labor Rates and Conditions Throughout the Country

Increased production, rather than higher prices or more extensive use of credits, appears as the ruling factor in the maintenance of strength and confidence in industry and trade at the outset of the spring season.

The construction industry, particularly, has experienced only such slackening as caused by weather conditions, transportation shortage and scarcity of skilled labor, principally bricklayers and plasterers. Conditions, generally, have steadily improved during the winter so that it is difficult to cite an industry which is not operating close to capacity.

The consuming capacity of the country with the increased employment of workers at advanced wages in some industries, is greater now than at any time in the last two years.

The common labor rate for the nation as applied to pick and shovel men in construction operations, is placed at 50c. per hr. as against 49c. for the preceding month, according to *Engineering News-Record's* figures. Local building conditions are as follows:

Atlanta—Much building work planned ahead. Considerable difficulty experienced in getting materials owing to transportation shortage.

Chicago—Building Trades' Council signed agreement with Building Construction Employers' Association, recognizing principles of Landis Award for three years.

Dallas—Surplus of building trades mechanics not so great as in February.

Denver—Employment at 100 per cent. Applications pending for advance of $1 per day in building trades wage rates.

Detroit—No idle men in construction field. Wage rates remain unchanged.

Kansas City—Scarcity of bricklayers, hodcarriers and common laborers.

Minneapolis—Official wage scale shown in table, but rates averaging 10 per cent higher are being offered. Present basis will hold until June 1.

Montreal—Plenty of men, especially roofers, electrical workers, painters and plasterers.

New Orleans—Labor working without contract under present scale of wages, effective until June 1.

New York—Tax exemption law declared unconstitutional. If this decision is sustained by the Court of Appeals it will curb residential building. Commercial and industrial construction, however, unaffected.

Philadelphia—Labor market critical. Contractors look for wage demands after May 1.

Pittsburgh—Enough building trades mechanics; shortage of men at steel mills.

St. Louis—New scale shown in table effective March 1. Carpenters and piledrivers ask advance effective May 1. Hoisting engineers demand higher rate after June 1.

San Francisco—Striking plasterers returned to work; construction active.

CURRENT BUILDING TRADES WAGE RATES PER HOUR

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	+$1.12½	$0.70	$0.70	$0.30	......	$0.65	$0.30@.35
Baltimore	1.25	.80@.90	.80@1.00	.87½	$0.65	.80@1.00	.30@.45
Birmingham	1.00	.75	.50@1.00	.15@.25	......	1.00	.20@.25
Boston	1.25	1.00	90@1.00	.80	1.00	1.00	.60
Cincinnati	1.25	1.00	1.00	.77½	1.00	1.00	.40@.60
Chicago	1.10	1.00	1.10	......	1.10	1.05	.72½
Cleveland	+1.40	+1.25	+1.25	+.87½	+1.00	+1.25	+.87½
Dallas	1.37½	1.00	1.00	.40	.87½	1.00	.30@.50
Denver	1.25	1.00	1.00	.75@.81¼	1.00	1.03⅛	.35@.55
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.12½	1.00	1.00@1.25	.65	1.00	1.00	+.40@.75
Los Angeles	1.25	1.00	1.00	.50@.62½	.....	87½@1.00	.50
Minneapolis	1.00	.80	.80	.65	......	.80	.35@.50
Montreal	.90	.65	.50	.30	.50	.65	.25
New Orleans	1.00	.85	.90	.65	.80	1.00	.35@.40
New York	1.25	1.12½	1.25	87½	1.00	1.12½	+.45@.70
Pittsburgh	1.30	+1.20	+1.12½	.90	......	1.00	-.50
St. Louis	+1.50	1.10	1.12½	+1.00	1.12	+1.25	+.40@.67½
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.56¼
Seattle	1.12½	.87½	.87½@1.00	93¾	1.00	.90@1.00	.30@.70
Philadelphia	+1.37½	+1.12½	+1.00	.75@1.00	+1.10	+1.10	+.50@.65

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Prices continue to advance with increasing third-quarter buying movement. No. 2 foundry, basic and bessemer iron, $31 at Pittsburgh, including freight from valley; a rise of about $2 per ton since March 1.

Railway Supplies—Track materials in heavy demand and very firm. Standard spikes up 25c. at Pittsburgh mill; 30c. in St. Louis and 40c. per 100 lb., f.o.b. San Francisco. Track bolts and angle bars also higher.

Pipe—Wrought steel pipe discounts five points lower in St. Louis warehouses. Cast-iron pipe, 6 in., up $2 in St. Louis; $3 in San Francisco and Chicago and $1 per ton in New York, since last month. Rises due to higher pig iron. Sewer pipe advanced in eight out of twenty-one cities reporting to *Engineering News-Record*. Clay drain tile up $10 per M. lin.ft. in St. Louis.

Road And Paving Materials—Liquid asphalt, and road oil (45 per cent asphalt) 6c. and 5c. per gal., respectively; same price in effect one year ago. Asphalt, New York, $20 in package, against $19; $16 in bulk, compared with $15 per ton, one month ago. Wood blocks, 3½-in., up 10c. in Philadelphia, 15c. in New York and 53c. per sq.yd. in Minneapolis; 4-in., $1 higher in Kansas City.

Sand Gravel and Crushed Stone—Gravel up 25c. in New York and Seattle, 15c. in Atlanta and 10c. per cu.yd. in Philadelphia. Sand advanced 50c. in New Orleans, 25c. in Seattle and 20c. per cu.yd. in Philadelphia, during month. Rise due to increased demand and cost of production at source. Crushed stone rose 50c. in Dallas and 25c. per cu.yd. in Cleveland.

Lime—Hydrated lime advanced in St. Louis, Kansas City and Philadelphia, but declined slightly in Atlanta. Lump lime higher in Minneapolis and Philadelphia. Quotations unchanged in New York but tendency in direction of higher prices.

Cement—Mill rise of 5c. at Mitchell, Ind., Mason City, Ia. and La Salle, Ill.; 15c. at Wyandotte, Mich., and 20c. per bbl. at Alpena, Mich., during month. Following advanced at mill, prices rose 10c., f.o.b. Birmingham, 15c. in Atlanta and 10c. per bbl., delivered in New York.

Structural Steel—Reinforcing bar mills withdrawing from second quarter tonnage obligations; demand steadily increasing and prices showing tendency to advance. For reasonably early deliveries market not below $2.50 per 100 lb.; deferred shipments, $2.75. Shapes at $2.45 base, not for early delivery; $2.50 minimum on sixty-day deliveries. Plates, $2.45, booked for first half; $2.50 minimum on early deliveries, with maximum at $2.75 per 100 lb.

Brick and Hollow Tile—Common brick advanced 50c. in Montreal, 60c. in Dallas, $1 in Atlanta, $1.50 in New Orleans, $2 in Kansas City and St. Louis, and $2.50 per M. in Detroit. San Francisco reported drop of 50c. per M. during month. Hollow tile advanced in New York, St. Louis, Kansas City, Cleveland, Atlanta and Detroit; no declines reported.

Lumber—Mills sold up for weeks ahead; declining further business. Prices holding firm with stronger tone, in most cities. Yellow-pine timbers, base sizes, up $2 in Philadelphia and Kansas City; $3 in Birmingham and Atlanta. Douglas fir advanced $1 in Minneapolis and Seattle; $2 per M. ft. in Philadelphia and Detroit. Hemlock and spruce higher. Denver reports slight drop in structural timbers.

Scrap—Iron and steel scrap weaker, due to recent heavy buying at mills. Price, however, higher than month ago.

Explosives—Slight rise in Philadelphia; lower in Birmingham. No other changes reported.

Linseed Oil—Raw oil up 12c. in New York and 8c. per gal. in Chicago, since last month. Tendency higher throughout the country, due to heavy demand and shortage of seed.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Apr. 5	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	**$31.55**	$20.50
Northern Basic	**31.27**	21.02
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	**33.27**	21.54
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	**34.44**	28.16
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	**27.00**	15.78
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@ 2.75 sil.)	**33.76**	21.34
Virginia No. 2 (silicon 2.25 @ 2.75)	**34.17**	27.74
Basic	**31.00**	21.00
Gray Forge	**31.00**	20.50
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	**32.00**	20.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	**33.01**	21.67
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	**31.00**	19.00
Basic	**31.00**	18.00
Bessemer	**31.00**	19.50

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Apr. 5	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$40.00	.....	$43.00	43.00
Standard openhearth rails	43.00	40.00	$43.00	43.00	43.00
Light rails, 8 to 10 lb	43@45	28@29	2.00*	43.00	43.00
Light rails, 12 to 14 lb	43@45	28@29	2.00*	43.00	43.00
Light rails, 25 to 45 lb	43@45	28@29	2.00*	43.00	43.00
Rerolled Rails	**42@45**	1.45@1.50*	.....	......	......

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.50	$1.65
Chicago, Hardwood and Red Oak	1.25	1.40
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco ..... Green Douglas Fir	.84	1.14
San Francisco, Empty Cell Creosoted Douglas Fir	1.70	2.25
St. Louis, White Oak	**1.30**	**1.55**
St. Louis (creosoted) (zinc treated)	1.70	2.05
St. Louis, Red Oak, plain	1.15	1.40
St. Louis, Sap pine-cypress	1.05	1.30

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named

	Pittsburgh Apr. 5	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, $\frac{9}{16}$-in. and larger	**$3.15**	$2.00@2.35	$3.00	**$3.90**	**$4.85**	$3.29
Track bolts	**4.00@4.50**	2.90@3.00	4.00	**5.00**	**5.85**	4.29
Standard section angle bars	2.75	1.40@1.50	2.75	**3.75**	4.10	**2.94**

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card

BUTT WELD

Steel Inches	Steel Black	Steel Galv.	Iron Inches	Iron Black	Iron Galv.
1 to 3	64	52½	¾ to 1½	30	13

LAP WELD

Steel Inches	Steel Black	Steel Galv.	Iron Inches	Iron Black	Iron Galv.
2	57	45½	2	23	7
2½ to 6	61	49½	2½ to 4	26	11
7 to 8	58	45½	4½ to 6	28	13
9 to 12	57	44½	7 to 12	26	11

BUTT WELD, EXTRA STRONG, PLAIN ENDS

Steel Inches	Steel Black	Steel Galv.	Iron Inches	Iron Black	Iron Galv.
1 to 1½	62	51½	¾ to 1½	30	14
2 to 3	63	52½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

Steel Inches	Steel Black	Steel Galv.	Iron Inches	Iron Black	Iron Galv.
2	55	44½	2	23	9
2½ to 4	59	48½	2½ to 4	29	15
4½ to 6	58	47½	4½ to 6	28	14
7 to 8	54	41½	7 to 8	21	7
9 to 12	48	35½	6 to 12	16	2

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	54%	62½%	**52%**
2½ to 6 in. lap welded	51%	59½%	**49%**

	Galvanized New York	Galvanized Chicago	Galvanized St. Louis
1 to 3 in. butt welded	41%	48½%	**39%**
2½ to 6 in. lap welded	38%	45½%	**36%**

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus **5%**. Cast iron, standard sizes, **25%** off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York Apr. 5	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	**$52.00**	**$62.00**	$50.30	**$61.20**	**$56.60**	**$64.00**
6 in. and over	**48.00**	**57.50**	47.30	**57.20**	**52.60**	**60.00**

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Apr. 5	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$40.00	**$50.00**	$62.50	......	$73.00
4	55.00	50.00	**50.00**	75.00	$76.50	83.00
5	80.00	80.00	......	100.00	97.75	108.00
6	105.00	100.00	**85.00**	175.00	127.50	133.00
8	170.00	150.00	**195.00**	187.50	212.50	199.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	......	**$0.114**	......		$0.15	**$0.12**	......
4	...	**.114**	$0.10	**$0.1175**	.15	.15	$0.12
5	...	**.171**	.125	.	.23	.18	.16
6	**$0.24**	**.171**	.150	**.1645**	.23	.21	.1855
8	**.38**	**.266**	**.25**	**.26**	.35	.30	.30
10	**.57**	**.399**	**.325**	**.364**	.53	.42	.441
12	**.72**	**.513**	**.425**	**.468**	.68	.54	.567
15	**1.13†**	**.684**	**.625**	**.781**	.90	.90	.819
18	**1.65†**	**.95**	**.85**	**1.092†**	1.25	1.32	1.071
20	**1.98†**	**1.14**	**1.125**		1.50	......	......
22	**2.64†**	**1.52**	**1.375**	**1.456†**	2.00	......	1.44
24	**2.97†**	**1.71**	**1.625**	**1.872†**	2.25	2.16	1.89
27	**4.81†**	**2.99**	...	**2.95†**	4.69†	**3.00**	3.34
30	**5.33†**	**3.312**	.	**3.65†**	5.94†	**3.60**	4.06
33	**6.93†**	**4.41**	. .	**4.45†**	6.88†	......	4.99
36	**7.91†**	**5.0225**	...	**4.80†**	7.50†	......	5.42

	3	5	8	12	24	36
Boston	$0.125	$0.19	$0.30	**$0.578**	**$1.90†**	**$5.75†**
Minneapolis	....	......	.40	.72	2.55	5.66†
Denver	**.135***	**.18***	.27	.47	1.70	.....
Seattle	.13	....	.36	.72†	2.60†	.....
Los Angeles	.11	.165	.275	.495	1.65	.....
New Orleans	**.112***	.168*	.28	.476	**1.182†**	.....
Cincinnati	.14	.215	.34	.66	2.25	4.92†
Atlanta	**.112***	**.168***	**.28**	**.476**	**1.82**	. ..
Montreal, *delivered*	.68‡	.45†	.70	1.35	4.50†	
Detroit	**.117**	**.1755**	**.273**	**.5265**	**2.34†**	6.15†
Baltimore	.12	.18	.25	.54	1.80	5.2275
Kansas City, Mo.	.135*	.19*	.30*	.62	*2.09*	3.95
Philadelphia	**.124**	**.1871**	**.286**	**.545**	**1.89†**	**4.37†**

*4-in., 6-in., 9-in., respectively. †Double strength. ‡3-in. [illegible]

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. **minimum** f.o.b. place named:

		Apr. 5	One Year Ago
New York, 45% asphalt	(at terminal)	$[illegible]	$0.05
New York, 65% asphalt	(at terminal)	[illegible]	.05
New York, binder	(at terminal)	[illegible]	.055
New York, flux	(at terminal)	[illegible]	.05
New York, liquid asphalt	(at terminal)	*.06*	.06
St. Louis, 50-60% asphalt		**.06**	.035
St. Louis, 40-50% asphalt		.035	..
Chicago, 40-50% asphalt		[illegible]	.05
Chicago, 60-70% asphalt		[illegible]	.0525
Dallas, 45% asphalt		.04	.10
Dallas, 55% asphalt		.048	.13
Dallas, binder		.053	.15
San Francisco, binder, per ton		9.50*	13.00*

* F.o.b. Oleum, Cal. Freight to San Francisco 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbl. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Mexican*)	$*19 00*	$*15.00*
Boston (*Mexican*)	20 00	16.50
Chicago (*Stanolind*)	22.25	16.00
San Francisco, *f.o.b. refinery*, Oleum, Cal	17.00*	11.00*
Dallas, (*Texas*)	23 00	15.00
Seattle, "*D*" *grade* (*California*)	**24 75**	**20.50†**
Denver (*California*)	24 00	..
Minneapolis *f.o.b. Twin Cities* (*Stanolind*)	25 45	19.10
St. Louis (*Mexican*)	*22 50*	*18 50*
Baltimore (*Standard Oil*)	*19.00*	*14.50*
Montreal (*Imperial*)	*22 00*	*17.00*
Atlanta (*Mexican*)	**26.00**	**23 50**
Detroit (*Mexican*)	*22 47*	*18.40*
Cincinnati (*Kentucky Rock*)	22.50	19.50
Maurer, N. J. (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	**21 50**	**18.50**
Philadelphia (*Mexican*)	*19.00*	*15.00*
Kansas City (*Texas*)	**27.50**	**25.50**

*Freight to San Francisco, 80c. per ton.

†F.o.b. Richmond, Cal.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade 1)	5-in. granite, 30 blocks per sq.yd.	$134.50 per M.
Chicago	About 4x8x4 dressed	3 60 per sq.yd.
	About 4x8x4 common	3.15 per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M
Boston	5-in. granite 28 blocks per sq yd.	3 15@3.20 per sq.yd.
Atlanta	Granite	2.66 per sq.yd.
Detroit	5-in. Granite	3.00 per sq.yd.
	4-in. Granite	3.25 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	100.00 per M
New Orleans	Granite, 4 x 8 x 4	3 25 per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	4x8x4 dressed	3 10 per sq.yd.
	4x8x4 common	2 90 per sq.yd.
Kansas City	Granite	*3 20* per sq.yd.
Philadelphia	Granite	135 00 per M.

FLAGGING—

New York	Bronx, 4 ft wide	$0.22	per square
	Manhattan, 4 ft. wide	.22	per square
	Queens, 5 ft. wide	.24	per square
	6x24-in. cross-walk	1.00	lin.ft.
Chicago	18 in. wide	.99	lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 75c.; 5 x 20 in., Queens, 85c. *St. Louis*: Class "A" straight, delivered, 5 x 16 in., $1 40 per lin.ft. *Chicago*: 5 x 18 in., delivered, $3 per lin.ft.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2 63
New York (*delivered*)	3½	16	3 19
Boston	3½	16	2.35
Chicago	4	16	3.00@3 25
Chicago	3½	16	2.50
St. Louis	3½	16	2 75
St. Louis	4	16	3.10
Seattle	4	16	Off market
Minneapolis	3½	16	2 62
Atlanta	3½	16	*2 00*
New Orleans	3	16	2 10
New Orleans	3½	16	2.30
New Orleans	4	16	2.60
Dallas	4	18	3.90
Baltimore	3½	16	none used
Montreal	4	16	4 50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	2.38
Kansas City	4	16	3 65
Philadelphia	3½	16	2 60

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel				Sand	
	1½ In.		¾ In.			
	Apr. 5	One Year Ago	Apr. 5	One Year Ago	Apr. 5	One Year Ago
New York	$2 25	$1.75	$2 25	$1 75	$1.00	$1.00
Denver	1.90	2 50	1 90	2 50	1.00	1.10
Chicago	2.25	2.00	2.25	2.00	2.25	2.00
St. Louis,	1 45	1.25†	1 65	1.30†	1.45	1 10†
Seattle	1.25	1 50	1 25	1.50	1.25	1 50
Dallas	2 25	2 25	2 25	2.25	1 87½	2.25
Minneapolis	1.75*	1 50	1 75*	1.50	1 00	1 00*
Cincinnati	1.50†	1.87½	1 50†	1.87½	1.25†	1.43
San Francisco	2.15	2.25	2 15	2 25	1 50	1 50
Boston	1.40†	2 40	1.40†	2 40	1.10†	1.65
New Orleans	2 85	2.08½	2 85	2.08½	1 85	1.35
Los Angeles	0 75*	1.50†	0 85*	1.50†	0.50†*	1.35†
Atlanta	1 90†	1 85†	1 90†	1 85†	1.24†	1.15†
Detroit	2.25	2.00	2.25	2.00	2.00	2.00
Baltimore	1.86	1 40	2 06	1 60	0 70†	2.00
Montreal	1 25†	1.25†	1 50†	1.50†	1 25†	1.25†
Birmingham (Crushed slag used instead of gravel)					1.25†	1.25†
Philadelphia	1 85	1.50	1.95	1.55	1 90	1.60
Kansas City	1.60†	2 00	1 60†	2.00	0 66*	1.20

New York—Grit, $1.75 per cu. yd.; ready mixed, $2.25

Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.

* At pit.

† Per ton.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In.		¾ In.	
	Apr. 5	One Year Ago	Apr. 5	One Year Ago
New York	$1 65	$1.65	$1.75	$1.75
Chicago	2.25	1.60	2.25	1.60
St. Louis *delivered*	2 00	1.65	2.10	1.65
Dallas	2 50	2.73	2.50	2.73
San Francisco	2.15	2.25	2.15	2.25
Boston, *delivered*	1.85*	3.00*	1.85*	3.00*
Minneapolis, *at plant*	2 00	2 00	2.25	2.25
Kansas City	1.50	2.10	1.50	2.10
Denver	3.50	3.50	3.50	3.50
Seattle *delivered*	3 00	3.00	3.00	3.00
Atlanta	2.00*	1 90*	2 00*	1.90*
Cincinnati	1 75*	1.75	2.25*	1.75
Los Angeles	1.00	1.75*	1.00	1.85*
Detroit	*1.60*@1.90*	1.90*	*1.60*@1.90*	1.90*
Baltimore	2.37	1.75*	2.43	1.65*
Montreal	1.80*	2.00*	1.90*	2.10*
Birmingham *delivered*	3.20	3.20	3.10	3.10
Phildelphia	1 80*	1.70*	1.65*	1.55*
Pittsburgh	2.85	....	2.85	....
Cleveland	3.25*	....	3.25*	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
East Canaan, Conn	1.25	1.35	4.00	1.00
Easton, Catasaqua, Pa	1.00	1.00	2.00	0.90
Birmingham, Ala	1.00	1.00	1.00	1.00
Buffalo, N. Y., and Erie, Pa	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.20	1.20	....	1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2.00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$16.80@$17.10	$13.10	$3.75*	$3.00@$3.25*
Chicago	20.00	20.00	1.50†	1.50†
St. Louis	23 20	20 00	18.75‡	18.75‡
Boston	21.00	14.50	4.40*	3.12*
Dallas	22.50	.....	..	2.50†
Cincinnati	16.80	13.30	....	10.75‡
San Francisco	22.00	16.00	....	1.75†
Minneapolis	25.50	21.00 (white)	1.60†	1.25†
Denver	24.00	.....	....	2.70†
Detroit	19.50	17.50	....	18.25‡
Seattle *paper sacks*	24.00	.....	2.80†	.....
Los Angeles	.....	.....	....	3.00*
Baltimore	22.00	16.25	....	.....
Montreal	.....	21 00	....	11.00‡
Atlanta	23.00	*14.50*	2.25†	1.95†
New Orleans	.....	17.25	2.40†	....
Philadelphia	16.00	15.00	13 50‡	12.50‡
Kansas City	25.60	24.00	.....	2.40*

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is **$1.70**, Sheboygan **$1.60**. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Apr. 5	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.50	1.60
Atlanta (Magnolia)	11.00 per ton	11.00 per ton
Cincinnati (Utica)	1.72	1.77
Boston (Rosendale)	2.60	0.80 per bag
St. Louis (Carney)	1 75	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Apr. 5	One Month Ago	One Year Ago
New York, del. by truck	$2.70@2.80	$2.60@2.70	$2.40
New York, alongside dock to dealers	2.30	2.30	2.30
Jersey City	2.48	2.48	2.12
Boston	2.75	2.75	2.50
Chicago	2.20	2.20	1.97
Pittsburgh	2.24	2.24	2.02
Cleveland	2.46	2.46	2.26
Detroit	2.47	2.47	2.17
Indianapolis	2.41	2.41	2.21
Toledo	2.48	2.48	2.20
Milwaukee	2.37	2.37	2.18
Duluth	2.14	2.14	1.94
Peoria	2.41	2.41	2.08
Cedar Rapids	2.48	2.48	2.21
Davenport	2.43	2.43	2.16
St. Louis	2.35	2.35	2.20
San Francisco	2.71	2.71	2.73
New Orleans	3.30	3.30	3.00
Minneapolis	2.39	2.39	2.24
Denver	2.85	2.85	2.90
Seattle	2.90	2.90	2.94
Dallas	2.25	2.25	2.25
Atlanta	2.90	2.75	2.39
Cincinnati	2.54	2.54	2.35
Los Angeles	3.40	....	3.30
Baltimore	2.61	2.61	2.50
Birmingham	2 50	2.40	2.27
Kansas City	2 42	2.45	2.40
Montreal (*delivered*)	2 88	2.88	2.40
Philadelphia	2.41	2.41	2.21
St. Paul	2 39	2.39	2.24

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind	$1.95	La Salle, Ill	$2.10
Universal, Pa	2.00	Hudson, N. Y	2.20
Steelton, Minn	1.95	Leeds, Ala	2.20
Fordwick, Va	2.20	Hannibal, Mo	2.10
Mitchell, Ind	2.10	Lehigh Valley District	2.10
Iola, Kan	2.10	Wyandotte, Mich	2.35*
Mason City, Ia	2.10	Alpena, Mich	2.20†

*Mar. 1, $2.20 per bbl. †Mar. 1, $2 per bbl.

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago Mill	Warehouse New York	Warehouse St. Louis	Warehouse Dallas	Warehouse San Francisco
032	22	$0 89	**$0 99**	**$1 24**	$0.98	$1 00	**$1 08**
049	28	1 13	**1 28**	**1 58**	1.25	1 33	**1 41**
068	35	1 38	**1 56**	**1 94**	1.53	1 61	**1 72**
093	45	1 78	**2 00**	**2 50**	1 97	1 935	**2 19**
126	57	2.19	**2 47**	**3 09**	2 44	2 451	**2.71**
153	68	2 62	**2 95**	**3 60**	2 91	3 05	.....
180	78	3.00	**3 39**	**4 22**	3.34	**3 351**	.....
245	103	3.97	**4 47**	**5 60**	4.41	4 427	.....
287	119	4 58	**5 16**	**6 44**	5.09	5.115	**5.68**
336	138	5 31	**5.99**	**7 39**	5.90	5 934	.....
395	160	6 16	**6.94**	**8 67**	6.85	6.88	.....

PAVING

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago Mill	New York	St. Louis	Dallas	San Francisco
036P	17	$0 68	**$0 77**	**$0.95**	$0.75	$0.731	.....
053P	24	.96	**1 08**	**1.35**	1.06	1.032	.....
072P	31	1.21	**1 37**	**1 71**	1.34	1.333	.....
097P	40	1.56	**1 76**	**2 20**	1.73	1 84	.....
049R	24	.96	**1 08**	....	1.06	1 032	.....
067R	31	1 21	**1.37**	....	1.34	1 333	....
089R	40	1.56	**1.76**	....	1.73	1 84	....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27Dia.	2.3	$22 00	$20 39	$20 72	**$21 43**	$25 50
26 "	2.5	22 00	21 93	22 39	**20 78**	27 58
25 "	3.0	22 00	24 45	24 93	..	30 71
24 "	3.4	24 00	26 33	27 10	**24 28**	33 16
22 "	4.33	27 00	31.06	32 27	.	35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut New York	Warehouse, Uncut Chicago	Warehouse, Uncut St. Louis	Warehouse, Uncut Dallas	Warehouse, Uncut San Francisco
¾ and larger....	$2 00	$2.35	**$3 34**	**$3 22½**	**$3 25**	$3 15	**$3 40**
⅝....	2 05	2.45	**3 39**	**3 27½**	**3 30**	3 20	**3 45**
½.......... ...	2 10	2.55	**3 44**	**3 32½**	**3 35**	3 25	**3 50**
⅜............	2 25	2.60	**3 49**	**3 47½**	**3 50**	3 40	**3.65**
¼....	2 50	2 65	**3 84**	**3 72½**	**3 70**	3 65	**3,90**

Includes 15c charge for cutting to lengths of 2 ft. and over.

Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¾ and larger	**$2 50**	**$2.95**	$2 85	⅜....	**$2 75**	**$3 20**	$3 10
⅝ in	**2 55**	**3 00**	2 90	¼.... ...	**3.00**	**3.45**	3.35
½	**2 60**	**3 05**	2 95	. .... .			....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common Apr. 5	Common One Month Ago	Common One Year Ago	Paving Block 3-inch*	Paving Block 4-inch*
New York (del.)....	$23.50	$23.50	$19.40@19.90	**$46 50**	**$54 00**
New York (at dock)...	20.00	20.00	16@16.50		
Chicago............	11 00	11 00	11 00	34 00	42 00
St. Louis, salmon....	15@**17**	15 00	16 00	**38 50**	40@**42**
Denver, salmon.....	12 00	12 00	12 00	.. .	....
Dallas..............	**11 60**	11.00	11.15	33.00	..
San Francisco	15 00	15 50	15 00	.. ..	
Los Angeles (del.).....	15 00	..	15 00	(not used)	
Boston..............	20.00	20 00	16.00	48 25	56 00
Minneapolis (del.)....	17@19	17@19	15 00	.. .	
Kansas City..........	**16 50**	14 50	14 50	..... .	.....
Seattle..............	13 00	13 00	14 00	50 00	....
Cincinnati	18 00	18 00	15.00	43 00	43.00
Montreal	**16 50**	16 00	16 00	100.00‡	68 00
Detroit (del.)	**20 00**	16 50@17.50	16 50	38 50	41.50
Baltimore (del.)....	19.20	19 20	20 00	40 00	45.00
Atlanta	**13 00**	12 00	9 00	39.00	.
New Orleans......	**17 25**	15 75	12 50	.	...
Birmingham.....	12 50	12 50	9 50		...
Philadelphia	19@.25	19@25	16.00	40 00	48.00
Pittsburgh (del.)	16 00	16 00			
Cleveland	16 00	16.00			

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡Imported

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York Apr 5 at Trucks*	New York One Year Ago	Chicago	Philadelphia	St Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12	**$0 1314**	$0 1112	$0 0674	**$0 125**	**$0 09**	$0 108	
6x12x12 .	**1971**	1667	0926		**118**	156	
8x12x12...	**2463**	2084	1263	**19**	**16**	244	**$0 2362**
10x12x12. .			1621	. .	**188**		**2905**
12x12x12..	.	.	1853	.	**232**		**3777**

* 5 per cent off for cash.

	4x12x12	8x12x12	12x12x12
Boston ...	$0.11	$0 21	
Minneapolis (f.o.b. cars).	736	.12125	$0 214
Minneapolis (delivered) ..	0836	1369	229
Cincinnati	0859	1611	
Kansas City	083	**1455**	
Denver	065	123	188
Seattle (delivered)	.11	25	36
Los Angeles (f.o.b.)	10	175	
New Orleans	12	23	36
Detroit (delivered)	**101**	**1895**	**27**
Montreal	115	225	30
Baltimore	10	215	
Atlanta	**0893**	**1674**	
Dallas.................	115		..
Birmingham	11	18	..
Pittsburgh (delivered)	08	152	179
Cleveland	**09**	**172**	

San Francisco, Philadelphia, Atlanta, New York and Chicago quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburg and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh Mill	Birmingham Mill	Warehouse New York	Warehouse Dallas	Warehouse St. Louis	Warehouse Chicago	Warehouse San Francisco
Beams, 3 to 15 in	**2 45@2 75**	$2 40	**3 44**	**4 50**	**3 35**	**3.20**	**3.60**
Channels, 3 to 15 in	**2.45@2 75**	2.40	**3 44**	**4 50**	**3 35**	**3.20**	**3.60**
Angles, 3 to 16 in., ¼ in. thick......	**2.45@2.75**	2.40	**3.44**	**4.50**	**3.35**	**3.20**	**3.60**
Tees, 3 in. and larger...	**2.45@2.75**	2.40	**3.44**	**4.50**	**3.35**	**3.20**	**3.60**
Plates, ¼ in. thick and heavier............	**2.45@2.75**	2.40	**3.44**	**4.60**	**3.35**	**3.20**	**3.60**

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse New York Apr. 5	Warehouse New York One Yr. Ago	Warehouse Chicago	Warehouse St. Louis	Warehouse San Francisco	Warehouse Dallas
¾ in. and larger	**$3.25@3.50**	**$4.00**	$3.35	$3 75	**$3.90**	$4.75	**$5.25**

CONE HEAD BOILER

	Pittsburgh Mill	New York Apr. 5	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
¾ in. and larger.	**$3 35@3.60**	**4.10**	3.45	3.85	**4.00**	4.85	**5.35**
⅝ and 11/16........	**3.50@3.75**	**4.26**	3 61	4 00	**4.15**	5.00	**5.50**
½ and 9/16.... ...	**3 75@4 00**	**4.50**	3 85	4 25	**4 40**	5.25	**5.75**

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire........	$2.80@3 00	$3 45	**$4 20**	$4.25	**$3.19**	$4.95
Cut...........	3.25	5.50	5.80	5.75	3.24	5.00

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs **$2.50** per roll in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.75 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., **$6.20**.

ROOFING MATERIALS—Prices f.o.b. New York, in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton.....................	$67.50
Tar pitch (in 400-lb. bbl.), per 100 lb	1 62½
Asphalt roofing (in barrels), per ton, f.o.b. plant*......................	38.75
Asphalt felt (light), per ton, f.o.b. plant*...........................	75.00
Asphalt felt (heavy), per ton, f.o.b. plant*..........................	75.00

* Delivered in Metropolitan Dist., $3.00 additional.

WINDOW GLASS—Double strength, box list, united inches, 34, "AA", "A" and "B" grades, all at discount of 84 per cent from standard lists, f.o.b. New York.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	**$2 65@3 25**	**$4 25**	**$4 15**	**$4 60**	**$4.34**
No. 12...............	**2 75@3 35**	**4 30**	**4 20**	**4.65**	**4 39**
No. 14...............	**2.85@3 45**	**4.35**	**4.25**	**4.70**	**4 44**
No. 16	**3.05@3 65**	**4 45**	**4.35**	**4 75**	**4.54**
Black					
*Nos. 18 and 20	**3 35@3 60**	**4 80**	**4 85**	5 70	4 70
*Nos. 22 and 24 .	**3 40@3 65**	**4 85**	**4 85**	5 75	4 75
*No. 26	**3 45@3 70**	**4 90**	**4 90**	5 80	4 80
*No. 28	**3 50@3 75**	**5 00**	**5 00**	5 90	4 90
Galvanized					
No. 10	**4 00@4 25**	**5 00**	4 85	5 75	**4.90**
No. 12	**4 10@4 35**	**5 10**	4 95	5 85	**5.00**
No. 14	**4 10@4 35**	**5 10**	4 95	5 85	5 00
No. 17 to 21	**4 40@4 65**	**5 25**		6 15	5.30
Nos. 22 and 24	**4 55@4 80**	**5 55**	5 40	6 30	5.45
*Nos. 25 and 26	**4 70@4 95**	**5 70**	5 55	6 45	5.60
*No. 28	**5 00@5 25**	**6 00**	5 85	6 75	5.90

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; **25c.** for 19 to 24 gage; for galvanized corrugated sheets add 15c. all gages.

LINSEED OIL—These prices are per gallon:

	New York Apr 5	New York One Year Ago	Chicago Apr 5	Chicago One Year Ago
Raw in barrels (5 bbl. lots)	**$1 13**	[illegible]	**$1 15**	$0 90

WHITE AND RED LEAD—Base price in cents per pound:

	Red				White	
	Apr. 5		1 Year Ago		Apr. 5 Dry or In Oil	Yr. Ago Dry or In Oil
	Dry	In Oil	Dry	In Oil		
100-lb. keg	14.25	15 75	12 25	13 75	14 25	12 25
25 and 50-lb. kegs	14 50	16 00	12 50	14 00	14 50	12 50
12½-lb. keg	14.75	16.25	12.75	14.25	14.75	12.75
5-lb. cans	17.25	18.75	15 25	16 75	17 25	15 25
1-lb. cans	19.25	20.75	17.25	18 75	19.25	17.25

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$38.00	$39 00	$40 00	$43 00
3x6 and 8	38.00	39 00	40 00	43 00
4x4-6 and 8	38.00	39.00	40.00	43.00
3x10 and 12	38.00	39.00	40.00	43.00
3x14	40 00	40.00	42.00	44.00
4x10 and 12	38.00	39.00	40.00	43.00
4x14	40.00	40.00	42.00	44.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$40.00	$42.00	$44.00
6x14	40.00	42.00	44.00
8x10	40.00	42.00	44.00
8x14	40.00	42.00	44.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22–24 Ft.	20 Ft. and Under	22-24 Ft.
3x 4 to 8x8	$50.00	$51.00	$54.50	$56.50
3x10 to 10x10	54.00	55.00	57.50	59.50
3x12 to 12x12	58.00	59.00	60.50	62.50
3x14 to 14x14	65 00	66 00	65.50	67.50
3x16 to 16x16	70.00	71 00	70.50	72.50
3x18 to 18x18	84.00	85.00	82.50	83.50
4x20 to 20x20	94.00	95.00	93.50	95.50

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under.

Other Cities

	8 x 8-In. x 20 Ft. and Under				12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$67.00	$125.00	$65.00	$65.00	$90.00	$140.00
Seattle	...	30 00	......	......	......	30 00
New Orleans	40.00	35 00	......	35.00	40.00	......
Baltimore	35.00	53.00	53.00	60.00	50.00	53.00
Cincinnati	45.00	51.50	51.50	51.50	45 00	53.50
Montreal	50.00	.....	.	....	95 00	90.00
Los Angeles	.....	.....	.....	......	......	.....
Denver	.....	40 75	39 75	....	......	42.75
Minneapolis	46.50	44 75	41 50	.....	49 00	45 75
Atlanta	36 00	....	.....	.....	40 00	.....
Dallas	48.00	.....	.....	.....	53 00	.....
Kansas City	45 75	44.75	44.75	.....	58 75	48.75
Birmingham	35 00	.....	.....	.....	43 00	.....
Philadelphia	47 00	41.50	40.00	45.00	58 00	42 00
Detroit	49 75	50 25	....	....	58 25	50.25
St. Louis	44.00	.....	.....	.....	51 00	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	$50.00	$85 00	$50.00	$60.00	$100 00
Seattle	......	25 00	.. .	.....	28 50
New Orleans, at mill	80 00	.....	.....	39 00	.....
Baltimore	65.00	44.00	44.00	37.00	55.00
Cincinnati	60.00	82 00	82.00	35.00	78 00
Montreal	.....	50.00	37.00	45.00	45.00
Los Angeles	.....	48 00	.....	.....	.....
Denver	.....	37.25	36 25	.....	37 75
Minneapolis	48.50	43 25	39 50	43.75	41.25
Atlanta	20 00	.....	.....	30.00	.....
Dallas	48.00	...	.....	51.50	.....
Kansas City	81.00	...	.....	69 00	
Birmingham	32.00	.....	.....	40 00	.....
Philadelphia	37.00	43.00	40.00	57.00	41 50
Detroit	48 75	42.00	..	47 00	42 50
St. Louis	45.50	.....	.....	35.50	.....

Birmingham—Quotes carload lots, f.o.b. sidings. $1.50 additional per M. ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractors on large projects.

St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M. ft. additional.

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M. ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.315	Detroit	$0.295
Birmingham	.69	Kansas City	.735
Boston	.365	New Orleans	.515
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.50†
Cincinnati	.295	Philadelphia	.325
Cleveland	.215	St. Louis	.43
Denver	1.275*	St. Paul	.595

* Minimum carload, 40,000 lb.

† Minimum carload, 50,000 lb., structural steel only; 80,000, lb. for other iron or steel products

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Apr. 5	One Month Ago	One Year Ago
$2.30@2.70	$2.15@2.30	$1.75

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	25%
Patent flattened strand, special and cast steel	25%
Patent flattened strand, iron rope	10%
Plow steel round strand rope	40%
Special steel round strand rope	35%
Cast steel round strand rope	27½%
Round strand iron and iron tiller	10%
Galvanized steel rigging and guy rope	12½%
Galvanized iron rigging and guy rope	+7½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft., ¾-in., 6; ⅞-in., 4½; 1-in., 3½; 1½-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.16¼	New Orleans	$0.18½
New York	.18	Los Angeles	....
Chicago	.18	Seattle	.18
Minneapolis	.20½	St. Louis	.19½
San Francisco	.18	Montreal	.30
Atlanta	.21	Detroit	.19
Denver	.22	Baltimore	.18
Cincinnati	.20	Kansas City	.20½
Dallas	.129	Birmingham	.20½
Philadelphia	.18		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin	
	40%	60%
New York	$0.27	$0.30
Boston	.23	.25
Kansas City	.2225	.2525
Seattle	.165	.195
Chicago	.22	.25
Minneapolis	.189	.2094
St. Louis	.2225	.2525
Denver	.2025	.2325
Dallas	.29	.375
Los Angeles	....	.....
Atlanta	.23	.26
Baltimore	.215	.225
Cincinnati	.22	.25
Montreal	.195	.235
Birmingham, *delivered*	.16	.17
New Orleans	.235	.265
San Francisco	.1625	.1925
Philadelphia	.2625	.295

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.13	$0.17½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.17½	0.22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.19½	0.24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.25	0.34
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$21.00	$11 50	$17.00
Stove plate	17.00	12.00	17.50
No. 1 machinery cast	21.00	16.50	21.00
Machine shop turnings	14.00	4.00	12.00
Cast borings	15 00	5.50	12.00
Railroad malleable cast	20.00	12.50	19.50
Re-rolling rails	21.00	13.00	21 00
Relaying rails	28.50	30.00	29@33
Heavy melting steel	19.00	...	......

SHIP SPIKES—Current prices per 100 lb.:

	San Francisco		Seattle
In.	Galv.	Black	Black
[illegible]	$8 25	$6.25	$8.00
[illegible]	7.30	5.80	7.75
[illegible]	7.15	5.65	7.70

Pittsburgh base in lots of 200 kegs or more, $3.50.

A Consolidation of Engineering News and Engineering Record
McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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There Are Others

UNDERPAID engineers, of whom there are too many, should read the following advertisement in the *New York Law Journal*: "Attorney (45), American, M. A. and LL. B. from Columbia University, eight years' experience as managing clerk, just returned to city after absence of year and a half, desires position in first-class downtown office; thoroughly experienced in all matters pertaining to a general civil practice; willing and dependable and can work independently; good references; salary to begin, $18 per week." Evidently the other professions have their troubles, too.

An Opportunity to Get Together

THE hearings on the New Jersey marginal railway before the Interstate Commerce Commission and the Port of New York Authority last week mark only the beginning of a solution of the intricate terminal problem of the metropolis, a problem which the new interstate port body was formed to solve. Wisely the Authority chose to make its first issue on the most simple and elementary feature in its comprehensive plan, the co-ordination of operation over an existing marginal railway made up of a number of separately owned parts. By arrangement, only the Authority's side of the case was presented. In a few weeks the railroads will reply and then we will have, for the first time, a public expression of the railway opposition to the interstate plan. Doubtless the railways have some good arguments against the scheme, but in addition it is to be hoped that they will take this opportunity to show some agreement as to suggestions for improvement of the obviously expensive and impeding methods now in vogue for getting freight into New York from the west. The time for mere obstruction has passed. The railways must have some constructive ideas on which they can reach substantial agreement.

Municipal Foresight Needed

THE UTTER LACK of foresight of most of our cities in matters that uncontrolled are bound to cause traffic congestion and other evils is forcefully illustrated by what has happened in the theater section of New York City. Data gathered by the Physical Survey of the Plan of New York and its Environs under the direction of Nelson P. Lewis, chief of the survey and formerly chief engineer of the Board of Estimate and Apportionments of New York City, show that there are seventy-eight theaters and other commodious places of amusement resort in the area between 38th and 51st Sts. and Sixth and Eighth Aves., New York City. These seventy-eight places have a combined seating capacity of 95,294. Within a radius of only 1,000 ft. from the center of Broadway and 42nd St., forty-four of these amusement places are located, with a total seating capacity of 55,911. At opening and closing time of the theaters vast throngs make an almost intolerable congestion of foot, automobile, and subway traffic, besides putting pressure upon surface cars and elevated lines. Mr. Lewis points out the London practice of withholding building permits for places of public assembly until after the police and fire departments have reported as to the effect of these places upon both traffic congestion and the fire hazard. In New York apparently there is nothing of the sort. Although the New York theater congestion is unparalleled in degree other American cities show the same general neglect of various factors that may lead to traffic congestion. The matter demands immediate attention from the municipal authorities of all our cities. Municipal engineering departments should take the lead even though in some cases they may appear to be stepping outside of any function ascribed to them in municipal charters.

Studying the Great Lakes

ANOTHER large-scale research in the field of civil engineering is placed before the world, in the study of the Great Lakes hydrography reported in this issue. It expresses the same high scientific spirit as is found in the famous track stress investigation, and takes a place with it in the small list of engineering classics. Dealing with a problem of extreme intricacy, it proceeded toward its objective by a most toilsome route, and finally succeeded in reaching definite results which contain a satisfactory solution of the problems taken up. The Great Lakes justify an intensive study of this kind, in view of their remarkable character and their intimate relation to the interests of the country at large. Heretofore we have known but little of their quantitative characteristics. Their relation to the national economy depends upon the water supplied to the basin, upon the water losses and upon fluctuations of level. The latter, which formed the specific subject of the present study, represent merely the starting point of an attack upon all the problems indicated. The ultimate result of the investigation will be a full quantitative determination of the hydrographic features of the Lakes. Even apart from the results of the study, its methods make it valuable to the civil engineering art. The analysis of intricate phenomena by rational formulation followed by least-square verification is a most powerful process. It has been too little used in application to lengthy records of varied natural phenomena. The example of its application and of its effectiveness given by Mr. Hayford's work will inspire others to fuller use of the method. Whether the old but ever new question of the Chicago water diversion, which is mentioned at the close of our abstract, is directly related to fluctuations of level in the Lakes, appears quite doubtful. For its best appreciation the present study should be considered as being free from any connection with Drainage Canal matters. In the ultimate development of the study when it leads to a determination of total net flow, its application to the Chicago problem will be more direct.

Truck Haulage Values

AN ANALYSIS of truck haulage in which light, medium weight and heavy trucks are compared, is presented in this issue by A. E. Horst, highway contractor. The data relate to haulage for road construction and are based on records of actual performance and costs. It is not the specific figures given, however, that make this analysis of most interest and value. These qualities lie instead in the fact that a way is indicated by which highway contractors can appraise the relative desirability of small or large trucks for any set of conditions. Other conditions of wages and prices and rates of depreciation than those assumed may easily exist, but they can be substituted and the comparison conducted in exactly the manner adopted with the assumed figures. The contractor will then have a knowledge of truck values that few contractors have when they are buying trucks. As things are now contractors are dependent on the truck salesman to get information of the kind noted in this article. It is therefore, as a guide to a way of knowing more of truck haulage economics in road construction, that the article and tabulations published are of general utility.

Outguessing the Future

CONFERENCES, to settle national or international troubles, have come to have a pretty bad name. Too frequently in the past few years have they come to nothing. The recent business cycle and unemployment conference report has, therefore, the handicap of its class to overcome. In spite of this the report is thought provoking, and its effect will be heightened when the full text of its more extended related study is made available. The essence of the suggestions made now are plain enough. Business moves in certain readily recorded cycles; the problem is so to judge the future by the past as not only to foresee the coming trend—which has been the common habit of the successful business man—but to control that trend for the benefit of the world. It is proverbial that the way to grow rich is to buy low and to sell high. Some men have this knowledge instinctively. Others, doubtless, have built up theories of how to do it, which satisfy themselves. The committee would make such knowledge general. We must not delude ourselves that this will be easy. There is no simple touchstone by which we can outguess the future, but there do seem to be certain fundamentals of economics which, if properly studied and properly recorded, will make it possible to flash warnings, which being observed will tend to keep progress on an even keel. In its advocacy of more statistics and more research, the committee is on solid ground; in its recommendations as to banking it is in a realm on which many theories are held but which only practice can prove. It is in its suggestion that some workable scheme of unemployment insurance be perfected, that the committee has hit on a basic need. If means can be devised whereby the working man is either guaranteed full time or at least carried over his jobless weeks, we will be approaching the millennium, for, after all, it is the man who has no leeway between income and legitimate expense who suffers most in depression and whose sufferings react to discommode the entire body of the people. The employment conference's report does not promise any early approach of the millennium, but it is valuable as a step in a proper study of how it is to be achieved.

The Civil Engineers and Society Co-operation

IN A decisive vote the American Society of Civil Engineers has once again refused to join the Federated American Engineering Societies. The performance of the federation in the two and one-half years since the last vote has not served to bring any civil engineering sentiment to its side; indeed, the trend is slightly the other way, for 581 more votes were cast against joining than in 1920. Further than that the trend has been national and not sectional. In 1920 nine of the thirteen districts voted against the federation, in 1923 twelve of the fifteen are in opposition. Nor is the common claim that New York dominates the opposition valid, for had all the metropolitan votes been favorable to the federation it would still have lost by over 150 votes. Leaving out New York altogether the adverse majority was over 1,000. The vote, therefore, is final. As at present constituted the federation does not appeal to the civil engineers.

There should be no misunderstanding as to just what this vote means. It was not on the question of co-operation between engineers; the issue was plainly on the record of the F. A. E. S. as the agent for such co-operation, with the future potentialities that record promised. The opposing arguments of the civil engineers' committees may be taken as representing the situation as it appealed to the members. The advocates believed that the federation, approximately as constituted, is the best means for bringing to bear the combined inflence of the engineering profession on public affairs and public opinion. The opposition believed that the federation is unresponsive and unrepresentative and that it has reduced rather than enhanced the influence of engineers. It felt, too, that the society can better serve the profession through devotion to its own technical activities and both the profession and the public through some less expensive and more independent kind of co-operation.

In spite of the voluminous and widely circulated defenses of the F. A. E. S. we believe its record warranted the civil engineers' vote. In its three years the federation has actually done very little and what has been done has been the work of a few men and not of the members of the societies that make it up. The same may be said of many societies, but the avowed purpose of the federation is to speak for the engineers of America so that its concentration of effort and opinion has a special significance. The waste report and the twelve-hour day study are admirable efforts, but they are no more the work of the engineering profession—or even of the F. A. E. S.—than any report or study by a group of engineers. The recommendations of the various committees may be judicious but they remain the views of certain selected men and not the views of a body of engineers. In other words, a representative council, with a highly variable representation unit, cannot in its occasional meetings voice the will or thought of the thousands it imperfectly represents.

Freely admitting that the federation is an honest attempt to fill a need long expressed by the best engineering thought, the need of some co-ordinated efforts by engineers of all kinds and from all places to impress what seems to be the group opinion of the profession on the general thought of the nation—freely admitting this, the federation has not succeeded in its aims. Among other things, it has mismanaged its publicity in the mistaken idea that engineering will gain prestige by the over-emphasis of a few individual engineers; it has, whether it wanted to or not, set up in Washington a lobby, which where possible has urged governmental action or made decisions authorized by the council (though rarely if ever by the members themselves) but which on occasion has been forced to take quick action along lines thought best by the Washington office but always in the name of the 50,000 or more engineers who could not possibly have anything to do with such a decision. Its leading spirits have shown the most naïve inability to understand that the thoughts and actions of a few men, however broad minded and public spirited, cannot be circulated as the views of a great profession.

These things, we believe, were in the minds of the members of the American Society of Civil Engineers who voted against the federation. They were voting against a record and not against an idea. The danger now is that the vote be taken as putting a quietus on any co-operation between the civil engineers and those engineers now making up the federation. Such a conclusion would be deplorable. So final an authority on the federation as Herbert Hoover has said that "the engineers of America can never express themselves as fully or with as much force and influence in matters of public interest as they could if they embraced the civil engineers." The civil engineers themselves have voted that they are strongly in favor of some kind of co-operation. In spite of the latest vote we believe that that sentiment still prevails, and it should be capitalized.

For two years those behind the federation have gone ahead on the idea that it was a perfected organization. Take it or leave it, they said in effect to the civils, all the time bringing to bear all possible pressure to make them take it. If that attitude persists and they take the stand that they are well rid of the civil engineers, the influence of the federation will steadily decline. If they cannot see why the only group of engineers who have been permitted to express themselves (no other of the major societies has had a referendum) cannot accept the federation, they are too short-sighted to represent truly the engineering profession. If, on the other hand, they take to heart this vote and make some effort to reform or even to make anew the federation idea to meet the objections which controlled the adverse vote, progress will surely, though doubtless slowly, be made toward the very necessary integration of all branches of the engineering profession.

A similar obligation rests just as strongly on the members of the American Society of Civil Engineers. Thirty-six percent of those voting want the federation as it is; enough more to make a large majority unquestionably favor some sort of co-operation. The thought of this majority is not co-ordinated or expressed but there can be little doubt that it believes that engineers need more recognition from the world and that the world needs the kind of thinking that engineers can give to its problems. The federation as an attempt to supply these needs is not acceptable to the civil engineers, but the society is none the less under obligations to consider, actively and not merely receptively, means whereby the desired ends may be reached. They cannot, nor do any but a few of their members want them to, set up a policy of isolation or self-sufficiency. They need the other engineers and the other engineers need them to present to the world a united engineering profession on those matters on which a united profession has a right to an opinion.

No one has authority to lay down a basis of discussion as to co-operation between the American Society of Civil Engineers and other engineers, but it would be fair to start on the assumption that the civil engineers would be interested in a looser form of co-operative organization, one that is more representative and more responsive and which is neither so expensive or so centralized as the F. A. E. S. has proved itself to be. Both sides would be serving the profession each is anxious to benefit by forgetting the bitterness of the late campaign and starting anew on some such basis to build up a real co-operative movement among engineers.

Seeking for Steel Economy

ONE important phase of the last few years' movement toward greater economy of construction has been a seeking for more efficient utilization of structural steel through higher working stresses. Doubtless the pressure of high prices and the competition of other materials, chiefly reinforced concrete, was a motive, but essentially the steel stress reform movement is part of a larger movement to make productive our developed engineering skill by eliminating excess safety margins. The conventional standard of 16,000 lb. per square inch for structural steel in tension and bending is the point of attack. Several voices have already been raised in favor of increasing this standard to 18,000. Now a weighty pronouncement is added to them by the report of an engineers' committee of the steel fabricators, summarized in this issue. The committee concurs in the 18,000 recommendation, but stipulates certain specification requirements that mean additional changes in designing and construction practice.

Meanwhile, bridge engineers have gone beyond their brethren of the building field by designing with working stresses of 20,000 lb. as instanced by the case of the Michigan Central arch, described in our pages some weeks ago. If such a stress is safe, and if bridge service is more severe than building service, the latter should be able to use still higher working stresses; but building engineers have not yet been willing to apply this conclusion practically. The fact is that they have not the same certainty with regard to their work that bridge engineers derive from stress measurements—scanty as these latter are. In consequence they are compelled to resort to one of two courses: either to fix a safety margin by estimating separately the allowances which it must cover, or else to make a cautious step forward in working stress on the basis of the fact that no steel building has failed except because of intolerably bad designing or construction. Which course was pursued by the committee is not revealed in the report, but it may be said that structural engineering would benefit from a clear statement on this point. Regardless of the reasoning back of the report, however, the structural engineer has to keep two facts in mind. First, purchasers of building steel accept and use a material of lower grade and greater variation than that which bridge engineers demand and get. Second, there is a certain small amount of bad or slipshod construction in the structural field, which requires to be safeguarded by an extra safety margin, handicapping the conscientious designer. Of these two obstacles to structural progress the latter is much the worst. The structural profession owes it to itself to place its work on a stress basis free from allowance for bad work, and then to fight hard for the elimination of bad work.

Building a New Concrete Bridge Over an Old One

Piers for Adams St. Structure Over Miami River at Troy Strengthened for Heavier Loads—Three New Arches Added—Old Arch Rings Support Formwork for New

THE unusual feature of constructing a new concrete bridge on top of a similar structure already in place, using the old bridge as support for forms for the new, was present in the reconstruction of the Adams Street bridge at Troy, Ohio. The reconstruction, part of the work being done by the Miami Conservancy District, was carried out under the direction of A. F. Griffin as division engineer, and W. D. Rogers as superintendent. The scheme of using the old bridge as a support for the new construction and of removing it afterwards was worked out by J. H. Kimball, assistant chief engineer of the district. The detail designs were made by H. G. Peterson. Price Bros. Co. were the contractors on the underpinning and reinforcing of old piers.

Official Plan Proposal—The official plan of the District originally proposed an improved channel for the Miami River at Troy following the old river closely and using the bridges as they then stood. Floods were to have been taken care of by making the levee on the north side of the river of limited height so that a large flood flow would overtop the banks and make use of the low ground on the north. The plan required, however, that the Adams Street bridge should be enlarged whenever conditions should be such as to make complete protection of the land on the north side of the river desirable. The demand for this protection appeared before much work had been done at Troy, and this fact together with the growing feeling that the bridge should be rebuilt led to a change in the official plan. The old bridge was built in 1913 and consisted of four reinforced-concrete arches. The foundations were very shallow, the big flood scouring the bed of the channel near the bridge to a depth of several feet below the pier footings. The tops of the arches were also so low as to be submerged in extreme flood and the waterway was far from adequate. It also developed that the concrete of the structure was of rather poor quality. The Conservancy Law requires the owners of bridges of inadequate waterway to make such modifications as the District requires at their own expense. The Adams Street bridge was a structure built and owned by the County of Miami, but the County Commissioners requested the District to make the necessary reconstruction at the County's expense.

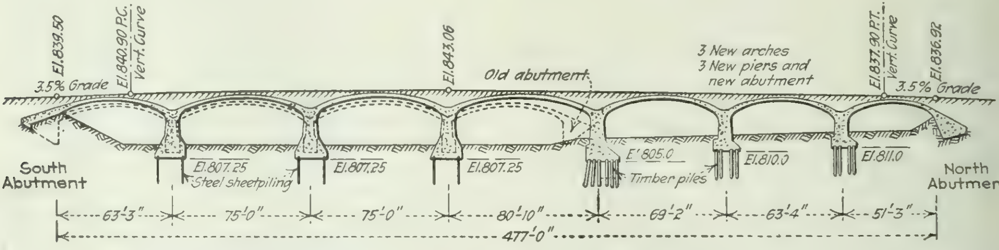


FIG. 1—SECTION OF RECONSTRUCTED ADAMS ST. BRIDGE OVER MIAMI RIVER AT TROY, OHIO
Dotted lines show the original position and size of piers, abutments and arches.

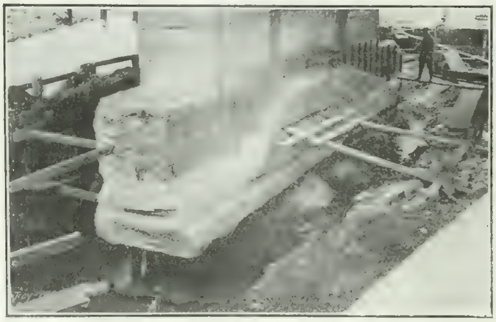


FIG. 2—STRENGTHENING OLD PIER FOOTINGS

The reconstruction of the bridge, as described in a recent issue of the Miami Conservancy *Bulletin*, presented an interesting problem.

Reconstruction Procedure—Ordinarily, wrecking an old structure of this sort would be considered first. The District, because of the size of the possible wrecking job and its expense, decided it would be cheaper to underpin and reinforce the old piers and use them to carry the new bridge and to use the old arches to carry the falsework for the new and to add extra arches at one end, rather than to build an entirely new bridge.

Some definite advantages in using the old structure as a basis for the new were recognized. Danger from floods washing out timber falsework was eliminated and less timber and labor expense would be required for formwork. Then, no additional right-of-way was required to be purchased. Considerable saving in the volume of concrete was effected. The principal difficulties were found in underpinning and reinforcing the old piers and in venturing upon a plan without any precedents upon which to base procedure methods.

Enlargement of Footings—The first job in reconstructing the old bridge was the enlargement and deepening of footings. The rebuilt footings are almost twice as wide as the old ones and extend about 3 ft. deeper into the river bed. Cofferdams of earth were thrown up around the piers, the water was pumped out, and the material around the footings excavated by hand.

Taking one-fourth of the length of the old footing at a time, excavation was carried 3 to 4 ft. below the bottom of the old footings and then underneath. During the baring of the pier foundations the discovery was made that some of the foundation piles extended only 3 or 4 ft. below the concrete. Steel sheetpiling 15 ft. long was driven 1 ft. inside of the line of the new footing, projecting up 1 ft. into the footing. Concrete was packed into the space underneath the old footing and around the old piles, out past the line of the sheetpiling. When the concrete was set the next section was dug out and the operation repeated. No measurable settlement was noted at the end of this work.

When the underpinning was completed holes were drilled through the old piers and tie rods placed through them. Then a jacket of concrete was placed entirely around the old piers, the network of steel in the jacket being held in place by the tie rods.

Spandrel walls, sidewalks, fill and paving, being a considerable part of the dead-load on the old bridge, were removed before much work was done in order that as little load as possible would be on the piers while they were being enlarged. It was necessary to remove these carefully and to unload all arches simultaneously and uniformly; otherwise, unbalanced forces might have pushed over one of the piers. Most of the work was done by hand. Small shots of dynamite were used in breaking up concrete wherever possible in order to lighten the handwork.

The reconstruction work on the piers and the south abutment did not turn out to be as difficult as was anticipated. Difficulty of driving sheetpiling in the restricted space under the bridge was overcome by the use of a small compact steam hammer. Since the north abutment had to be replaced by a new pier immediately north of it, reconstruction there was complicated. As the excavation for the new pier removed the earth support from behind the old abutment, some means of supplying a temporary support until the old bridge was taken down was necessary. This part of the work is indicated by Fig. 5. Heavy timbers wedged against concrete footings were placed in line with the direction of the force against the abutment and braced to prevent buckling. The pressure from this support was developed by the use of jacks and heavy timber wedges. Then the excavating was done and when the pier was poured the concrete was boxed around the timber. The holes so left were filled in after the completion of the bridge and permitted the removal of the braces for the old abutment.

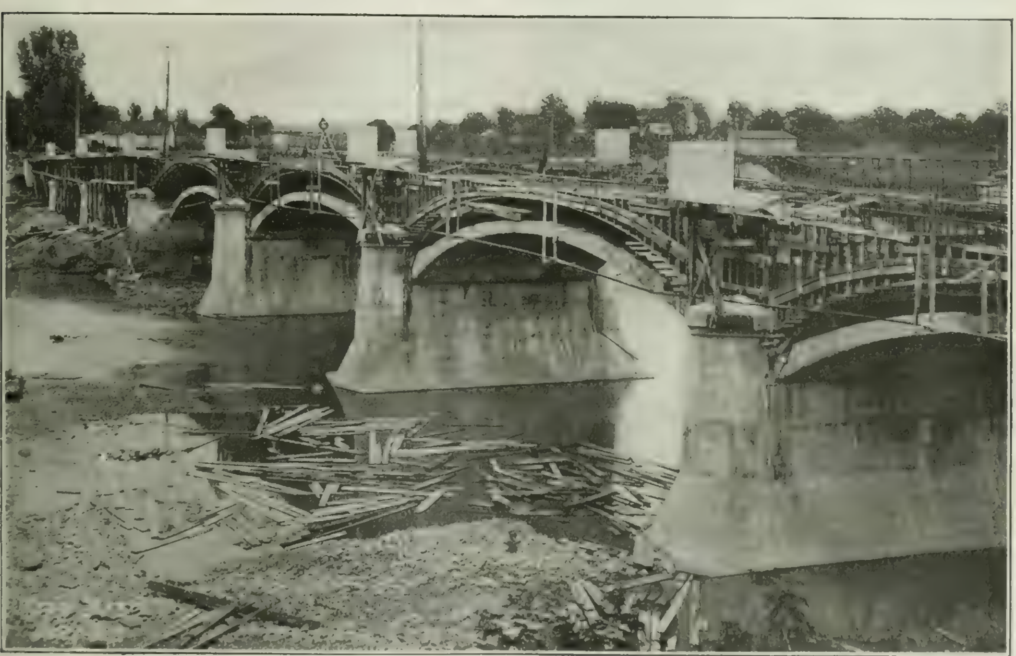


FIG. 3—FORMS FOR NEW ARCH RINGS IN PLACE

Placing New Arches—When the piers had been reconstructed and all the upper part of the old bridge, except the arches, was removed, the forms for the new arches were built on top of the old bridge. The only difference from the forms ordinarily used on such work was in the posts, for instead of long bents resting on piles or sills in the river bed the posts were short and rested on top of the old concrete arches, leaving the waterway unobstructed. As the posts carrying the arch forms for the new spans on the north end rested on the ground, these arches could be poured in the usual way. However, on the part of the new bridge that rested on the old a different method was necessary. It was calculated that pouring each new arch complete would have caused an unbalanced loading on the piers that might have been dangerous. So each new arch was poured in three longitudinal sections, one section being poured on all of the arches and then another and finally the third. By proceeding in this manner the unbalanced thrust on the piers did not exceed a safe figure. A difficult part of the reconstruction was the removal of the old arches after the new arch rings had set. This was done in the following manner:

Underneath the bridge a trench was dug deep enough so that the old concrete falling into it would all be below the grade of the improved channel. Then 1-in. holes were drilled through the old arches 7 ft. apart longitudinally and 3 ft. apart laterally, and corresponding holes were cast into the new arches above. Due to the same difficulty about having too large an unbalanced thrust on the piers, the old arches had either to come down all at once or else be removed uniformly. The practical difficulty of so managing affairs that all of the arches would let go and fall at the same time was so great that this method was not seriously considered.

Demolition of Old Arches—The piecemeal method of demolition was therefore decided upon. The holes mentioned were so arranged that bolts could be run through them, taking up a bit in the lower arches, suspended from the upper ones in case that, during operations, the old arches showed any signs of failure. Scaffolding was then suspended from the upper arches by means of rods run through the holes mentioned, through the new arch rings, and workmen with jap drills and sledges and small charges of dynamite began taking out little bites from all of the arches working in about the same rate on each.

The network of reinforcing steel held the old concrete together very well and the steady nibbling reduced each arch to a very narrow rib without any necessity arising of suspending any of the old structure from the new arch ring.

As soon as the wrecking operations were completed, the new spandrel walls and sidewalks were poured. Sidewalks are cantilevered out without brackets.

Redesign Considerations—Considerable study was required in the design of the new bridge because of the limiting conditions of street approaches and the necessity of conforming to the span lengths of the old bridge arches. The length of the spans of the old bridge governed the length of the three comparatively short spans that were added at the north end as the principle was approximated of having the center span the longest and having the spans decrease somewhat uniformly toward either end. The deep water channel through Troy follows the old river channel and runs under the old bridge. The entire bridge is designed to carry a concentrated live-load of one 20-ton truck with 14 tons on the rear wheels and 6 tons on the front wheels. The sidewalks are designed to carry a live-load of 100 lb. per square foot. The materials will receive a maximum stress under total dead and live-loads of 500 lb. per square inch for the concrete and 14,000 for the steel. These stresses are considered about one-fourth of those which would break the materials. A variation of 80 deg. in temperature was considered a maximum.

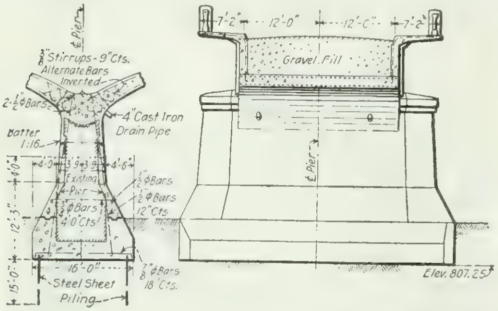


FIG. 4—ELEVATION AND SECTION OF REINFORCED PIER

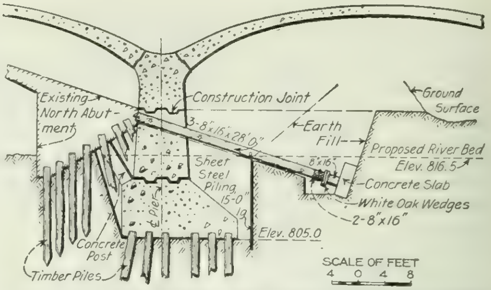


FIG. 5—OLD ABUTMENT TEMPORARILY STRENGTHENED TO TAKE ARCH THRUST DURING RECONSTRUCTION

In designing the forms, care was taken to reduce the number of vertical joints to the minimum. The posts supporting the form work for the three northerly spans rested on sills embedded in concrete. Pins set to record the settlement of the arches showed a maximum settlement of one-fourth inch in the four arches built over the old bridge, and a maximum of five-eighths inch in the three northerly arches, readings on these being taken before the concrete was placed and after the forms were removed.

The article in the *Bulletin* from which the material herein was taken was written by C. N. Phillips, office engineer. Charles H. Paul is chief engineer of the district.

Grade Crossing Protection in Illinois

New rules for the construction and protection of highway grade crossings, issued by the Illinois Commerce Commission, provide that railways must reconstruct crossings so as to make the plank or other paving level with the tops of the rails over the entire distance between points 16 in. beyond the outside rails. The width of paving is to be not less than 18 ft., or 30 ft. for hard roads. If the graded or traveled width exceeds 18 ft. the paving must be for the full width. Road approaches to new crossings must be built by the railway with grades not exceeding 1 per cent for the first 25 ft. from outside rails and thence not exceeding 3 per cent within the right-of-way lines, the width of approach to be that of the traveled or graded part of the highway and not less than 18 ft. Clearing of brush and trees at crossings is to be done by the railway for 500 ft. on each side of the crossing and by the highway commissioners for 300 ft. along the road. Where gates are installed, they must be maintained and operated for each 24-hour period, except that when it is certain there will be no traffic for at least six hours the gates may be left without an attendant for such period. Warning signs are to be set by the railway on both sides of crossings outside of incorporated cities and villages, with stop signs at crossings designated as extra-hazardous.

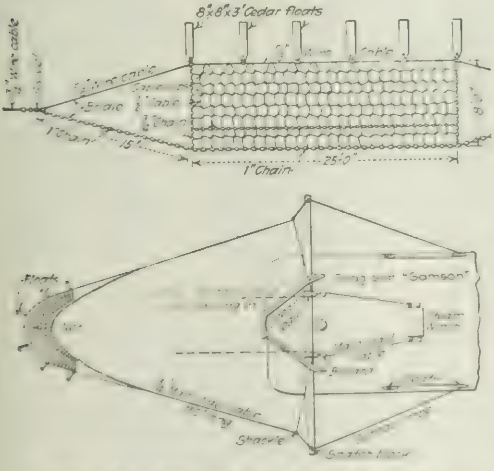
Cable Net Used to Clear Boulders From Harbor Entrance

Boulders Up to 6 Ft. in Diameter Removed From Ship Channel at Vancouver, B. C., at Cost Much Less Than Plan Requiring Diver

By C. C. Worsfold
District Engineer, Department of Public Works, Canada
New Westminster, B. C.

THE entrance to Vancouver Harbor, B. C., has been dredged to a depth of 35 ft. at low tide, and widened to 900 ft. on the 35-ft. contour at the narrowest point. On sweeping the channel after the dredging was completed to ascertain if any high spots remained, numerous loose boulders were found of sizes ranging up to 5 or 6 ft. in diameter. After removing some of these with the aid of a diver, a very much quicker and less expensive means was devised for using a net made of wire cable and operated from one of the snag boats of the Dominion Government dredging fleet.

Difficulties of the work as at first undertaken were that the heavy current in the narrows, which is sometimes as much as seven knots per hour, made operations with a diver slow and expensive. It was possible for a diver to work only at slack water periods or when there was but little variation in the tides. The most favorable tides occurred only two or three days each month and there was not more than one hour at each of these tides during which he could work under water. In ordinary tides the duration of slack water is only a few minutes. Under these conditions the removal of two or three boulders per day was the best that could be done even under favorable circumstances.

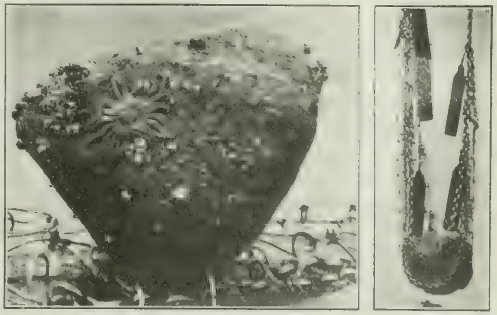


DETAILS OF NET AND PLAN OF DRAGGING [illegible]

After a total of sixteen working days with a diver, in the course of which nineteen boulders were removed, it was figured that the cost for dredging, crew, equipment, diver and all incidentals totaled $2,000, or $105 per boulder. Endeavor was then made to find a better method of carrying on the work and the idea of a drag net was developed.

The drag net, made of ½-in. galvanized wire cable, and shown in the accompanying illustrations, is 25 ft. long by 8 ft. wide, the cable being clipped together to give a 1-ft. mesh. The chain at the bottom gives weight to the lower edge and like the chains at the ends affords a convenient means of edging off the net as the cable is woven into the chain links. A ⅜-in. cable was used for the top to keep the top as light as possible.

The top cable and the bottom chain are continued beyond the ends of the net to form a bridle ending in a swivel 15 ft. from the net proper. From this swivel there is 150 ft. of ¾-in. cable running to the winch on the snag boat with which the net is dragged along the bottom.



BOULDER LANDED BY MEANS OF SHEAR LEG TACKLE

Boulders up to 16 tons in weight with dimensions ranging up to 6x6x8 ft. have been taken aboard this way. The size of the one shown above is 4x4x3 ft.

When a "catch" is made, out-haul lines are cast off and as the bridle comes to the surface the net becomes a sling; the shear legs then take the load and swing it in on deck.

Six floats made of dry cedar, 8 x 8-in. in section and 3 ft. long, give a buoyancy of 300 lb. in all and are fastened at equal distances along the cable at the top of the net. This is the amount of flotation calculated to hold the upper 6 ft. of the net in a more or less vertical position while still allowing the 2-ft. section between the chains at the lower edge to lie flat on the bottom so that when a boulder is encountered the whole of the net will not drag under it, the top being brought forward by the ⅜-in. wire rope which has the same length as the bottom 1-in. cable. Between the top cable held up by the floats and the chains at the lower edge a bag or sling is formed which serves to catch and retain the boulders.

The dragging is done by propelling the snag boat either up channel or down, with a fixed length of main-haul cable paid out and held well out toward the end of the outriggers by tension in the outhaul cables.

Men stationed on the outriggers can tell by the tension on the lines when a boulder has been caught. With a boulder in the net the boat is stopped and the outhaul lines are let go. The two main-haul lines from the net are then thrown over the bow and the net is hauled up by the winch until the swivels are on deck. The main tackles in the shear legs can then be hooked into the swivel ring and the net raised from the bottom and swung in on the deck. After several boulders have been taken aboard, the boat is run to the dumping ground and the boulders put overboard.

The largest boulder brought up weighed 16 tons and its diameters was approximately 6 x 8 x 6 ft. The sizes ranged from this all the way down to the smallest that the mesh of the net would retain. The greatest number brought up at one lift was ten, which varied in size from 1 ft. up to 3 ft. in diameter. As many as thirty boulders have been brought up in one day and of course there were many drags in which no boulders were caught.

In preparation for the work of boulder removal, the channel bottom was surveyed and the location of the boulders charted. The best practical means of marking the location in the channel, as a guide for the work of the snag boat, was by means of range flags on shore. As no range flags up and down the channel could be placed, it was, at best, difficult to drag any exact spot that could be indicated only by cross channel ranges, particularly when the current was swift.

However, 526 boulders were removed with the net in about 25 working days. The total cost of the operation was $221 for materials for the net and $100 time for the crew of the snag boat while making up the net, plus the $100 per day snag boat charge for the 25 working days. This totaled $2 821 in all, or $5.20 per boulder, which is about one-twentieth the cost per boulder by the method that required the diver.

The net was devised by the writer, who acknowledges as factors in its successful construction and operation the co-operation of Captain R. C. Menten of the snag boat "Samson" and K. W. Morton, the writer's assistant engineer who worked out the details of design.

Economic Study of Trucks for Road Construction

Light and Heavy Trucks Compared on Ton-Mile Basis-Costs and Plant Investment—Eight Speed Rates Considered

Condensed from a paper read at the annual convention, Jan. 16-19, 1923, of the American Road Builders Association by A. E. Horst, Henry W. Horst Co., Rock Island, Ill.

IN determining the economical truck equipment to employ in hauling road materials the following conditions have to be regarded:

General Conditions:

1. Distance materials are to be hauled.
2. Will the road support the wear and tear of heavy traffic?
3. Time lapse before getting onto subgrade after a rain.
4. Investment allowed in estimate for hauling equipment.

Investment:

1. Comparative original costs.
2. Comparative depreciation.
3. Comparative investment in proportion to load-per-day carried.

Operation and Maintenance:

1. (a) Ease of securing drivers. (b) Rate of pay.
2. (a) Ease of securing experienced mechanics. (b) Rate of pay.
3. (a) Ease of securing mechanical parts and comparative costs. (b) Will stocking of parts be necessary? (c) Likelihood of delay in waiting for parts.
4. Cost of tires.
5. Life of tires.
6. Comparative consumption of gasoline and oil.
7. Comparative cost of maintenance of road for various type of trucks.

To what extent does each affect the cost of transportation. In order to avoid generalities and arrive at some definite conclusions, let us assume the following:

TABLE—COMPARATIVE TRUCK COSTS AND PERFORMANCE BASED ON WEIGHTS AND SPEEDS

Miles a day	50			60			70		
1. Working days a year	150			150			150		
2 Miles per year	7,500			9,000			10,500		
3. Average mile haul	1.5			1.5			1.5		
4. Trips per day	17			20			23		
	No. 1	No. 2	No. 3	No. 1	No. 2	No. 3	No. 1	No. 2	No. 3
5. Tons hauled each trip	1.6	3.2	6.4	1.6	3.2	6.4	1.6	3.2	6.4
6. Ton miles per day	41	82	164	48	96	192	55	110	220
7. Investment per unit	1,000	4,000	5,000	1,000	4,000	5,000	1,000	4,000	5,000
8. Charge off per year	700	1,793	1,844	700	1,793	1,844	700	1,793	1,844
9. T. M. hauled each year	6,160	12,300	24,600	7,200	14,400	28,800	8,250	16,500	3,300
10. Fixed cost per T.M.	11.4	13.5	7.4	9.7	12.4	6.4	8.5	10.9	5.6
11. Driver cost per 150 days	525	525	525	525	525	525	525	525	525
12. Driver cost per T.M.	8.5	4.3	2.1	7.3	3.6	1.8	6.4	3.2	1.6
12a. Driver plus fixed cost per T.M.	19.9	17.8	9.5	17.0	16.0	8.2	14.9	14.1	7.2
13. Gas, oil, tires, repairs per mile	6.5	14.0	17.2	6.5	14.0	17.2	6.5	14.0	17.2
14. Gas, oil, tires, repairs T.M.	7.9	8.5	5.2	8.1	8.4	5.4	8.3	8.9	5.5
14a. Driver, plus gas, etc. T. M.	6.4	12.8	7.3	15.4	12.0	7.2	14.7	12.1	7.1
15. Total cost T.M.	27.8	26.3	14.7	25.1	24.4	13.6	23.3	23.0	12.7
16. Theoretical trucks needed 435 T.M. per day	10.6	5.3	2.7	9.0	4.5	2.3	7.9	3.9	1.9
17. Actual trucks needed	11	6	3	9	5	3	8	4	2
18. Investment in fleet	11,000	24,000	15,000	9,000	20,000	15,000	8,000	16,000	10,000
Six Miles Work									
19. Fixed cost	3,900	4,700	2,600	3,300	4,300	2,200	2,900	3,800	1,900
20. Gas, oil, etc.	5,700	4,400	2,500	5,300	4,100	2,500	5,100	4,200	2,400
21. Total cost	9,600	9,100	5,100	8,800	8,400	4,700	8,000	8,000	4,300
22. Remaining investment	7,100	19,300	12,400	5,700	15,700	12,800	5,100	12,200	8,100
Twelve Miles Work									
23. Fixed cost	7,800	9,400	5,200	6,600	8,600	4,400	5,800	7,600	3,800
24. Gas, oil, etc	11,400	8,800	5,000	10,600	8,200	5,000	10,200	8,400	4,800
25. Total cost	19,200	18,200	10,200	17,200	16,800	9,400	16,000	16,000	8,600
26. Remaining investment	3,200	14,600	9,800	2,300	11,400	10,600	2,200	8,400	6,200

Miles a day	80			90			100		
1. Working days a year	150			150			150		
2 Miles per year	12,000			13,500			15,000		
3. Average mile haul	1.5			1.5			1.5		
4. Trips per day	27			30			33		
	No. 1	No. 2	No. 3	No. 1	No. 2	No. 3	No. 1	No. 2	No. 3
5. Tons hauled each trip	1.6	3.2	6.4	1.6	3.2	6.4	1.6	3.2	6.4
6. Ton miles per day	65	129	260	72	144	288	80	160	320
7. Investment per unit	1,000	4,000	5,000	1,000	4,000	5,000	1,000	4,000	5,000
8. Charge off per year	700	1,793	1,844	700	1,793	1,844	700	1,793	1,844
9. T. M. hauled each year	9,750	19,400	39,000	10,800	21,600	43,200	12,000	24,000	48,000
10. Fixed cost per T.M.	7.2	9.2	4.7	6.5	8.3	4.3	5.8	7.5	3.8
11. Driver cost per 150 days	525	525	525	525	525	525	525	525	525
12. Driver cost per T.M.	5.4	2.7	1.3	4.9	2.4	1.2	4.4	2.2	1.1
12a. Driver plus fixed cost per T.M.	12.6	11.9	6.0	11.4	10.7	5.5	10.2	9.7	4.9
13. Gas, oil, tires, repairs per mile	6.5	14.0	17.2	6.5	14.0	17.2	6.5	14.0	17.2
14. Gas, oil, tires, repairs T.M.	8.0	8.7	5.3	8.1	8.7	5.4	8.1	8.7	5.4
14a. Driver, plus gas, etc. T. M.	13.4	11.4	6.6	13.0	11.1	6.6	12.5	10.9	6.5
15. Total cost T.M.	20.6	20.6	11.3	19.5	19.4	10.9	18.3	18.4	10.3
16. Theoretical trucks needed 435 T.M. per day	6.7	3.4	1.7	6.0	3.1	1.5	5.5	2.7	1.3
17. Actual trucks needed	7	4	2	6	4	2	6	3	2
18. Investment in fleet	7,000	16,000	10,000	6,000	16,000	10,000	6,000	12,000	10,000
Six Miles Work									
19. Fixed cost	2,500	3,200	1,600	2,200	2,900	1,500	2,000	2,600	1,300
20. Gas, oil, etc.	4,600	3,900	2,300	4,500	3,800	2,300	4,300	3,800	2,300
21. Total cost	7,100	7,100	3,900	6,700	6,700	3,800	6,300	6,400	3,600
22. Remaining investment	4,500	12,800	8,400	3,800	13,100	8,500	4,000	9,400	8,700
Twelve Miles Work									
23. Fixed cost	5,000	6,400	3,200	4,400	5,800	3,000	4,000	5,200	2,600
24. Gas, oil, etc	9,200	7,800	4,600	9,000	7,600	4,600	8,600	7,600	4,600
25. Total cost	14,200	16,200	7,800	13,400	13,400	7,600	12,600	12,800	7,200
26. Remaining investment	2,000	9,600	6,800	1,200	10,200	7,000	2,000	7,800	7,400

Miles a day	110			120		
1. Working days a year	150			150		
2 Miles per year	16,500			18,000		
3. Average mile haul	1.5			1.5		
4. Trips per day	37			40		
	No. 1	No. 2	No. 3	No. 1	No. 2	No. 3
5. Tons hauled each trip	1.6	3.2	6.4	1.6	3.2	6.4
6. Ton miles per day	89	178	356	96	192	384
7. Investment per unit	1,000	4,000	5,000	1,000	4,000	5,000
8. Charge off per year	700	1,793	1,844	700	1,793	1,844
9. T. M. hauled each year	13,300	26,800	53,400	14,400	28,900	57,600
10. Fixed cost per T.M.	5.3	6.7	3.5	4.9	6.0	3.2
11. Driver cost per 150 days	525	525	525	525	525	525
12. Driver cost per T.M.	3.9	2.0	1.0	3.6	1.8	.9
12a. Driver plus fixed cost per T.M.	9.2	8.7	4.5	8.5	7.8	4.1
13. Gas, oil, tires, repairs per mile	6.5	14.0	17.2	6.5	14.0	17.2
14. Gas, oil, tires, repairs T.M.	8.1	8.6	5.4	8.1	8.8	5.4
14a. Driver, plus gas, etc. T. M.	12.0	10.6	6.4	11.7	10.6	6.3
15. Total cost T.M.	17.3	17.3	9.9	16.6	16.6	9.5
16. Theoretical trucks needed 435 T.M. per day	4.9	2.4	1.2	4.5	2.3	1.1
17. Actual trucks needed	5	3	2	5	3	2
18. Investment in fleet	5,000	12,000	10,000	5,000	12,000	10,000
Six Miles Work						
19. Fixed cost	1,800	2,300	1,200	1,700	2,100	1,100
20. Gas, oil, etc.	4,100	3,700	2,200	4,000	3,700	2,200
21. Total cost	5,900	6,000	3,400	5,700	5,800	3,300
22. Remaining investment	3,200	9,700	8,800	3,300	9,900	8,900
Twelve Miles Work						
23. Fixed cost	3,600	4,600	2,400	3,400	4,200	2,200
24. Gas, oil, etc	8,200	7,400	4,400	8,000	7,400	4,400
25. Total cost	11,800	12,000	6,800	11,400	11,600	6,600
26. Remaining investment	1,400	7,400	7,600	1,600	8,800	7,800

1. Grades not to exceed 4 per cent and road conditions similar to those found in the states of Indiana, Illinois, Iowa and Michigan.
2. Material hauled in proportioned batches to the mixer and not dumped on the sub-grade.
3. The use of a turntable to turn trucks at the mixer.
4. Gasoline at 25c. a gallon.
5. Lubricating oil at 60c. a gallon.
6. A 10-hour working day.
7. 150 working days per year.
8. 800 sq.yd. of pavement 7½ in. thick laid per day.

With these assumptions in the background, let us classify trucks of 2-ton capacity and less as light trucks. Let us depreciate them over 2 years of 150 workings days each, thus making the average yearly expenditure on a truck one-half of its original cost (one-half of $1,000) plus yearly expense of say $200 or a total of $700. This class of trucks is designated as Type 1.

Similarly, for sake of comparison, let us classify trucks of 2-ton to 3½-ton capacity as medium trucks, depreciated over 3 years with average yearly expenditure of $1,793. These will be designated as Type 2, while all trucks of over 3½-ton capacity will be classified as heavy trucks, depreciated over 4 years with average yearly expenditure of $1,844. These trucks will be designated as Type 3.

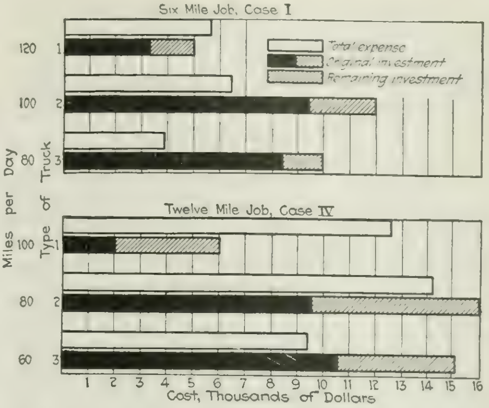


FIG. 2—INVESTMENT COSTS IN THREE SIZES OF TRUCKS

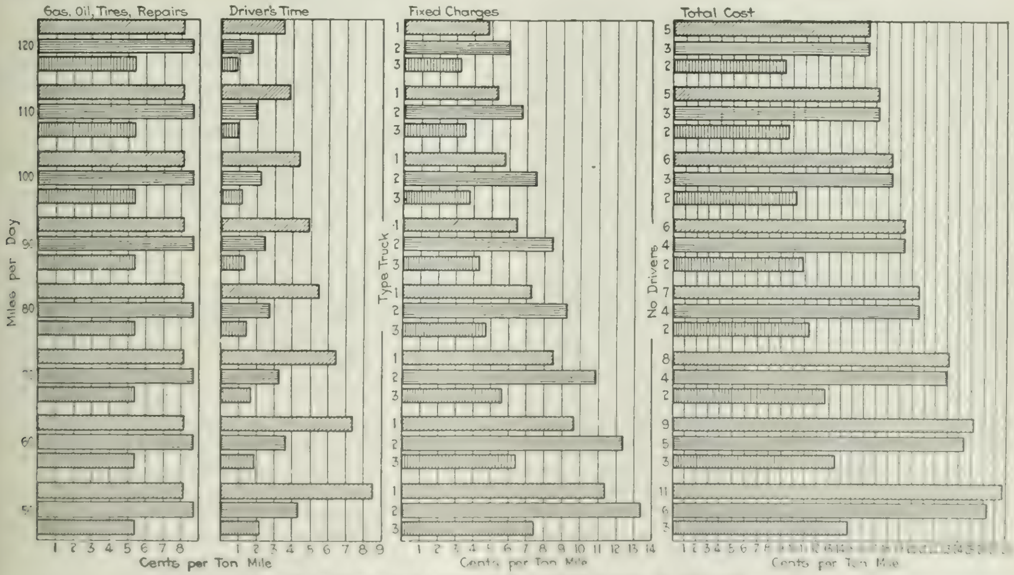


FIG. 1—TON-MILE COSTS FOR THREE SIZES OF TRUCKS

The table gives a cost, performance and investment comparison of the three types of trucks at speeds from 50 to 120 miles per day. Fig. 1 shows graphically the ton-mile costs given in the table for each truck for each speed. Using the same figures, Fig. 2 shows the comparative total operating cost, original investment and remaining investment on the three types of truck, first, on the completion of a 6-mile job operating 120, 100 and 60 miles a day and, second, on the completion of a 12-mile job operating 100, 80 and 60 miles a day.

In view of these tabulations and charts and the apparent economy of Type 3 consider the following:

1. Can we afford to have but 3 trucks for handling 12 miles of work? Suppose one truck breaks down, we operate but 66⅔ per cent efficient whereas with one of six light trucks out of commission we operate 84 per cent efficient.

2. Can we afford to take chances with heavy loads on highways which are being paved because they cannot take care of the present ordinary traffic?

3. Can we afford to put one additional man every one-half mile on our sub-grade over and above those required to keep the grade in shape for light trucks? (This additional expense alone amounts to over $1,600 on a 12-mile job).

4. Compare a jerky operation with 3 trucks of 4 batches each with the more continuous operation of 6 light one-batch units.

5. Compare the investment of $15,000 in a fleet of 3 large trucks for 12 miles of work after which we still have $10,600 tied up in 3 units, with an investment of $6,000 in 6 lighter trucks and, after 12 miles of work, but $2,000 tied up in 6 units.

Each type of truck has its place in the transportation problems of the highway contractor. It is only possible, however, to secure the best and most economical equipment for each job through an intelligent analysis of all factors involved in the operation of the truck. In other words, let us make an accurate analysis of the ton-mile cost.

Terrazzo Floor for Industrial Shoe Factory Building

Tests Determine Best Type for Use Under Severe Traffic Conditions—Satisfactory After Nineteen Months

By H. S. Wright
Portland Cement Association, Boston, Mass.

TERRAZZO floors have long been used in corridors and other public spaces of public and semi-public buildings, but the advantages of this material for floors of industrial plants are not so well appreciated. Approximately 210,000 sq.ft. of terrazzo floor was laid at the shoe manufacturing plant of Hilliard & Merrill, Inc., of Lynn, Mass. Recent inspection after 19 months of severe trucking showed the floors to be in better shape than when first laid. Mr. Nichols, the plant engineer, outlined the method of construction which was carried out by the William M. Bailey Co., Boston.

The rough slab was first picked, swept clean and washed with clean water. After a thorough cleaning, the floor was again wet down and a 1:1 cement-sand grout was brushed into all holes in the floor, bringing the rough slab approximately to an even grade. One-inch round steel reinforcing bars were used as screeds. These bars were set to a level on the rough slab and just before the grout had set, a 1:2 mixture of cement and trap rock was dumped on the floor and screeded off with a straight edge. The mixture was as dry as it was possible to make it and still dump it out of a mixer.

Following this operation and just before the time when the topping material was stiffening up, an even coating of graded trap rock was spread over the entire top to a depth of perhaps ½ or ¾ in. After the topping material had stiffened the dry trap rock was rolled into the surface with a 150-lb. roller made of the same material as the top mix. This roller was operated longitudinally and laterally until the entire area under construction had been rolled. The floor was then rolled with a 900-lb. roller which required two men to operate, and last of all with an 1,800-lb. roller rolling not only laterally and longitudinally but also diagonally. This last roller brought up some water and fine material to the surface. As soon as possible after rolling the floor was given by hand a steel trowelling to smooth out any of the stone that had been up-ended by the rolling processes. Twelve men on the trowelling operation were able to finish about 15,000 sq.ft. of floor in two hours.

As a final operation the floor was surfaced with ordinary grinding machines, with small carborundum blocks and coarse powdered emery. A copious supply of water was necessary in order to make the grinders operate satisfactorily. The grinding operation was started from four to seven days after the topping had been placed. The finished top was 1 in. thick.

The trap rock aggregate was evenly graded from material passing a ⅛-in. ring up to material passing a ¾-in. ring. It was remarkably free from dust owing to the fact that the companies who supplied the stone carried on their operations under cover. The stone was dry when it arrived at the job.

The entire operation from picking the rough slab to turning over the finished floor cost 16 cents per square foot with finishers at $1.10 per hour and concrete laborers at 75 cents. This cost includes plant charges, power and all overhead.

In order to ascertain the best type of floor to be used under the severe traffic conditions, Mr. Nichols devised a machine consisting of a central vertical shaft driven by a worm gear and motor having attached to the shaft a spider consisting of four arms, each one in turn having at its extremity a box running on a single two-wheel truck, the wheels being of steel 5 in. in diameter by 1¼ in. face. The machine revolved fifteen times a minute. The total loading in the four boxes was about one ton. Granolithic floor of the best approved type without treatment was destroyed in about 5 minutes. Several sections of granolithic treated with surface hardeners lasted a few minutes longer. The type of floor which is described above withstood 30 hours of continuous wear test without appreciable wear. The tests were carried no further, as it was obvious that this type of floor would give better service than any other known type.

The building is occupied by a large shoe manufacturing plant. The heaviest wear on the floor comes at three points, the first where trucks carrying sole leather are in continuous operation during the entire working period over a trucking aisle about 15 ft. wide and 100 ft. long; the second at elevator doors where heavily-loaded trucks, both of the box and stevedore variety, are pushed off the elevators over metal thresholds upon the floor; and the third, and perhaps worst, where tacks dropped from lasting machines are being continuously ground into the floor surface by loaded trucks and the feet of workmen. In none of these places does there appear to be any serious amount of wear and in no case is there any ravelling of the floor. None of the floor finish has broken loose from the sub-floor.

Mr. Nichols states that the best quality maple mill floor lasts only one to one and one-half years under their type of operation. Another noteworthy item is that the floor after grinding is so smooth that trucks do not have the usual heavy rumble in riding over it, yet there is sufficient roughness so that the floor is not dangerous to workmen in leather shoes.

In one section of the factory where a great deal of wax is used, the floor has become as slippery as glass. In the office section, the floor was treated with one of Toch Brothers' compounds, giving it the color of battleship linoleum, a most pleasing appearance.

State Drainage Survey of Indiana

A complete survey of drainage conditions and drainage projects in Indiana is being made by the division of engineering of the State Department of Conservation. Inquiries have been sent to all county drainage commissioners for information as to the officers, areas and outlet streams of projects in their respective counties, together with the names of engineers and contractors. In addition, representatives of the Division of Engineering are visiting all county seats to inspect court and surveyors' records. From these records they plot on county maps the boundaries of the drainage districts and make notes of land values, assessment, cost of construction and the adequacy of the several projects. Codification and revision of the tangled drainage laws is now being made by a commission appointed at the last session of the Indiana legislature, and this commission is working in co-operation with the Division of Engineering.

Shrinkage and Temperature Changes In Reinforced Concrete

A Preliminary Study Based on Some Strain-Gage Observations Made on a Reinforced-Concrete Bridge at Fairmont, W. Va.

By E. H. Harder
Concrete-Steel Engineering Co., New York City

In an article describing the Monongahela River Bridge in Fairmont, W. Va. (*Engineering News-Record*, Sept. 22, 1921, p. 472), the writer briefly mentioned that extensive strain-gage measurements had been made at the crown and haunches of two of the large arches. At the time that article was written the results of these measurements were not available, but the writer did hint that the steel stresses were higher than usually computed. It is not the purpose of the present article to discuss these tests in detail because the results are still indeterminate, largely because of lack of knowledge of the action and effect of shrinkage together with the action and effect of two materials in combination expanding and concentrating according to different coefficients of expansion. The writer merely wishes to present several carefully computed examples taken from the mass of data accumulated and to draw the necessary inferences from these to stimulate research work dealing not only with the secondary stresses of reinforced-concrete structures but also the primary stresses due to shrinkage and temperature changes.

While this article deals mainly with shrinkage of the concrete, it is necessary to inject temperature changes into the discussion because both produce internal stresses in reinforced concrete which are closely related.

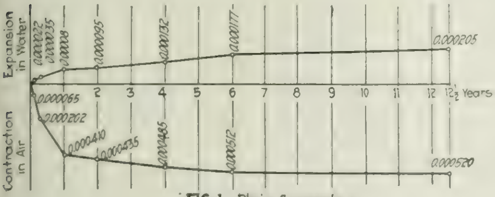


FIG. 1 Plain Concrete

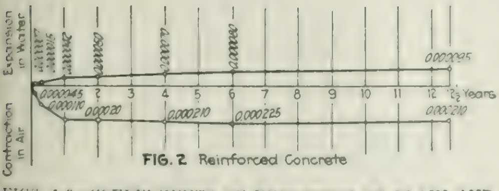


FIG. 2 Reinforced Concrete

FIGS 1-2—COEFFICIENTS OF EXPANSION OF PLAIN AND REINFORCED CONCRETE PRISMS

From tests made by Graf and Bach. Fig. 1 (above) on plain prisms; Fig. 2 (below) on reinforced prisms.

Without going into detail regarding the actual strain-gage measurements, it is necessary briefly to acquaint the reader with the *modus operandi*. Several bars at the extrados were exposed sufficiently to permit the introduction of the points of a 20-in. Berry strain gage into gage holes drilled into these bars. The two outside bars at the intrados were also exposed. Across each face of the arch at the crown as well as over the top, concrete gage lines were established by inserting two brass plugs about 5 in. long and 20 in. apart. Figs. 4 to 7 give the vertical spacing of these gage lines on the arch faces. Readings were taken in the usual manner and compared with readings on a standard bar of steel. A mercury thermometer gave the temperature of the standard bar while mercury and electric resistance thermometers gave the temperature of the concrete. At the haunches, similar arrangements were made to obtain the deformations occurring at these points.

The coefficient of expansion of the steel standard was not measured, but the usual figure 0.0000065 was used throughout. At first we attempted to reduce the strain-age readings for concrete by assuming the same coefficient of expansion but it was soon discovered that 0.0000055 gave results for concrete more nearly comparable with calculated results. It is doubtful if this coefficient is the correct one for green concrete and the writer feels the need of better information regarding the variation of the coefficient with time. Such data would have little bearing on design work but in attempting to interpret the strain-gage readings in question, such a curve would have been invaluable.

FIG. 3—NON-UNIFORM SHRINKAGE

Primary and Secondary Shrinkage Effects—When these tests were planned, it was our desire to check the theory of arches so far as thermal changes were concerned. Others had checked the theory so far as external forces influence the stresses, but the field of temperature stresses was practically unexplored. While we realize the importance of shrinkage we felt that we could obtain the secondary stress effect of shrinkage closely enough by carefully measuring the crown deflections, but in this connection, we did not clearly realize at the start of the tests that shrinkage would be manifested in still another way. Therefore, for the purpose of discussion, the writer has divided the effects of shrinkage into a primary effect and a secondary effect. By secondary effect is meant that stress developed at any section of a monolithic structure due to deformations which in turn are caused by shrinkage. By primary effect is meant that stress produced in the steel as well as the concrete by virtue of the fact that the latter shrinks or expands while the former possesses no such properties.

The primary stress effect of shrinkage of a bar of plain concrete resting on the laboratory table and hardening in air would not be measurable by means of the strain gage. This instrument would merely record a change of length which could only occur by some internal rearrangement of the various particles of the concrete, thereby causing local and internal stress. It is not the writer's purpose even to attempt a discussion of these stresses, since their nature is speculative and perhaps structurally unimportant. If our bar of concrete is reinforced by the introduction of a steel rod, we are enabled by means of the strain gage to record the changes of length in both the concrete and the steel. As the concrete contracts or shrinks, the steel rod is put into compression, while at the same time the concrete is put in tension due to the fact that the steel prevents a free shrinkage of the concrete. These stresses are herein termed primary stresses due to shrinkage.

Mathematically, this compressive stress in the steel may be written:

$$f_s = \frac{1}{1 + np} E_s . \epsilon$$

and the tension in the concrete

$$f_c = \frac{p}{1 + np} E_s . \epsilon = p . f_s$$

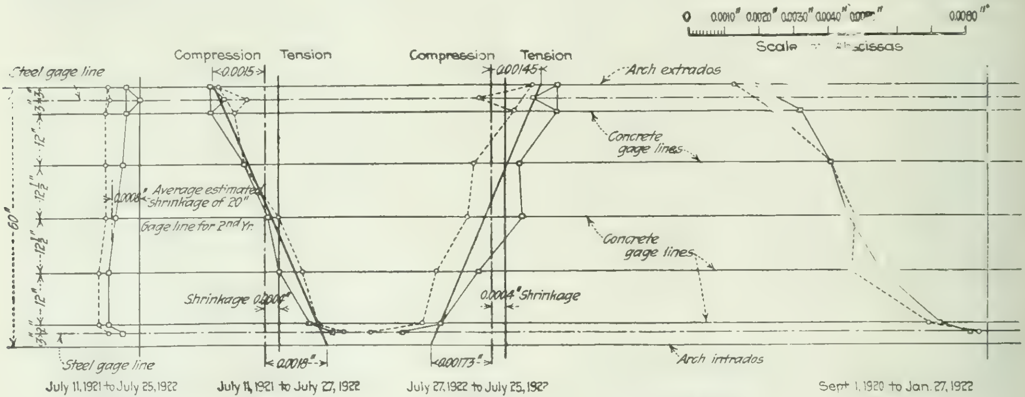
where n = ratio of moduli of elasticity of steel to concrete;

P = ratio of steel area to concrete area;

E_s = modulus of elasticity of steel;

ϵ = coefficient of shrinkage of plain concrete.

These equations may be true for concrete test specimens of small cross-section reinforced with a relatively large bar since their derivation depends upon the assumption that the shrinkage of the concrete is uniformly restrained over its cross sectional area, but for large sections these relations give results widely divergent from those of a few tests recorded by recent investigators.



July 11, 1921 to July 25, 1922
2° Temp. drop
FIG. 4

July 11, 1921 to July 27, 1922
53° Temp. drop
FIG. 5

July 27, 1922 to July 25, 1922
51° Temp. drop
FIG. 6

South Face
North Face

Sept 1, 1920 to Jan. 27, 1922
7° Temp. drop
FIG. 7

FIGS. 4-7—COMPARATIVE READINGS OF STRAIN GAGES ON FAIRMONT BRIDGE

Some Earlier Tests—So far as the writer knows, experimental data throwing any light upon these questions are very meager. Emerson (*Engineering News*, March 10, 1904, p. 222) measured what he termed the initial stresses of steel in concrete, but his investigations did not extend beyond a time interval of 84 days. The tests show a difference of these initial stresses for 1:2:4 and 1:3:6 concrete which is to be expected, but it is interesting to note that crushed stone aggregate gave lower initial stresses than did gravel concrete of the same mix.

Perhaps the most interesting experiments touching upon the difficulties involved in our problem are those of Bach and Graf. Four concrete prisms 39.37 in. long (one meter) having a section area of 62 sq.in. were made without reinforcing, and four similar prisms were reinforced by a single bar (0.49 sq.in. area) in the axis of the prism. The mix was 1:3:2. After hardening for several days packed in wet cloth, two prisms of each set were allowed to harden in air and the remaining prisms were immersed in water. The shrinkage measurements covered a period of twelve years and six months, and are shown graphically in Figs. 1 and 2.

The length of the prisms hardened in the air contracted 0.225 mm. (equivalent to 0.000225 in. per in. of length) in 6 years. With a modulus of elasticity of 30,000,000 for steel, the unit compressive stress in the reinforcing bar is 6,750 lb. per square inch. This compression produced a tension in the concrete which was greatest adjacent to the steel and decreased toward the edge of the section. Furthermore, in such a test specimen, there is a further decrease of this tension in the direction of the axis of the prism as the outer ends of the same are approached.

The average total compression in the steel was 6,750 × 0.49 = 3,310 lb. With a modulus of elasticity of 3,550,000 for concrete, this compression would cause a shrinkage of 0.00015 in. per in. or a total of 0.015 mm. in the length of the prism (1 m.). According to Figs. 1 and 2, the difference in shrinkage at the end of 6 years between the plain and the reinforced specimen was 0.512 — 0.225 mm. per meter or almost twenty times the shortening caused by a compressive force of 3,310 lb. if this force were uniformly distributed over the entire section of the prism. It is obvious therefore that the shrinkage over the section is not uniform but increases toward the outer edge of the section, as shown in Fig. 3. Actual measurements showed a difference of 0.38 mm. between the shrinkage at the steel bar in the center of the section and a point 4 in. away in a time interval of 1,723 days.

The latest data on shrinkage of plain as well as reinforced concrete are to be found in Bulletin No. 126, University of Illinois, entitled, "A Study of the Effect of Moisture Content Upon the Expansion and Contraction of Plain and Reinforced Concrete," by Torata Matsumoto. The tests on reinforced-concrete specimens are akin to those by Emerson and show clearly the primary stresses in both steel and concrete. It is also quite evident that the measured steel and concrete stresses are average stresses over the cross-section of the specimen and give no clue to the variation of shrinkage away from the reinforcing toward the outer edge of the section. It is data of this latter nature which are desirable to reduce long time strain-gage readings.

Experiments at Fairmont—Referring now to the experiments on the Fairmont bridge, Fig. 4, two dates were selected approximately one year apart and for which the temperatures of the arch were practically the same. The average temperature of all the thermometers was taken for each date and between July 11, 1921, and July 25, 1922, the difference between these averages was approximately 2 deg. F. The stress effect of such a small difference of temperature is not measureable with a Berry strain gage so that the deformations as plotted to the left of the vertical line in Fig. 4 represent the primary effect of shrinkage. The average shrinkage as estimated from these curves for a 20-in. gage line is 0.0008 or equivalent to a temperature drop of 7.3 deg. F. By checking this equivalent temperature drop from deflection data, we obtained 9.3 deg. F. For this small shrinkage during the second year, the primary stress effect is not very marked. However, the deformation of the steel gage line clearly shows the resistance to shrinkage as offered by the reinforcing. The secondary stress effect is too small to be accurately measured by the means employed. At the extrados, the steel deformations are shown conventionally by the apex of the triangle and had the extreme fiber at the intrados been measured, the lower steel deformation would have been shown by the same convention. The curves showing the various deformations are not so ideal as one might wish, but the reader must remember that measuring slight deformations with a portable strain gage while standing 90 ft. above the river is not a simple matter. Besides, the operator had to continually battle with dust and at times with cinders and soot from the locomotives below.

Referring next to Fig. 5, the two dates selected are July 11, 1921, to Jan. 27, 1922, approximately a time difference of six months. The deformations were plotted from the full vertical line with due regard to the sign for each gage line, i.e. — for compression and + for tension. As thus plotted, the deformations over the comprehensive area of the arch are too great by the amount of the shrinkage, while the tension deformations are too small by the same shrinkage, which is approximately one-half of the estimated shrinkage of 0.0008 for the entire year. The deformations as measured and recorded can therefore be changed to deformations designating stress by shifting the full vertical line (axis of ordinates) to the left by 0.0004 in., because this shrinkage has no stress effect other than a small primary effect, so that the vertical dot and dash line now becomes the true axis of ordinates. The full sloping line represents the deformation curve as computed according to approved methods for a drop of 53 deg. F. and in accordance with the computed end abscissas of 0.0015 and 0.0018 inches.

In Figs. 4 to 7, there is a difference between the deformations as recorded for the inner and outer faces of the arch. The reasonable interpretation of these differences is that; first, the transverse girders expand and contract due to temperature changes and due to shrinkage, causing side thrusts and side deflections of the arch, and second, the south face of the rib is subjected to a different exposure from that of the inner or north face. We must, therefore, at least for the time being, be content with striking an average between the two.

Fig. 6 represents the deformations for a temperature rise of 51 deg. F. from Jan. 27, 1922, to July 25, 1922. Again the shrinkage correction has been applied as described for Fig. 5, and the full sloping line gives the computed deformations for a 20-in. gage line and for a rise of 51 deg. F.

Note in Fig. 6, how the deformations of the extrados steel lag behind the concrete deformations which indicate tension, and how the intrados steel deformations project beyond the deformations for the intrados concrete which indicate compression. This is quite reasonable since we know the primary stress effect of shrinkage is to place the steel in compression, thereby reducing the tension in the extrados steel and increasing the compression in the intrados steel. But the amount of this lag and lead seems to have little in common with the indicated pure shrinkage deformations of Fig. 4. The explanation must be sought elsewhere and can be explained on the basis of a difference between coefficients of expansion of steel and concrete. For a slow temperature change from summer to winter there is no good reason for not assuming equal temperatures for steel and its surrounding concrete. The steel wants to expand a length of 20 $\times$ 0.0000065 $\times$ 51, while the concrete wants to expand a length of 20 $\times$ 0.0000055 $\times$ 51. The difference between these expansions is really in the nature of a shrinkage of 20 $\times$ 0.000001 $\times$ 51 or 0.00102 in. The concrete is here holding back the steel and thereby preventing full expansion. Since the average primary or initial compression of the intrados steel due to the shrinkage of 0.0004 is 0.00035 in., the compression for a "shrinkage" of 0.00102 is 0.00088, or a total compression of 0.00123, which agrees quite well with the lead for intrados steel in Fig. 6. The steel deformations for the extrados steel are not so reliable as those of the intrados steel since it was a serious matter to keep the small gage holes free from rust.

Referring again to Fig. 5, one would expect the lead to be in the extrados steel and the lag in the intrados steel because of reversal of stresses. Here, however, we have a drop of 53 deg., which on the same basis as described above would result in an apparent expansion of 0.00106 in. in a 20-in. gage line, i.e., the steel wants to contract more than the concrete and is thereby in tension which is analogous to the tension caused by an expansion of concrete with increasing moisture content. This time we have a primary tension in the steel amounting to 0.00089 in. from which must be deducted the primary compression of 0.00035 in. due to shrinkage or a net tension of 0.00054 in., which again agrees substantially with the curves of Fig. 5. At the same time it is noticeable that the concrete gage lines show the effect of these primary steel stresses due to shrinkage and difference of coefficients of expansion.

Fig. 7 is an example of the deformation curves for the inner and outer faces of the arch from the date of the beginning of the lowering of the arch centering on Sept. 1, 1920, to Jan. 27, 1922. These curves represent the measured deformations as obtained from field notes and are due to full dead-load, a temperature drop of about 47 deg. F. and the unknown and complicated shrinkage factor. It is not the writer's intention to interpret these curves nor does he wish to give the deformations of the extrados steel until he has had opportunities to verify these measurements on other arches. Fig. 7 is merely given to show the reader a sample curve of what may be expected for long time readings. In the interpretation of this last figure, it is first essential to deduct from the plotted ordinates the extent of the shrinkage between the two dates given.

Questions to be Answered.—Due to our present insufficient knowledge of the distribution of shrinkage

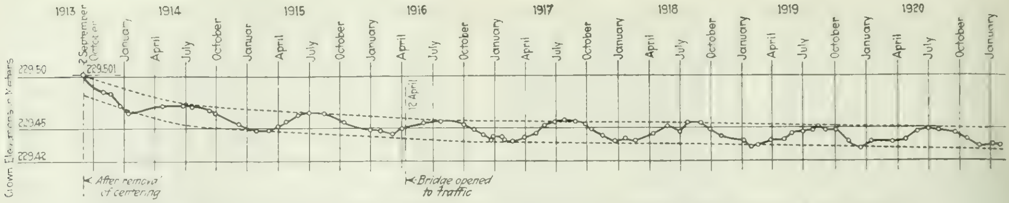


FIG. 8—CROWN DEFLECTION MEASUREMENTS ON NECKAR BRIDGE OVER SEVEN YEAR PERIOD

over a large section reinforced at the top and bottom, the investigator of long time strain-gage readings on reinforced concrete must answer some very vexing questions, before he can properly interpret his results. The leading questions are as follows: How great are the deductions which can be made from the deformation abscissa and which would represent shrinkage not producing stress? In this case, where the shrinkage is large compared with that of Figs. 4, 5 and 6, would we be justified in assuming a uniform shrinkage over the entire surface or, if not, to what extent does the steel reinforcing alter these shrinkage deductions? To what extent are the stresses caused by the dead-load plus the secondary stresses of temperature and shrinkage affected by the primary stresses (tension) caused by shrinkage? Are these tensile stresses uniform over the entire section or are they greater in the vicinity of the steel? How has the modulus of elasticity varied between the two dates and how does this modulus vary with varying unit stresses? How large are the stresses caused by the difference between the coefficients of expansion of concrete and steel, and how are such stresses distributed over the section?

Neckar River Bridge Measurements—Data in regard to shrinkage obtained from crown deflection measurements are not applicable because such data can only give us a measure of average shrinkage producing secondary arch stresses. Fig. 8 shows an interesting curve of crown elevations covering a period of seven years. The bridge in question is a three hinged plain concrete arch across the Neckar River at Cannstadt. During a period of seven years from the time the centers were struck, the crown of this 187-ft. span dropped 2 in. due to shrinkage. In Fairmont similar conditions prevail and in two years' time from the dropping of the arch centering, the crown of the center span dropped about ¾ in., which is less, in proportion, than for the Neckar bridge during the first two years. The fact that the Fairmont arches are hingeless as well as reinforced accounts for this difference, likewise the shape of the arch, radial thickness, etc. The coefficient of shrinkage as estimated for the Neckar bridge is 0.00041 after seven years. Some European specifications call for a shrinkage stress provision by using a shrinkage coefficient of 0.00025, which is equivalent to a temperature drop of 38 deg. F. These specifications permit a reduction of this equivalent temperature drop to 18 deg. F., provided the arch is built with keyways and provided that the keyways are concreted not less than 14 days after the last section is poured. From a consideration of all shrinkage data available and from our experience with the Fairmont tests, the writer fails to find any justification for such a reduction of 20 deg. equivalent temperature drop because the time interval of two weeks is too short.

There is so much room for research work in the investigation of primary and secondary stresses in reinforced concrete—both on test specimens and completed structures—that it is difficult to mention a point of beginning, and impossible to see the end. Not only does shrinkage vary with time, and quantity of cement per unit of concrete, but it varies with different brands of cement. Just which constituents of the cement are responsible for this shrinkage are still imperfectly understood. Strange to say, shrinkage also varies with different kinds of aggregate. Since the writer believes that the long time strain gage tests partially described in this article are the first of their kind, it is his hope that others will be stimulated to make similar tests or to make known through the technical press the results of such tests that have been made. Such work will show whether or not shrinkage is really the important factor it now seems to be and may stimulate research in the chemical field to produce a cement with a very small shrinkage coefficient. From present knowledge of this phenomenon, it would seem that a non-shrinking cement is of more importance than the attempt to produce a super cement of high tensile or compressive strength.

Sir Henry Thornton Pays Tribute to U. S. Railway Work in France

Speaking at the annual banquet of the Pittsburgh Traffic Club recently, Maj.-Gen. Sir Henry Thornton, president of the Canadian National Railways, and during the World War deputy director-general of movements and railways for the British armies, paid high tribute to the work of the American railway transport service in France during the war. General Thornton had opportunity to judge of the mettle of the railway troops not only by the results they achieved but also by contact with them while in action. He said:

> I have long wished an opportunity to express publicly the admiration which those who were employed in the British Transport Service felt for our American allies, and the successful way in which they met the serious transportation difficulties which confronted them in France. I have also hoped upon some occasion to pay my humble tribute to the skill and the energy of your railway department. There has been an unmerited silence upon this subject.
>
> The people of the United States know little the debt they owe to the genius of their railway officers who perfected and administered the wonderful American transportation in France. Much has been said, and properly so, of the magnificent work of the soldiers in the trenches, the officers who commanded them. Much has been said in praise of fighting generals and the anxieties they must have experienced; many other services have received their just and merited praise, but I am here to say that none of those would have had even an opportunity to perform their service had it not been for the efficiency of the American transport department, which day by day kept the front supplied with food, explosives, munitions and all of those things which enter into the conduct of a great war.

Winds and Barometric Effects on the Great Lakes

By John F. Hayford

Director, College of Engineering, Northwestern University, and
Research Associate, Carnegie Institution of Washington, D. C.

TO SECURE a much better formulation of the laws governing evaporation and stream-flow than is now available to the engineering profession is the ultimate object of the extensive investigations of which certain phases only are reported upon in this article. It appeared at the outset that maximum effectiveness in securing this ultimate object would probably be obtained by first investigating evaporation as it takes place on the full scale of nature at the surface of the Great Lakes and then applying that knowledge to the study of stream flow. It is believed that the Great Lakes, each to be considered in turn as an evaporation pan, furnish the most promising opportunity in the world for such a full scale study of evaporation. The surrounding conditions are extremely favorable. The pertinent meteorological and hydrographic data have been recorded in considerable detail for many years by the U. S. Weather Bureau and the U. S. Lake Survey.

This article is essentially a condensation of a volume of 133 pages by the same author and under the same title which has recently been issued as Publication 317 of the Carnegie Institution of Washington. That Institution has since 1911 supported the extensive investigation, which is still in progress, of which this report covers a part only. Some of the statements in this article are based on developments in the investigation since Publication 317 was prepared for the printer.

It gradually became evident, in the attempt to determine the change of total content from day to day of one of the Great Lakes with sufficient accuracy to isolate the evaporation, that it was necessary first of all to determine the effects of winds and of barometric pressures on the Great Lakes. The investigation was therefore concentrated on those effects. They are now understood and may be computed with the requisite accuracy. This part of the investigation is complete. The direct study of evaporation and stream flow, based upon this knowledge, is proceeding.

A large amount of data has been used to date in this general investigation. Certain parts of the investigation depend upon hourly observations of the winds and hourly observations of the water surface during from thirty-four to fifty-two days at each of the five stations, Buffalo, Cleveland, Milwaukee, Mackinaw and Harbor Beach. Other parts depend upon daily means of the elevation of the water surface for eight months at each of the five stations named, and also at Marquette on Lake Superior, and upon barometric pressures as regularly observed at many stations around the Great Lakes twice a day by the U. S. Weather Bureau.

The facts have been intensively studied. Up to September, 1921, more than 24,000 man-hours of time had been spent in this investigation, under the auspices of the Carnegie Institution.

How Problem Was Attacked—It appeared at the outset that there were several different factors or influences operating simultaneously to cause fluctuations of the elevation of the water surface at a gage, no one of which could be safely neglected while attempting to evaluate others. This led to the adoption of the least-square method of computation for the investigation, since it is in just such cases that this method has the maximum advantage over all other methods.

In the broader investigation of evaporation, including the investigation of wind effects and barometric effects which is here reported, seventy-four least-square solutions and the corresponding studies had been made up to September, 1921. Typical solutions each contained from 100 to 600 observation equations, each having for its absolute term the observed change in elevation of the water surface at a gage during a day or an hour, and each containing from two to eight unknown constants to be determined.

In general the order of procedure has been (1) to study the particular problem in hand in the light of all available evidence and to develop a theory as to the relation of the different quantities involved, such as, for example, the change of elevation of the water surface at a gage, the direction and velocity of the wind, the distribution of barometric pressure over the lake, the temperature, humidity and recent rainfall; (2) to express that tentative theory (or a part of it) in the form of a general equation and set up the corresponding observation equations for a least-square solution to test the validity of the theory; (3) to make the least-square solution and thus secure a set of computed values of the unknowns, assumed to be constant, which are supposed in said theory to express the relations between the observed quantities, and also to secure a set of residuals which are the discrepancies between the tentative theory and the observed facts; (4) to study the outcome of the least-square solution in the light of the internal evidence of the solution; (5) to study the outcome of the least-square solution in the light of all the available external evidence, such as might be furnished, for example, by comparisons with other independent least-square solutions and with evidence entirely independent of such solutions; (6) to develop an improved theory with the benefit of all the light gained from steps (1) to (5) inclusive and then to repeat all of the processes (2) to (5) inclusive, upon a new least-square solution based either upon the same data as before, or the same data together with added data, or upon entirely different data for other times and places. The whole cycle (2) to (6) was carried through once for each least-square solution made.

The last few paragraphs indicate why it can be said with sincerity that in this investigation a large collection of carefully observed facts have been intensively and extensively studied. The conclusions are believed to be correspondingly reliable.

Results—The outcome of the investigation to date may be very briefly characterized as follows:

(1) Reasonably accurate numerical expressions have been obtained for the effects of barometric pressures on the elevation of the water surface at the six stations, Buffalo, Cleveland, Milwaukee, Mackinaw, Harbor Beach and Marquette, on Lakes Erie, Michigan, Huron and Superior. With these expressions one may, from the distribution of barometric pressures ordinarily shown on the forecast maps of the Weather Bureau, compute the disturbances in elevation of the water surface thereby produced at the stations named.

(2) The general method has been developed by which such a numerical expression for the barometric effect at any station on any body of water may be derived from observations of the water elevation at that station and the forecast maps for the same period.

(3) A general expression, including the necessary numerical constant, has been obtained for the effect of winds of any given velocity and direction in producing a disturbance of elevation of the water surface at any given station on any body of water anywhere in the world. The data required in regard to the station and the body of water are such as are ordinarily shown on good charts, namely, the depths of the water at all points, the location of the shore line and the location of the station.

(4) Three of the prevailing seiches, or free oscillations under the influence of inertia, on Lake Erie have been isolated. Their periods and probable methods of oscillation

have been shown. The relation between these seiches and the uncertainties in daily mean elevations of the water surface at gage stations has been discerned. The appreciation of this relation aids decidedly in obtaining accurate determinations of the daily mean elevation of the mean surface of each lake.

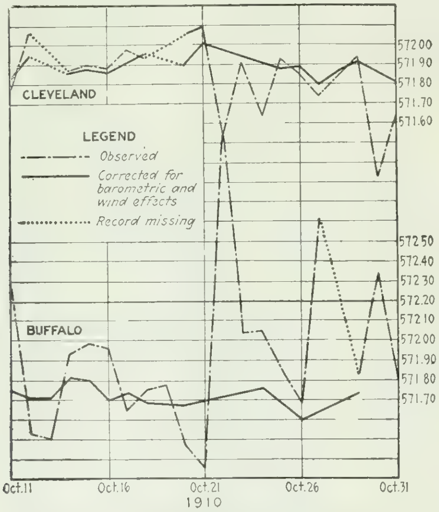
(5) The accuracy with which the elevation of the mean surface of any one of the Great Lakes may be determined for any given day has been decidedly increased.

When one determines the fluctuation of elevation of the mean surface of a lake he thereby determines the fluctuation in the total water-content of the lake.

The progress made in determining the evaporation from the surface of the Great Lakes is not yet sufficiently great or certain in character to warrant a definite statement here.

Six Fluctuations—On any one of the Great Lakes at any time there are six fluctuations of the surface of the water in progress, namely, ripples, wind waves, tides, wind effects, barometric pressure effects and seiches.

The ripples and wind waves are visible and familiar. Imagine them to be entirely smoothed out at each instant by putting the water from each ripple crest and wave crest into the adjacent troughs so that the surface would appear to the eye to be smooth and level. Such a lake surface with ripples and wind waves eliminated would never be level except by accident. That smoothed surface would be subject to tides, to wind effects, to barometric effects and seiches.



LAKE ERIE WATER SURFACE OCT. 11 TO 31, 1910

As observed and as corrected for wind and barometric effects. The apparent fluctuation of 0.76 ft. at Cleveland and 1.69 ft. at Buffalo smooth out into fairly continuous graphs when corrections are made.

It is the elevation of that smoothed out surface at the gage which is actually recorded by an automatic gage, such as was used at each of the six observation stations. The water in the still well of the gage is connected with the water outside through holes so small that the separate waves and ripples outside produce no appreciable change in the elevation of the surface of the water in the still well. The gage therefore records at any instant substantially the mean elevation of the outside water surface, during the past minute, or the past few minutes, not its instantaneous elevation.

The tides on the Great Lakes, having a range of less than 2 in. as a rule, may safely be ignored in this investigation.

Lake Slopes—The smoothed out lake surface, from which ripples and visible wind waves have been eliminated by assumption, is not level at any time on any one of the Great Lakes, except by accident. It is always disturbed by wind and by barometric pressures. But the slope in that surface is always and everywhere too small to be visible to the unaided eye. Anywhere on the Great Lakes where the depth of water is as much as 10 ft. and under the most extreme conditions of wind and barometric pressure such slopes are probably not greater than 0.011 ft. vertical to 1 mile horizontal. The slopes of the character referred to in this paragraph persist with one sign for many hours, as a rule, and sometimes for several days, until the wind changes or the barometric conditions change.

It is these long continuous invisible slopes of the water surface produced by winds and differences of barometric pressure that cause the recorded mean elevation, for any hour or any day, at a gage, to be different from the actual mean elevation of the whole surface of the lake for that hour or that day. The difference between the mean elevation of the water surface at a gage for any hour or any day and the mean elevation of the whole lake surface during that time is the combined wind effect and barometric effect.

A uniform increase or decrease in the barometric pressure over the whole of a lake has no influence on the position of the water surface. But if the barometric pressure becomes smaller over one part of the lake than it is over any other part, then the water tends to move from the region of the high pressure toward the region of low pressure.

Equilibrium would be established when the decrease in relative barometric pressure in the region of low pressure has been compensated by an accumulation there of an extra layer of water just equivalent to the relative defect in barometric pressure. In the condition of equilibrium the slope of the water surface is upward towards the region of the barometric low.

Barometric Effects Evaluated—The isobars, lines of equal barometric pressure, over any one of the Great Lakes, are continually changing, just as the barometric pressures over all other parts of the continent are continually changing. So the position of equilibrium of the water surface of any one of the Great Lakes as subjected to the influence of the barometric pressures is continually changing. The investigation shows that in general there is a moderate lag (about three hours upon an average) in the response of the water surface to a changed distribution of barometric pressures and that in general the water after having been put in motion toward the position of equilibrium is carried past that position by inertia, thus making the actual barometric effect greater than that corresponding to equilibrium. For six stations on the Great Lakes, Buffalo and Cleveland on Lake Erie, Milwaukee, Mackinaw and Harbor Beach on Lake Michigan-Huron and Marquette on Lake Superior, the barometric effects have been evaluated. For these stations, given the barometric gradients over the lake at any time, the effect of the barometric pressures in disturbing the water level—that is in making it higher or lower at the station than the mean elevation of the whole lake surface—can be computed with reasonable accuracy.

The error in the computed mean barometric effect on any given day at a station is probably less than 5 per cent of that effect on about one-half of all the days. The computed barometric effect, as stated later, seldom exceeds 0.20 ft. at any one of these six stations, and is less than 0.10 ft. during much more than one-half of all the days. On a small percentage of exceptional days, at times when the barometric gradients are changing rapidly and irregularly, which is usually when a well developed low pressure area is over or near the lake, the computed barometric effects are subject to abnormally large errors, much greater than 5 per cent. These exceptional days are usually solitary, not in groups.

The effect, E_1, of barometric pressures in making the elevation of the water surface at Milwaukee at any hour greater than the mean elevation of the whole surface of Lake Michigan-Huron is expressed numerically as follows:

$$E_1 = (P_4 - P_5)\ (-4.97) + (P_3 - P_6)\ (+8.44)$$

In this formula E_1 is expressed in units of 0.001 ft. and a positive value means that the water surface at Milwaukee is higher than the mean surface of the whole lake.

The quantity $P_4 - P_5$, a "westward barometric gradient," is understood to be the excess in hundredths of inches of mercury of the barometric pressure at latitude 45 deg. and longitude 87½ deg. over the barometric pressure at latitude 45 deg. and longitude 80 deg., 7 hours earlier than the hour for which the barometric effect is to be computed. The first of the two points named in the preceding sentence is a short distance west of Lake Michigan-Huron and the second is a short distance to the eastward of the lake, so that the line connecting these points is one across the lake from west to east near its middle latitude. Similarly the quantity $P_3 - P_6$, a "northward barometric gradient," is understood to be the excess of the barometric pressure, in the units specified, at latitude 47½ deg. and longitude 85 deg. (a point north of Lake Michigan-Huron) over the barometric pressure at latitude 42½ deg. and longitude 85 deg. (a point to the southward of Lake Michigan-Huron) 4 hours earlier than the hour for which the barometric effect is to be computed. The two intervals, 7 hours and 4 hours, are the lags in the two components of the barometric effect as determined from the observations. The formula enables one to compute the barometric effect at any time at Milwaukee, if the barometric pressures at the points named are known, from the forecast maps of the Weather Bureau or otherwise. The constants —4.97 and +8.44 were determined from the observations by the least-square method of computation.

Similar formulas have been derived for each of the other five stations which have been named. The general method for evaluating the effects of barometric pressures at any station on any body of water has been developed.

At Milwaukee the computed mean barometric effect for a day exceeded 0.19 ft. on 8 days out of 8 months in 1910 and 1911. The maximum was +0.30 ft. on July 25, 1911. On 62 days out of the 244 in these 8 months the barometric effect was 0.10 ft. or greater. At Buffalo the maximum computed mean barometric effect for any day during 8 months in 1909 and 1910 was 0.55 ft. At each of the other four stations of the six which have been named the barometric effects are smaller than at Milwaukee or Buffalo. The maximum computed barometric effect at any hour at any one of the six stations is in general nearly twice as large as the maximum computed mean barometric effect for any day. The maximum barometric effect usually persists for only an hour or two. At Milwaukee for the particular 35 days which have been examined in great detail the maximum computed barometric effect was 0.44 ft. at noon on Sept. 24, 1910.

Wind Effects—It is known that wind drives the surface water to leeward and tends to pile up the water on the lee shore of a lake. It produces a slope upward to leeward on the imaginary smooth surface of the lake to which reference has been made. This has long been known qualitatively.

The research now under consideration has given a quantitative determination of this effect. The slope produced at any point is fixed by the condition that the return current, beneath the surface, to windward, produced by gravity, must return the water to windward at the same rate that it is delivered to leeward by the surface current. Assuming that in the return current under the influence of gravity the relations of velocity, mean hydraulic radius and slope are those expressed by the well known Chezy formula, it follows that after the steady regime has been established for any given wind the slope at any cross-section is inversely proportional to the cube of the mean depth of the water at that cross-section. It was also found from the evidence given by the observations that the slope is proportional to the 2.4 power of the wind velocity.

The necessary constant to reduce these mere proportionalities to definite values has been determined from the observations made at several points on the Great Lakes. There is available now from this investigation a general formula shown hereafter, for computing such wind effects. The formula and its constant are applicable anywhere in the world on any large body of water. That is, given such facts for any body of water as are shown on a chart,—depths, distances, configuration of shore, etc.,—the effect of any wind of known direction and velocity in producing a disturbance of the elevation of the water surface at any point may be computed.

It has been found that the response of the water to the wind is prompt. There is no appreciable lag.

The formula expressing wind effects is

$$W = +\ 0.088\left(\frac{h^{2.4}}{100}\right)\Sigma_x$$

W is the effect at a given time of the wind at a given gage station in elevating the water surface at that station above the mean elevation of the whole surface of the lake; h is the velocity of the wind at that station. Σ_x is a quantity appropriate to the station for each wind direction which expresses the relation between the effect of a wind of a certain velocity, on the one hand and the depth of the lake at every point, the shape of the bottom, the horizontal dimensions of the lake and shape of the shore on the other hand. W is expressed in units of 0.01 ft. and h is in miles per hour. The method of determining Σ_x from a chart is too complicated to be set forth here. It is stated in full in the publication by the Carnegie Institution.

The value of Σ_x for each of the eight primary directions of the wind, N, NE, E, etc., for the six stations on the Great Lakes which have been referred to in connection with barometric effects vary from —8.32 for a northeast wind at Buffalo (and +8.32 for a southwest wind) to —0.05 for a southeast wind at Harbor Beach (or +0.05 for a northwest wind). In general the values of Σ_x and therefore the wind effects for winds of a given velocity are largest at Buffalo and smallest at Marquette.

The maximum computed wind effect at any instant within the limits of time covered by the observations used in this investigation at any of the six stations occurred at Buffalo at 10 a.m., Oct. 27, 1910, when a wind of 53 m.p.h. from the southwest caused the water surface at Buffalo to be 1.02 ft. higher than the mean elevation of the whole surface of Lake Erie at that instant. The mean computed wind effect for the whole of that day at Buffalo was 0.22 ft. At Milwaukee in sharp contrast to Buffalo the maximum computed wind effect at any instant within the limits of this investigation was only 0.032 ft. at midnight on Sept. 6, 1911, when a wind of 31 m.p.h. from the east raised the water surface at Milwaukee 0.032 ft. higher than the mean elevation of the whole surface of Lake Michigan-Huron. The mean wind effect for the whole of that day at Milwaukee was only 0.003 ft. At Mackinaw and Harbor Beach the wind effects are still smaller than at Milwaukee. At Marquette the average wind effect is not more than one-half as large as at Milwaukee.

Seiches—Seiches in lakes have long been known. A seiche is an oscillation of the water of a lake under the influence of inertia. The water oscillates with the free period of the lake, or of a portion of the lake, for a considerable time after it has been given an impulse, or a series of impulses, just as a piano wire or the air in an organ pipe oscillates. On the Great Lakes the water is continuously being given impulses by the changing of the wind in direction and velocity and by the changing barometric pressures. Thus seiches are started on these lakes. When once started the water surges past the position of equilibrium fixed by the existing winds and barometric pressures. The water surface oscillates back and forth about the position of equilibrium until the energy put into the oscillation by the impulse or impulses has been dissipated. The study of the effects of winds and of barometric pressures on the Great Lakes has incidentally discovered three of the principal seiches in Lake Erie, shown their periods, determined their manner of oscillation, and in a few special cases it has traced a particular seiche to its initial impulse.

It has been established that the water of Lake Erie frequently oscillates lengthwise the lake in such a way that the surface is high at Cleveland near the west end of the lake when it is low at Buffalo and vice-versa. The period of this seiche is 13.1 hours for a complete oscillation—from high to high or low to low at a given point.

During the investigation it became clear that in the eastern one-third of Lake Erie, a portion which is much deeper than the remainder of the lake, there is a seiche with a period of 3.7 hours. This portion of the lake oscillates lengthwise.

Near Cleveland there is frequently a seiche in the form of an oscillation back and forth across the lake from Cleveland to the Canadian shore with a period of 2.6 hours.

For engineering purposes one rarely needs to use a unit of time smaller than 1 day in connection with Great Lakes problems. For each day the mean elevation of the water surface is ordinarily taken as furnished by the U. S. Lake Survey, computed by them from twenty-four hourly ordinates read from the gage record, proper instrumental corrections being applied. In general the effects of the 13.1-hour seiche and of seiches of shorter period are nearly eliminated from such daily means. The elimination is thoroughly good, however, only when the seiche is in progress throughout the whole 24 hours with but slight variation in range. Ordinarily a new seiche starts with an unsymmetrical first wave. The mean elevation for the day on which a very large seiche starts tends, therefore, to be considerably affected. The understanding of seiches gained during this investigation has made it feasible even when one is dealing only with the mean elevation for each day, as ordinarily furnished by the U. S. Lake Survey, to detect the particular daily means which are much vitiated by the beginnings of new large seiches. These particular daily means may then properly be rejected from any study or assigned light weight. This outcome of the study of seiches, a criterion for detecting vitiated daily means, has proved to be especially valuable in the investigations of evaporation and stream-flow which are now in progress.

Applying the Corrections—The graphs illustrate the gain made in determining the mean elevation of the whole surface of Lake Erie from observations at Buffalo and Cleveland by applying corrections for the effects of winds and the effects of barometric pressures, and by detecting the particular daily means which are vitiated by new large seiches. The dot-and-dash graphs show observed daily mean elevations, each being the mean of twenty-four hourly ordinates read from a gage and corrected for gage errors. The continuous graph has in each case been obtained by applying to the observed daily mean elevation the computed correction for the effects of winds and of barometric pressures and rejecting by the criterion the particular daily means which were found to be seriously vitiated by new large seiches. Note (1) that the continuous graph (corrected values) is much smoother than the dot-and-dash graph (directly observed values); (2) that although the dot-and-dash graph shows an apparent fluctuation within the 20 days of 0.76 ft. at Cleveland and at Buffalo of 1.69 ft., the continuous graph shows an apparent fluctuation in the same interval of only 0.21 ft. at Cleveland and at Buffalo; and (3) that whereas the dot-and-dash graph shows apparent fluctuations in opposite directions at Buffalo and Cleveland on Oct. 22 (the most extreme case), Oct. 12, Oct. 21 and Oct. 27, there is little if any evidence of such a relation in the continuous graphs (corrected values). These evidences, and much similar evidence from other graphs, indicate the greater accuracy and reliability of the corrected values (continuous graphs) as compared with the directly observed values (dot-and-dash graph) considered as a means of determining the mean elevation of the whole surface of Lake Erie. In connection with comment (3) note that the mean elevation of the whole surface of Lake Erie cannot change in opposite directions at the same time. To bring out the full force of comments (1) and (2) it should be stated that a consideration of the external evidence as to rainfall, runoff, evaporation, inflow from the Detroit River and outflow through the Niagara River shows it to be reasonably certain that on no day during the 20 under consideration did the mean elevation of the whole surface of Lake Erie change as much as 0.03 ft. in either direction. All apparent fluctuations in one day in excess of that amount are evidences of error. The continuous graphs conform much more closely to the degree of smoothness required by this criterion than do the dot-and-dash graphs.

From all the evidence, and more particularly from the careful numerical studies, it is clear that the present understanding of wind effects, barometric effects and seiches, used as it has been in this investigation, enables one to determine the mean elevation of the whole surface of Lake Erie as accurately from a single day of observation at Buffalo as it could formerly be determined from 16 days of observations. On Lake Michigan-Huron the wind effects and the seiches are much smaller than on Lake Erie and hence the relative gain secured by taking account of them is smaller. Nevertheless the evidence shows that the mean elevation of the whole surface of Lake Michigan-Huron may now be determined as accurately from a single day of observation at Mackinaw as it formerly could be determined from 6 days of observation.

A large increase has thus been secured in the accuracy with which the fluctuations in total water content of each of the Great Lakes from day to day may be known.

Economic Importance of New-Found Accuracy—The following statements suggest why the increase in accuracy which has been secured is needed in connection with other engineering problems of large economic importance, which have arisen in connection with the Great Lakes. A sheet of water 0.01 ft. thick covering Lake Erie contains 2,800,000,000 cu.ft., is equivalent to the whole outflow into the Niagara River under typical conditions for about 3.7 hours and would develop about 10,500,000 kw.hr. of energy if it were utilized in a good hydro-electric generating station having an effective head of 200 ft. such as is available at Niagara. At 2c. per kilowatt hour this amounts to $210,000. The whole controversy which has already extended over many years, between the navigation interests backed by the United States on the one side and the Sanitary District of Chicago on the other side has turned upon a question of a few tenths of a foot only, as to the elevations of the lake surface as compared with what they would have been if no Chicago drainage canal had ever been built, or if somewhat less water had been allowed to run through it. According to the ultimate outcome of this controversy Chicago may be forced to spend many millions of dollars in works for sewage treatment, or the controversy may be settled by much less costly regulation of the Great Lakes for the joint benefit of navigation, power development and sanitation. It has been estimated, and the statement published with a statement of its basis, that a lowering of the lake levels by 0.1 ft. causes an annual loss of revenue to vessel owners of $590,000, which loss must be made good by an increase in rates. (See Diversion of Water from the Great Lakes and Niagara River, p. 390, Government Printing Office, 1921.) That is, a gain of 0.1 ft. in depth in the Great Lakes would be worth more than one-half million dollars per year to the people of the United States.

In estimating the importance of applying corrections for the effects of winds and of barometric pressures it is important to note that these corrections sometimes remain of the same sign for several days at a time. For example, the corrected mean elevation for the whole surface of Lake Erie for the 5 days, July 21 to 25, 1910, is 0.14 ft. less than the observed mean for that period. That is, the mean correction for the effects of winds and of barometric pressures for these 5 days is —0.14 ft. The correction for these two effects remained so persistently negative for 26 days at this time that for the whole period the mean correction was —0.07 ft. For October, 1909, the mean correction for the whole month was —0.09 ft. That is, if one neglected the corrections for wind and barometric effects for October, 1909, thereby ignoring the fact that the lake surface had a persistent slope in one direction during all of that period he would reach a conclusion that is in error by nearly 0.1 ft. even though he had used the mean of the two stations, Buffalo and Cleveland. At Milwaukee the corrections for the effects of barometric pressures were positive on every day from July 8 to July 30, 1911, inclusive. The correction was greatest on July 25, namely, +0.30 ft. Its mean value for this period of 23 days was +0.11 ft. Without a knowledge of the necessary barometric corrections one is thus misled by the Milwaukee record by more than 0.1 ft. for more than 3 weeks, in so far as the mean elevation for the whole surface of Lake Michigan is concerned.

Precast Concrete Units Used For Relining Railroad Tunnels

Ribs Placed in Halves by Special Crane With Universal Jaw—Cost Said to Be Less Than Usual Methods of Lining

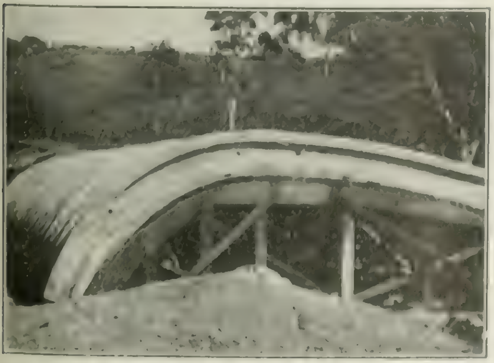
A METHOD used in replacing the timber lining of Redwood Canyon tunnel on the San Francisco and Sacramento R.R., just outside the city of Oakland, Calif., employs concrete ribs and slabs which are cast outside the tunnel, brought in on flat cars and placed by a crane designed especially for this work. Timber lining put in this tunnel when it was constructed in 1912 became weakened by age and seeping water and the problem was to replace the lining without traffic interference.

Under the present construction program it is possible for the work train to remain in the tunnel for only a few hours each day in the early hours of the morning as the use of the tunnel tracks at any other time would interfere with regular train schedules. This is not a drawback with the precast unit method, however, because the worst spots are given attention first.

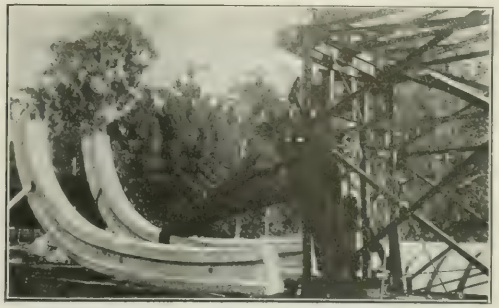
The nearest suitable casting yard that could be located on railroad right-of-way was 6 miles from the tunnel. Here ribs and slabs are cast on built-up wooden platforms, with the aid of removable metal side forms. The mix for both ribs and slabs is 1 part of cement to 6 parts graded sand gravel and crushed rock.

Each half-rib weighs 5 tons and is made to conform to a curve that gives the tunnel a width of 16 ft. and a height of 22 ft. inside the concrete. The rib cross-section resembles that of an I-beam with a thick web; in the plane of the arch the ribs are 24 in. thick, the width being 8 in. and 14 in. in the web and flange respectively. The groove on either side of the rib formed by the web-and-flange construction serves to hold the slabs that take the place of lagging and close the space between the ribs when in final position. Each rib is reinforced heavily with $\frac{3}{4}$-in. corrugated steel bars.

After remaining on the casting forms long enough to allow ample time for curing, the ribs are loaded by the yard crane onto flat cars equipped with racks or cradles taking four ribs per car. Each half-rib is cast with reinforcing bars projecting at the upper end for bonding into the keystone of the arch which is cast in the tunnel so as to unite each pair of halves after they have been set in place. Before pouring the ribs transverse wood pins are placed in the form to provide three holes through the web of each half-rib. Two of these are for the chains by means of which the rib is picked up from the forms and loaded onto flat cars; the third is at the center of gravity of the rib and is used by the claw or clamp with which the rib is placed in final position.



RIBS ON WOOD PLATFORM IN CASTING YARDS
Metal side forms have been removed. Note three holes in web used for lifting and placing



SPECIAL CRANE IN POSITION FOR LIFTING RIB
Jaw on boom end is clamped to rib by bolt through web. Universal joint just behind jaw aids in accurate placing in tunnel.

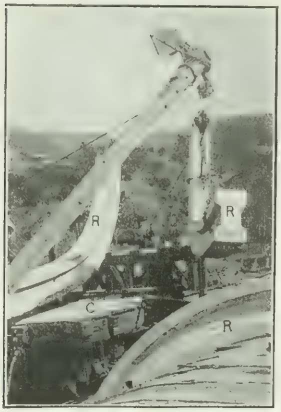
A crane adapted to handling the ribs in the limited clearance inside the tunnel, and shown in the accompanying illustration, was designed expressly for this job. It consists of a well-braced structural steel frame, mounted on a flat car, and operating an L-shaped boom. The boom has at its outer end a claw and a universal joint. These make it possible to lift the rib from the car and adjust it to any position that may be required in setting it accurately in place where it is fastened securely before the crane lets go. As now organized, the work of setting and securing each rib in place occupies from fifteen to thirty minutes.

Formerly the claw consisted of a detachable clamp bolted to the ribs as they lay on the car. To this claw the end of the crane boom was attached by means of a pin. More recently a new jaw has been devised which is expected to greatly facilitate and speed up the work. The new jaw combines the clamp and the universal joint in a single device which is not detached from the crane.

When a pair of half-ribs is lined up in final position, a rigid, box-like steel form is fastened at the crown of the arch in such a way as to hold the upper ends of both ribs firmly until the concrete poured into the form to make the keystone of the arch has had time to harden. Prior to placing the ribs concrete sills are poured as a footing and, where necessary, a concrete invert or struts beneath the track is also put in.

The slabs between the ribs do not have to be put in immediately after the ribs are placed. Some 600 ft. has been left without any slabs, the old wood lagging being allowed to remain. As the ribs are ordinarily spaced 3 to 4 ft. apart, this has been found to serve very effectively. Where slabs have not been put in, a longitudinal tie between successive ribs is grouted in place along the crown of the arch. Slabs are 10 in. high and weigh about 100 lb. each; they are brought into the tunnel on flat cars and a small jib crane is used to facilitate placing them. When in place the slabs are grouted with a mixture 1 part cement to 2 parts sand.

Timbering in a part of this same tunnel was replaced by concrete lining poured continuously in the ordinary manner, the work being done with the same labor and under the same general conditions as when using the precast system. The cost of this monolithic lining is said to have been one-third more than that built by the precast method. The initial cost of the latter method can be kept still lower when the lagging is still in good shape by postponing the addition of the slabs which is a separate operation entirely.



CRANE LOADING RIBS ON FLAT CAR

Note reinforcing rods projecting from upper end of ribs. The ribs weigh about 5 tons each.

In addition to the lower cost, advantages claimed for the precast unit method are that (1) it eliminates form work in the tunnel,, (2) affords the best opportunity for securing good concrete by making it possible to pour in the open air where there is ample time for thorough curing and inspection, (3) a timber lining can be economically replaced without the necessity of working continuously through the tunnel as the precast ribs can be quickly placed at any point where the wood bents have become decayed or faulty and when in place the concrete ribs can carry the load immediately, (4) the dangers due to green concrete and form work in the tunnel are eliminated.

The process was designed and patented by Pierre Zucco of Pierre Zucco & Co., consulting engineers, San Francisco, Calif.

Garbage Furnace Selections by Small Cities

Some of the difficulties met by small cities in selecting a garbage incinerator from the various kinds now available were set forth as follows by Samuel A. Greeley, consulting engineer, Chicago, in a paper recently presented to Michigan Engineering Society:

> As regards incineration, the most difficult hurdle is the selection of a furnace. A variety of incinerators are on the market, most of them under active salesmen with very little yard stick for comparison. The only specific advice that can be given of general applicability is that the principal factors contributing to the failure of an incinerator are faulty design in one or two important particulars, and general poor construction both as regards material and workmanship. It is surprising the extent to which the smaller communities are willing to put themselves in the hands of a contractor building an incinerator, whereas in the construction of a sewer, thorough engineering supervision and inspection are provided. In some incinerators insufficient furnace bracing is provided, or the main flue is too small, or the door castings are too light. In others the foundations are too light, or the fire brick work is poor or the general arrangement for receiving refuse is awkward. Many incinerators throughout the country are apparently disposing of refuse with more or less success. One of the major difficulties results from the lack of engineering.

In concluding his paper, Mr. Greeley said:

> In no community should the refuse disposal problem be approached without first establishing for that community the fundamental considerations. After these are determined, careful engineering work should be given to the development of the details so that failure will not result.

Higher Stresses for Steel Buildings Proposed by Fabricators

A BASIC working stress of 18,000 lb. per square inch is proposed in a specification for structural steel for buildings recently adopted by the American Institute of Steel Construction, an association of steel fabricating concerns. The specification was prepared for the association by a board of engineers retained for the purpose, consisting of Prof. George F. Swain, Prof. M. S. Ketchum, E. R. Graham, W. J. Watson, and W. J. Thomas. Essential provisions of the specification are summarized in the following:

Material—Bridge steel is specified (A.S.T.M. 1921 specification), thus calling for material of slightly higher ductility than building steel as currently specified, but no higher in ultimate strength or yield point, which are 55,000-65,000 and one-half of the ultimate, respectively.

Impact for Live-Load—In the case of live-loads which tend to produce impact or vibration, an impact addition to the static live-load stress is specified. The amount of this addition is not specified.

Minimum Thickness—For steel in outside exposure, $\frac{5}{16}$ in. is fixed as minimum thickness; for inside exposure, $\frac{1}{4}$ in. Light structures, including one-story buildings, are excepted.

Heavy Trusses—Girders or trusses having end reactions of 40,000 lb. or more are to be supported on steel columns carried to the foundation. The gusset plates in such trusses are to be not less than $\frac{3}{8}$ in. thick.

Workmanship—Punched work is permitted, but workmanship "equal to the best practice in modern structural shops" is required. Faced edges are required only at the contact surfaces of compression joints.

Construction Details—Faced ends of compression members are required to be spliced only sufficiently to hold the connecting members in place.

Rivets of a length exceeding five diameters are to be increased in number 1 per cent for each additional $\frac{1}{16}$ in. of grip, and are to have the points quenched before driving. Members are required to have centric connections and the connection rivets are required to be centric to the members unless the eccentricity is provided for. The fixation moment at the end of a beam connected to another beam rigidly is to be provided for. No shop connection is to have less than two rivets and no field connection less than three.

Web Stiffeners—At the ends of plate girders and rolled beams, web stiffeners are required. Stiffeners are also required where the average web shear exceeds that allowed on an unstiffened web, and in this case the stiffener spacing should not exceed the permissible depth of an unstiffened web under the same unit shear, determined by the formula

$$42.4\, t\sqrt{18{,}000\, A/S - 1}$$

where t is the web thickness, A is the gross web area, and S is the total shear. In any case plate-girder webs are to have a thickness not less than 1/160 the unsupported distance between flanges.

Allowable Unit Stresses—The following are the principal items of the allowed working stresses:

	Lb. per Sq.In.
Tension, bending and short-length compression	18000
Column compression, gross section	$\frac{18000}{1 + l^2/18000r^2}$

with a miximum of 15000 and with l/r limited to 120 for main members and 200 for bracing	
Compression in unstayed beam flanges...... with l/b limited to 40 as a maximum	$\frac{20000}{1 + l^2/20000b^2}$
Shear on pins and power-driven rivets......	13500
Shear on turned bolts....................	12000
Shear on hand rivets and rough bolts........	10000
Bearing values, twice the shear values	
Shear on girder webs, gross section........ provided h, the depth between flange angles, does not exceed $30t$. For greater depth the average shear on the vertical section must not exceed	12000 $\frac{18000}{1 + h^2/18000t^2}$
Bearing on expansion rollers..............	$600d$

Increase for Combined Stresses—Stresses may be increased 25 per cent for load and wind in combination, and 33⅓ per cent for wind stresses in members carrying no load stresses.

Reversed Stresses—Members subject to stress reversal are to be designed to carry either stress with half the smaller added.

Water Softening at Columbus, Ohio —Results and Studies

Long Settling Periods Probably Are Unnecessary; Overtreatment of Small Portion Is Desirable

Extracts from paper presented to Indiana Water Supply and Sanitary Associations, Feb. 15, by Charles P. Hoover, chemist in charge, Columbus (Ohio) Water Softening and Purification Works.

DURING the fourteen years that the softening plant at Columbus, Ohio, has been in operation 10.7 lb. of lime per million gallons of water has been required to reduce the hardness 1 p.p.m. and 11.5 lb. of soda ash per million gallons has been required for each part per million of hardness reduced. Of this 2.3 lb. has been neutralized by alum added for coagulation purposes leaving 9.2 lb. as against a theoretical 9.1 lb. actually required. Costs of operating and maintaining the plant since 1909 have varied from \$14.58 to \$37.32 and averaged \$22.91 per million gallons. The cost of chemicals included in these figures varied from \$8.90 to \$30.78 and averaged \$16.38 per million gallons.

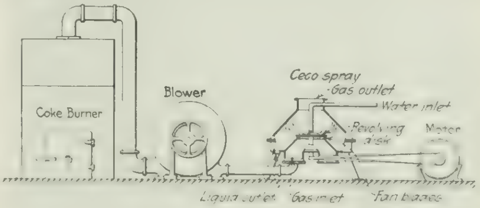
Recent studies have disclosed that temperature is a far greater factor than time in completing the chemical reactions. The effect of temperature is more pronounced in water having a hardness above 400 than in water with less than 300 r.p.m. At higher temperatures less calcium and magnesium remain in solution than at lower temperatures. At higher temperatures the reaction between the lime and the soda-ash and the calcium and magnesium salts results in a more crystalline and thus less soluble precipitate than at lower temperatures. As the temperature lowers, more and more colloidal and soluble is the precipitate formed.

Results at Columbus from 12,000 determinations during the past eleven years indicate that the period of reaction between the softening chemicals and the calcium and magnesium is short. Ninety per cent of the reaction accomplished takes place in the mixing tanks, 3 per cent in the 15 hours through the settling basins, and 7 per cent in passing through the filters.

The average hardness of the river water is 273 p.p.m.; of the water entering the settling basins, 119 p.p.m.; at the outlet, 113 p.p.m.; and of the filtered water, 101 p.p.m. These figures are rather startling because they indicate that large settling basins are not so necessary for water softening as has always been supposed. The results indicate that the colloidal precipitates crystallize in passing through the settling basins and are thus removed, but that it is not the place where chemical reactions take place. The filters are more effective in removing colloids than the settling basins, and in addition to removing 7 per cent of the hardness, I believe would also have removed the 3 per cent lost in the settling basins.

As temperature is a factor over which no control is possible in a large plant, it is essential to take advantage of such factors as can be controlled. At the Columbus plant and at the new plant at Newark, Ohio, all of the chemicals required to soften the water are added to a portion of the water, approximately 25 per cent, which is subsequently mixed with the 75 per cent undosed portion. This overtreatment gives the effect of mass action, resulting in quick formation of large flocs and crystalline precipitate.

After mixing the undosed portion with the dosed portion, the mixture is made to pass slowly through baffled mixing tanks. The large flocs already formed serve as a nucleus upon which the newly forming precipitates can build, and as the water rolls over and under the baffles, the flocs seem to grow in size, very much the same as rolling up a snow ball. By the time the water reaches the settling basins, it is so well coagulated that sedimentation takes place almost instantaneously. The suspended matter in well softened water should settle in five minutes' time, but I have never been able to duplicate plant results in this respect in bottle experiments.



PLANT FOR MAKING CONCENTRATED SOLUTION OF CO_2

Another factor that tends to improve coagulation is the addition of aluminum sulphate applied to the raw water at the same point that the lime and soda-ash are added. When the Columbus plant was built, provision was made for applying coagulant at the entrance to each or any set of basins, at the outlet of the last set of settling basins, or in the softened water channel on the way to the filters. The process of adding the coagulant to the water in the settling basins was soon changed and better results were obtained by adding most of the coagulant to the raw water as it entered the plant and a small additional dose to the settled water as it passed to the filters.

Carbonation—In experiments on carbonation, made during the past year, in the first plant CO_2 gas, in cylinders, was applied to water by means of a chlorinator. A sketch of the second plant is shown. It consists of a coke burner and a blower for sucking the gases from the burning coke and forcing them into an absorber. The CO_2 gas enters at the bottom and the water is fed in at the top. The water drops onto a disk which revolves at the rate of 1,800 r.p.m. and the gas meeting this film of water is absorbed. The carbonated water, discharged from the absorber, during a few of our tests, contained as high as 600 to 700 p.p.m. This process consists in highly carbonating a portion of the water and feeding the highly carbonated portion into the balance of the supply.

Another carbonator on the market, used by the soft-drink bottling plants, when operated at 30 lb. pressure, produces an effluent showing 24 lb. of CO_2 in 500 gal. Theoretically one of these carbonators would produce enough CO_2 to carbonate 2,000,000 gal. of water. The cost, including a 2-hp. motor, is about \$900. Theoretically, 171 lb. of CO_2 gas would be required to carbonate 1,000,000 gal. of Columbus softened water. At the water softening plant at Defiance, however, 450 lb. of CO_2 gas are prepared for each million gallons of water treated and on this basis one carbonator would absorb enough gas for only 1,000,000 gal. of water.

Old Bollman Truss Bridges on the Valley R.R. of Virginia

Three Bridges Now Being Replaced Have Carried Traffic for Fifty Years Without Structural Change

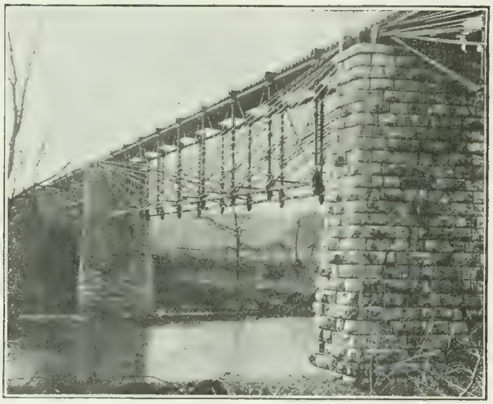
By Philip George Lang, Jr.
Engineer of Bridges, Baltimore & Ohio R.R., Baltimore

PECULIAR historic interest attaches to three old bridges on the Valley R.R. of Virginia (part of the Baltimore & Ohio R.R.), now in process of replacement with modern spans. The section of line in question traverses the Shenandoah Valley between Harrisonburg and Lexington, Va. The bridges involved, which are shown by views herewith, are single-track structures, and may be briefly described as follows:

Bridge 117, crossing the North River west of Mount Crawford, Va., comprises two deck Bollman truss spans of 98 ft. 6 in., and one deck Bollman truss span of 148 ft. 9 in. Bridge 120, crossing the same stream east of Cave station, consists of two deck Bollman truss spans of 98 ft. 7 in. and 63 ft. 5 in. respectively, and one deck Whipple truss span of 147 ft. Bridge 129, crossing Middle River east of Verona, consists of three deck Bollman truss spans, each 98 ft. 7 in. long, and one deck Whipple truss, 147 ft. long. All the spans given are measured center to center of end bearings.

The piers and abutments supporting these structures are built of good quality limestone, derived from the inexhaustible local supply found in the underlying strata of the Shenandoah Valley, upon which also the substructures foot. The existing masonry is in good condition, and, with slight modifications to accommodate the new superstructures, will be continued in use.

Records covering the fabrication and erection of these spans are no longer available, but it is believed that the superstructure of bridge 117, at Mount Crawford, was fabricated in 1872, at the Baltimore & Ohio R.R. Co. bridge shop, then located at Mount Clare, Baltimore. Bridges 120 and 129 built either in 1872 or 1873, were possibly fabricated at the same point, although they may have been built at the plant of the Patapsco Bridge & Iron Works, Canton, Md.



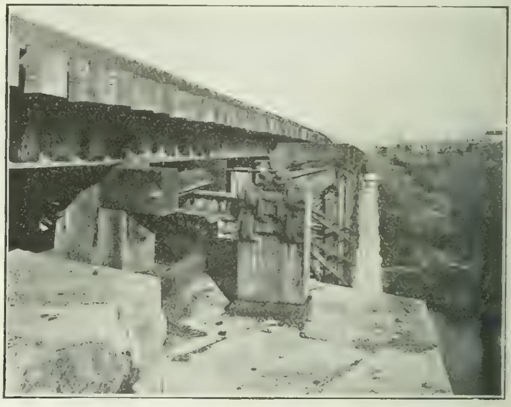
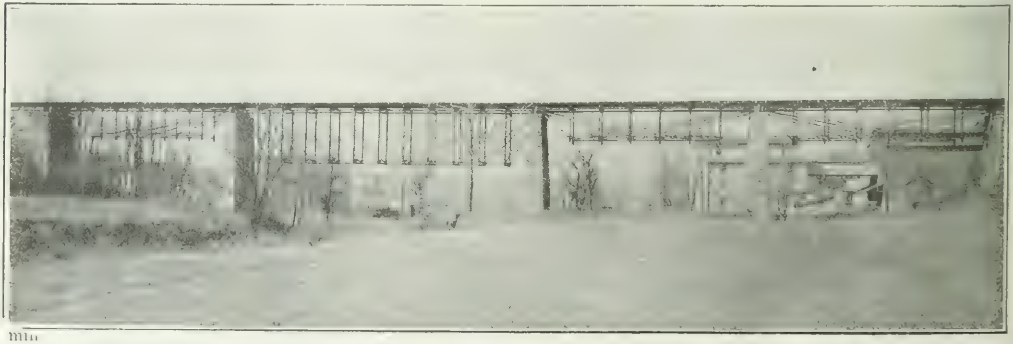


FIG. 1—CHANNEL SPAN (148 FT. 9 IN. C. TO C.) AND END BEARING OF SIDE SPAN (98 FT. 6 IN. C. TO C.) OF NORTH RIVER BRIDGE, MT. CRAWFORD, VA.

The so-called "Bollman" truss was devised and patented by the late Wendell Bollman, a resident of Baltimore, for eighteen years a member of the Baltimore & Ohio organization, and for ten years its Master of Road. Mr. Bollman subsequently became president of the Patapsco Bridge & Iron Works, and in that capacity was engaged for several years in the design and fabrication of iron bridges.

These old spans constitute interesting relics of the past, and embody concrete examples of what was con-



MIDDLE RIVER BRIDGE AT VERONA, WITH WHIPPLE CHANNEL SPAN AND THREE BOLLMAN SIDE SPANS sidered first-class bridge practice fifty years ago. The history of the engineering profession would be vastly enriched were equally perfect specimens of contemporary motive power and rolling stock available, to visualize to our own generation the rolling loads contemplated by the bridge designers of half a century ago.

The fact that since the early 70's locomotives and rolling stock have been subject to steady increase in weight and severity of effect on bridges is forcibly illustrated by the structures now considered, which have been continued in operation under the lightest types of current motive power, subject to speed restrictions. However, notwithstanding the age of the spans, and the fact that even the light classes of power operated over them far exceed in effect the loads contemplated by the designers, their replacement is not due to actual deterioration but to the changing character of the traffic now operated on this line.

In the Bollman truss the panel loads are transferred directly to the end bearings, and this action is accompanied by an undulatory action, to which the term "weave" has been applied, and which is particularly noticeable in the deck type, represented in the Valley Railroad bridges.

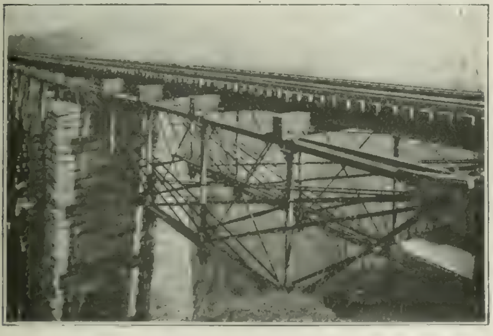


FIG. 3—SPAN OF 63 FT. 5 IN. NEAR CAVE STATION

The floor construction of these bridges was never changed or any other alteration made in their structure. Their extended life and utility, and the fact that it has been possible to maintain them for many years under conditions which their designers could not foresee, is a striking proof of the excellence of the material and workmanship used in the completed structures. These examples of railroad bridge super-structures, now rapidly disappearing as current structural types, represent an important link in the development of the present-day metallic railroad bridge, and constitute an enduring monument to the skill of a past generation of railroad builders, who successfully encountered the problems of their day.

Water and Sewage Plants in Minnesota

Of 400 water systems in Minnesota, thirty-eight are surface supplies. Twenty of the latter receive some kind of treatment and five of the remainder are taking steps toward treatment, said J. A. Childs, engineer, Minnesota State Board of Health, at the recent meeting of the Minnesota Surveyors and Engineers Society. Of eighty sewage treatment works seventeen are septic tanks and sixty-three are Imhoff tanks. Only forty-five of the Imhoffs are adequate in size.

Looking for Gravel for Road Construction

Abstract of Paper Presented to Minnesota Surveyors and Engineers Society by C. A. Motl, Assistant Engineer, Minnesota State Highway Department.

INVESTIGATIONS for gravel should be carried on continuously. The engineer should study his particular territory minutely, both in the field and on the maps available, and should take advantage of every indication that might occur. Special vegetation is perhaps the best indicator that we have, where the soil covering is not too deep. Gravel pits should be located if possible in advance of any construction, as their location might often influence the route to be taken. The engineer should bear in mind that gravel will be needed for many years to come, and the securing of an adequate supply in advance is just as important as the building of a permanent bridge or culvert.

In making the investigation, it is well, first, to take preliminary soundings over the area under investigation. These soundings should be made wherever there is an indication of gravel existing. Where gravel is found, a sample should be taken and preliminary screen and quality tests made. Where the indications appear to be most favorable, more extensive soundings should be taken, and more tests made, until the engineer is absolutely certain that he can guarantee a given amount of gravel in the pits he has chosen. A record map should be made of the location of all the preliminary, as well as final soundings and tests, so that the work will not need to be duplicated in the future.

In the past it has often been customary to limit the gravel investigation merely to pointing at a hill and telling the contractor to "go to it." In many cases after the contractor went, he soon came back, with nothing to show for his trouble but a long bill of extras. Since all other items of construction appear to be carefully investigated by surveys and extensive plans, why should not gravel pits be included along with the rest? Correct information on this item is as necessary as the balance of quantities on a grading plan, or the giving of volumes on a concrete bridge.

As a general suggestion, it may be said that a gravel deposit should be surveyed, by surface measurements covering both the location and the contours; by soundings giving depth of strippings and gravel, and by tests, giving quality, quantity, and screen sizes at various depths at all the test holes. Test holes should not be over 50 ft. on centers, and in many deposits much closer. An accurate plat should be made of all the information obtained, and this plat should become a permanent record in the engineer's office. With such information, it will be known in advance, just how much oversize there is in the gravel; how much clay for binder (this is important in sandy soils); how much stripping is required; how the gravel should be taken out to give the best results, and what kind of equipment would be best to use in the pit.

Pineapple Co. to Develop Island of Lanai

The Hawaiian Pineapple Co. has recently purchased practically the entire island of Lanai which is one of the Hawaiian group located about 55 miles from the City of Honolulu, Island of Oahu. Lanai is the sixth largest of the group and comprises about 139 sq. miles. Beginning next year considerable areas on the island are to be planted to pineapples which will be shipped to Honolulu for canning, and in order to facilitate transportation a suitable harbor and modern structures will be provided on the island. The harbor will be developed at Kaumalapu on the southwest side of the island where a small bay is sheltered on three sides by high cliffs. With a small breakwater and some dredging this is to be made into a safe port for steamers of the type expected to handle the pineapple. Francis B. Smith of San Francisco has been retained by the company as consulting engineer in connection with the development of transportation and harbor facilities.

Structure of Collapsed Hartford Water-Tank Tower

Inclined Columns of Tank Supported on Grillages at Fifth Floor Level—Swaybracing Removed Before Collapse

By Prof. Carlton T. Bishop
Sheffield Scientific School, Yale University, New Haven

As reported in last week's issue (p. 640), the collapse of the main entrance tower at the new plant of the Fuller Brush Co. in Hartford, Conn., on March 31 resulted in the death of ten men. The tower projected from the center of the front face of the main three-story-and-basement building, and was 28 ft. square, about 113 ft. high above the ground, and 124 ft. high above the foundation. A 50,000-gal. water tank contained in the top of the tower was supported by four inclined steel columns which transmitted the load to the brick walls by means of grillage beams at the fifth floor level, about 65 ft. above ground.

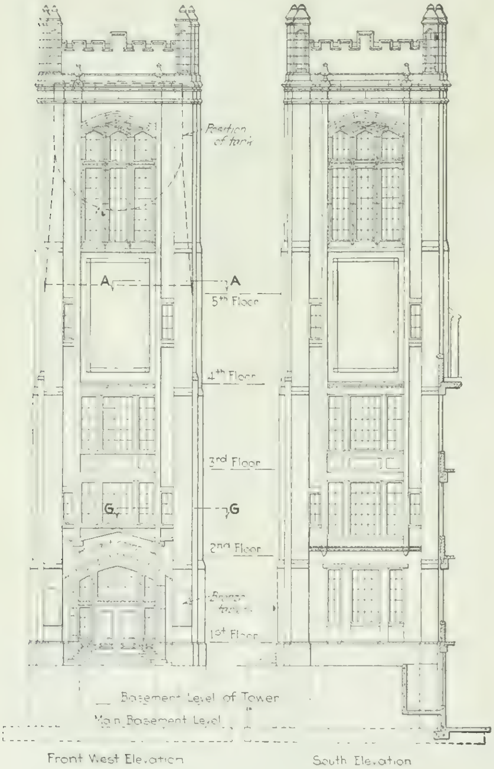


FIG. 1—FULLER BRUSH CO. TOWER
Tank in upper part filled at time of collapse

The outward thrust of the inclined steel columns of the tank was resisted by horizontal channels connected by bent plates to the columns about 1½ ft. above their bases. These channels joined adjacent columns, thus forming a square, no provision being made for direct connection between diagonally opposite columns. Just inside the walls and immediately above the fifth floor was a reinforced-concrete coping. The five 1-in. square rods in this coping were bent down at the ends "under and between" the grillage beams, but it is not clear whether or not they were so bent that they would be effective in preventing the spreading of the column footings.

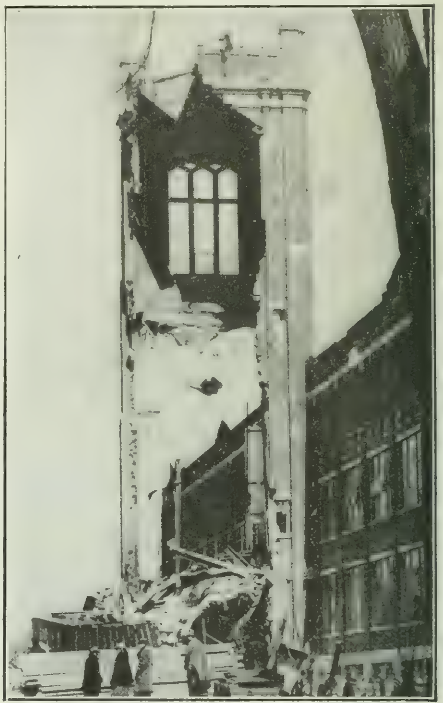


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FIG. 2—TOWER SHORTLY AFTER COLLAPSE
View looking north; southwest corner of tower gone.

One of the men who was fatally injured said that he had seen a large crack in the front wall of the tower under the large upper window. This would be only one or two feet above the column footing. He reported his discovery to the vice-president of the contracting company and they were on their way to the crack when the crash came which killed them both.

Another development is the fact that at least half of the eight 1-in. square swaybracing rods in the side faces of the steel tank support had been removed the afternoon before the accident. These rods extended from the top of each column to the bottom of the adjacent columns. The rods were removed by order of the engineers, who maintained that they were not necessary after the tank was enclosed by the walls so that no wind pressure on the tank need be considered. The daily press is placing emphasis upon the fact that the tower failed in less than 24 hours after the rods were removed, whereas up to that time it had stood two or three weeks after the tank had been filled. The rods were removed because they interfered somewhat with the use of the space under the tank. After the tower was nearly completed it was decided to use this space as a school room for the instruction of branch managers and assistants. A new floor was placed about 3 ft. above the original fifth floor, to obtain a greater floor area. A ceiling was constructed below the tank, the central and corner portions being horizontal, while the side portions sloped upward to include all of the lower windows. The exposed portions of the steel columns were wrapped with metal lath and plastered.

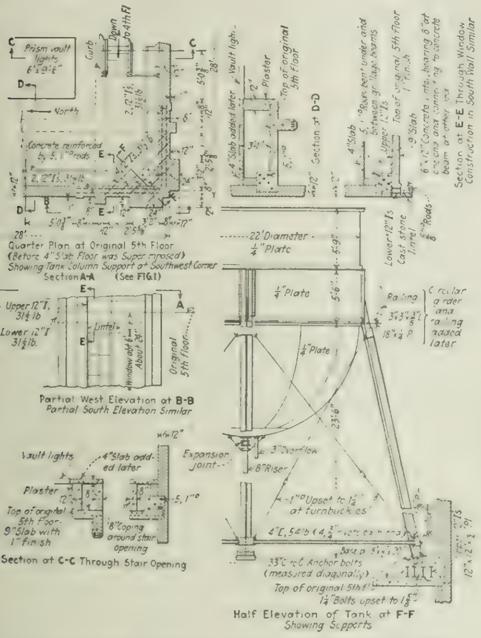

Prism vault lights 6'x9'-6"
Curb
Down to 4th Fl
C
D
North
Concrete reinforced by 5, 1"⌀ rods
2, 12" I's, 31½ lb
E
F
24"
12"
8"
1"
5'0⅞" - 8"
2'5⅝"
3'2"
28'
5'0⅜"
Quarter Plan at Original 5th Floor
(Before 4" Slab Floor was Superimposed)
Showing Tank Column Support at Southwest Corner
Section A-A (See FIG.1)
Upper 12" I, 31½ lb
Lower 12" I 31½ lb.
Lintel
Window abt 6'-1" About 28"
Original 5th floor
Partial West Elevation at B-B
Partial South Elevation Similar
Vault lights
4" Slab added later
Plaster
Top of original 5th Floor
9" Slab with 1" finish
8" Coping around stair opening
5, 1"⌀
Section at C-C Through Stair Opening
4" Slab added later
Vault lights
12"
Plaster
Top of original 5th Floor
3'-1"
5, 1"⌀
Section at D-D
4" Slab
5, 1"⌀ Rods bent under and between grillage beams
Upper 12" I's
Top of original 5th Floor 1" finish
9" Slab
6"x12" Concrete, bearing 8" at one end and connecting to concrete beam at other end
Section at E-E Through Window
Construction in South Wall Similar
Lower 12" I's
Cast stone lintel
⅝"⌀ Rods
22' Diameter - ¼" Plate
5'-9"
¼" Plate
5'-6"
Railing
3"x3"x⅜" L
18"x¼" P
Circular girder and railing added later
¼" Plate
23'-6"
3" Overflow
Expansion joint
8" Riser
1"⌀ Upset to 1¼ at turnbuckles
4" [, 5.4 lb
Base p
33" c to c Anchor bolts (measured diagonally)
Top of original 5th fl
1¼" Bolts upset to 1⅝"
Half Elevation of Tank at F-F
Showing Supports

FIG. 3—TANK SUPPORT AND DETAILS OF FLOORS AND WALLS

The city's supervisor of buildings has announced that his investigation, in which he was aided by A. S. Lynch, consulting engineer of New Haven, shows "that the cause of the disaster is in no way related to the permit for the erection of this plant nor to the plans and specifications filed in the office of the Supervisor of Buildings. I am satisfied that the cause of this disaster was beyond the control of this department." The engineering firm of Greenwood & Noerr of Hartford investigated the collapse for the general contractors who built the main building and all of the tower except the steel tank and supports. These engineers have reported that the R. G. Bent Co., the contractors, built the tower according to the plans and specifications furnished them by the architects, that their work was all that could be asked for, and that the contractors should be absolved from any blame for the collapse. The report of H. G. Balcom, consulting engineer of New York, who investigated for the Fuller Brush Co. and for the architects and engineers, Buck & Sheldon, of Hartford, has been made. This report is said to have fixed the responsibility and it is awaited with much interest, although its findings will not be made public until released by the State's Attorney.

The accompanying drawings have been adapted from the architect's drawings, obtained through the courtesy of Buck & Sheldon. Fig. 1 shows the front and side elevations of the tower with the position of the tank indicated. Fig. 2 is a view of the tower soon after the collapse. The southwest corner was completely destroyed. The upper portion of the north wall, which remained, was such a menace in the high wind that only the firemen and those most intimately interested ventured into the ruins to search for the bodies of those buried. An attempt was made to pull it down by means of cables attached to two trolley work-cars, but two charges of dynamite were required before the wall finally fell. The east wall was subsequently removed by men working on staging.

The tank as well as the masonry fell substantially straight down. A certain amount of the debris spread forward, or to the west, as may be seen from the view, Fig. 2.

Fig. 3 shows the arrangement of the tank and its supports. The four plate-and-angle columns rested on grillage-beam footings at the corners of the tower, and each column was anchored to the footings by two 1½-in. bolts passing through a plate on the under side of the upper grillage beams. These grillage beams were all embedded in concrete, and a reinforced-concrete coping surmounted the floor at the walls on all four sides. The upper diagonal beams rested upon the lower beams in the walls. The lower beams rested either upon the brick walls or upon the reinforced-concrete and cast stone lintels over the windows. The tops of the windows were about 1 ft. below the lower beams. The concrete lintels were wall-bearing at one end, but connected to the reinforced-concrete floor beams which entered the walls at the opposite sides of the windows. The bearing of these floor beams was increased by additional concrete on the sides away from the windows, doubling the width of the beams as they entered the walls.

For the sake of clearness the plan shows the original fifth floor before the additional school-room floor was added. The sectional views indicate the method of supporting this additional floor. The stairs shown in the plan were extended to reach the upper floor.

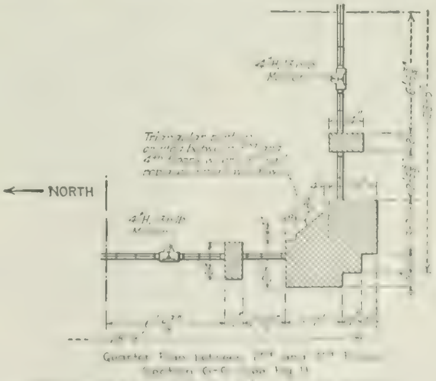


FIG. 4—WALL DETAILS [illegible] SECOND STORY

The 12-in. walls with pilasters extended from the column footings down to the fourth floor, where the pilasters were increased in thickness. Between the fourth and third floors the central wall panels were replaced by windows, and between the third and second floors small windows were added, so that the remaining wall areas were as shown in Fig. 4. There were two steel mullions in each side of the tower as indicated.

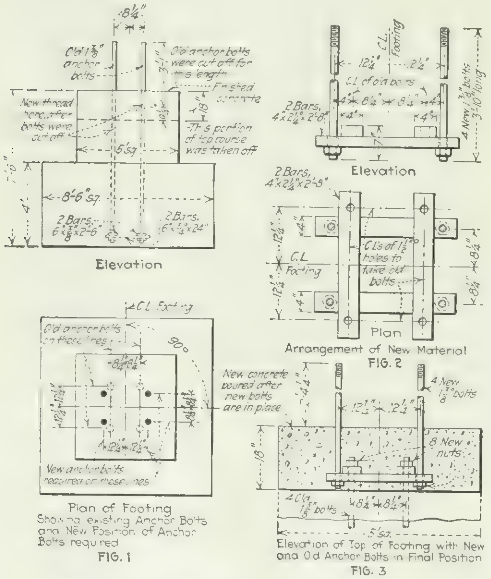
From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Placing New Column Foundation Anchor Bolts While Using Existing Ones

By Harry J. Finebaum
Resident Engineer for Clarence W. Hudson,
Hill-to-Hill Bridge, Bethlehem, Pa.

In one of the column foundations which had been built for the viaduct portion of the Hill-to-Hill Bridge at Bethlehem, Pa., it was found necessary to revise the position of the anchor bolts so that the axes of the bolts in the new position would be 90 deg. with those of the existing bolts. The latter were embedded practically the full depth of the concrete footing and were held together at the bottom by four anchor plates in accordance with the design as shown in Fig. 1.


Old anchor bolts
Old anchor bolts were cut off for this length
Finished concrete
New thread here after bolts were cut off
This portion of top course was taken off
5' Sq.
8'-6" Sq.
2 Bars, 6"x⅝"x2'-6"
2 Bars, 6"x⅝"x2'4"
Elevation
Old anchor bolts on these lines
90°
New anchor bolts required on these lines
2 Bars, 4"x2¼"x2'-8"
C.L. Footing
C.L. of old bolts
4 New 1⅜" bolts 3'-10" long
Elevation
C.L.'s of 1½" holes to take old bolts
Plan
New concrete poured after new bolts are in place
4 New 1⅜" bolts
8 New nuts
4 Old 1⅜" bolts
5' Sq.

Plan of Footing Showing existing Anchor Bolts and New Position of Anchor Bolts required
FIG. 1

Arrangement of New Material
FIG. 2

Elevation of Top of Footing with New and Old Anchor Bolts in Final Position
FIG. 3

METHOD OF PLACING NEW ANCHOR BOLTS

The method of providing new anchor bolts, herein described, was devised under the desideratum that the new anchorage must be as positive as the one designed originally, in its ability to resist uplift. Fig. 1 shows the plan and elevation of the existing foundation and its anchor bolts.

Eighteen inches of the top course of the footing were taken off by means of air drills and feather wedging and the exposed surface levelled by hand chiseling. The four existing bolts were then cut off about 9 in. above this surface and the ends rethreaded. Four new 1⅜-in. bolts with four steel bars, 4 in. x 2¼ in. x 2 ft. 8 in. long, assembled as shown in Fig. 2, were then slipped over the old bolts. The size of these steel bars was determined from the following conditions:

1—Two of the bolts on any one side of the footing were considered under a tension equal to the safe tensile strength of the bolts.

2—The moments developed in the bars by the above assumed forces acting on the bolts were then computed and the bars designed to carry these moments.

The new bolts were next set to the correct elevation, nuts were placed on the old bolts and turned to a bearing on the upper surface of the top 2¼-in. bars. The final assembly of the old and new anchor bolts is shown in Fig. 3. Concrete was then poured to complete the top course of the footing to the finished elevation required for seating the steel column.

Coal Towers Made Portable by Rollers

Because of the large shipments of coal and coke coming into San Francisco by steamer, the State Harbor Board has just finished the placing of six large rollers under each coal tower, so that the towers can be easily and quickly moved to points on the dock convenient to the ship's hatches.

Previously it required a crew of six men, with two hydraulic jacks and rollers and a motor truck, to move one of the towers. With this equipment it required about two hours to move a tower only a few feet on the dock. Now, by means of the rollers placed under the towers, any tower may be moved in five minutes by the ship's tackle.

Each of the rollers is 8 in. in diameter and 3 ft. 6 in. long, with a 10-in. groove in the center. There is an iron bark bearing for each roller which is connected to another iron bark timber which in turn is bolted to the timbers supporting the tower. A large greased iron washer is placed between the two iron bark timbers, enabling the rollers to be turned at any angle, thus permitting the towers to be moved in any direction along the dock.

WOODEN ROLLERS FACILITATE MOVING OF TOWERS

Liquid Oxygen for Blasting Operations

RECENT SUCCESSFUL use of liquid oxygen for blasting in mining operations at Pachuca, Mexico, suggests its practicability and economy for certain kinds of excavating operation in engineering construction. In a notable paper presented last month at the New York meeting of the American Institute of Mining and Metallurgical Engineers, M. H. Curlya and G. H. Clevenger give full details of the operations at Pachuca. Under the conditions the authors find an excellent case for liquid oxygen as compared with the ordinary explosives used in mining.

The production of liquid oxygen explosive is a field operation. It involves the installation of a liquefying plant and the provision of containers and minor apparatus for making the cartridges. At Pachuca the liquefying plant had a capacity of 25 liters per hour and the cost was 2.79c. per pound. With a larger and improved plant it is estimated that the cost could be reduced to 1.86c. per pound. These are operating costs exclusive of capital charges and overhead.

WITH the active season in construction work near, increased opportunity will be offered contributors to enliven the pages of ***"From Job and Office"*** with new ***"how to do it"*** articles. There is a tendency to let pass, in the stress of actual planning and execution of engineering-construction projects, details that are worth talking about. Help us make this specialized "kink" section of *Engineering News-Record* a story of the season's progress. Any person, either in the office or out on the job, is a potential contributor.

From the plant the oxygen is carried in special flasks to the working face. Here it is poured into other special containers into which the cartridges are dipped and soaked. The absorption process requires about 10 minutes and during this time and in pouring the liquid there is large loss by evaporation. The cartridges are paper cylinders filled with an absorbent—carbon black was used at Pachuca. Once dipped the cartridges have to be used quickly as they become non-explosive in about half an hour. They should be prepared for firing, put in the holes and fired at a certain age in minutes, which differs with different absorbents and wrappers, when their explosive effect is maximum. The explosion is by detonation using ordinary electric detonators. The cost as given in the paper referred to is as follows:

> The cost given herewith is computed and stated on the basis of the comparative cost of 40 per cent gelatin dynamite. These unit costs have been derived from the present operations. Liquid oxygen 2.79c. per pound, carbon-black cartridges 1.38 x 12 in. 1.85c. each, and 1.1 x 12 in. 1.40c. each. The equivalent of 1 lb. 40 per cent gelatin dynamite requires 2.1 lb. of liquid oxygen and 1.8 cartridges 1.38 x 12 in. and 2.6 cartridges 1.10 x 12 in. The total cost then of L.O.X. equivalent in breaking effect to 1.0 lb. of 40 per cent gelatin dynamite would be:
>
> | | Cents U. S. Cy. |
> |---|---|
> | 2.1 lb. liquid oxygen at 2.79c. per lb. | [illegible] |
> | 1.8 cartridges at 1.85c. | 3.33 |
> | Total cost, if 1.38 by 12 in. cartridges are used | 9.19 |
> | 2.1 lb. liquid oxygen at 2.79c. per lb. | [illegible] |
> | 2.6 cartridges at 1.40c. | 3.64 |
> | Total cost, if 1.10 by 12 in. cartridges are used | [illegible] |
>
> Average total direct or operating cost of, say, 9.35c. per lb. No allowance is made in this for amortization or interest on the capital expenditure for the liquid oxygen plant and equipment. In other words, 40 per cent gelatin dynamite would have to be delivered at the mine for 9.35c. U. S. Cy. per lb. (20.6c. U. S. Cy. per kg.) to equal the direct costs secured with L.O.X. in an experimental unit.

Summarizing the case for and against liquid oxygen explosive the paper states:

> The advantages of L.O.X., which are somewhat the same as those given by various authorities, but with added weight on account of demonstration at Pachuca, are briefly as follows: (1) A substantial saving in cost over the present cost of dynamite. (2) Greater safety, although it is difficult to place a definite monetary value upon this advantage. (3) Freedom from noxious gases, when properly used, renders it possible to return to the working face sooner than when dynamite is used. (4) Small increase in the oxygen content of the air at the working face is an advantage. (5) Although the powder magazine cannot be entirely dispensed with, there is no hazard from the storage of large quantities of high explosives. (6) Entirely eliminates thawing of powder; this is of no consequence at Pachuca but in a cold climate it would be an important advantage. (7) No high explosive in the waste pile or mill bins, for the L.O.X. cartridges become harmless soon after dipping. (8) No danger from drilling into missed holes, for the cartridges are harmless if not detonated soon after loading. (9) No loss of explosive and hazard to innocent persons through theft of explosive. (10) A feasible and economical method whereby mining companies can manufacture their own explosive. (11) The liquid oxygen can advantageously be used for welding and cutting, also in mine-rescue apparatus.
>
> The disadvantages of L.O.X. are likewise much the same as those that have been previously cited by other authorities. These are: (1) Require additional capital expenditure for liquid-oxygen plant and other equipment. (2) The limitation on the number of holes that can be fired in a single round is a disadvantage in large stopes and drifts. (3) Rapid and uninterrupted loading is imperative. (4) Variations in strength and general characteristics of explosive, owing to constantly diminishing oxygen content. (5) Not as convenient to use, especially in inaccessible parts of a mine. (6) With present technique not feasible to use it in holes having running water. (7) Questionable as to the advantage of using it for shaft sinking. (8) Cannot be used in gaseous or dusty coal mines.
>
> The disadvantages cited are not serious and are more than offset by the advantages.

Small-Diameter Dynamite Cartridges Inferior

Extract from report of the Bureau of Mines

BY S. P. HOWELL AND J. E. CRAWSHAW

AS THERE is a continuing tendency to use small diameter drill holes in order to lower drilling costs, and as the small hole requires a small diameter of explosive cartridge, the Bureau of Mines, in co-operation with the Institute of Makers of Explosives, has carried out a series of tests to show the effect of cartridge diameter on the strength and sensitiveness of certain high explosives. These tests show:

(1) That both the rate of detonation and sensitiveness to explosion by influence increase with the increase in diameter of the cartridge.

(2) That gelatin dynamites rapidly decrease in sen-

sitiveness to detonation and explosion by influence on ageing while the ammonia dynamite is little affected.

(3) That the insensitiveness of gelatin dynamites to detonation and explosion by influence on ageing proceeds more rapidly the smaller the diameter of the cartridge.

(4) That the insensitiveness to detonation and explosion by influence proceeds more rapidly with 60 per cent strength than with 40 per cent strength, L. F. gelatin dynamite.

As regards safety, the effect of cartridge diameter is very important, as the more rapid decrease in sensitiveness to detonation of the smaller diameter is likely to cause more misfires, while the decrease in sensitiveness to explosion by influence is likely to cause more partial failures from foreign material in the borehole. Further, insensitive gelatin dynamite sometimes burns in the borehole instead of detonating, and on burning, gives off large quantities of oxides of nitrogen which are very poisonous, even in small percentages. Also, in the smaller diameters of cartridge the proportion of paper wrapper to explosive ingredient is greater, and as most explosives on detonation give greater or less quantities of noxious gases (chiefly carbon monoxide) the smaller diameters of cartridge will give the greater quantities of poisonous gases because of this increased ratio of paper wrapper.

The results obtained from investigation of the samples which failed to detonate show the great importance of well tamping gelatin dynamite shots as this confinement will insure better and more complete detonation.

Accordingly, as the result of these tests which have shown a marked increase in rate of detonation and sensitiveness to explosion by influence for the larger diameters of cartridges and the very marked decrease in rate of detonation and sensitiveness to explosion by influence on ageing of the ⅞-in. diameter of cartridge, particularly of the gelatin dynamites, it is pointed out that both economy and safety in the use of explosives are lost by the use of that diameter of cartridges, and therefore, every effort should be made to use drill holes of such a diameter as will accommodate cartridges of not less than ¼-in. diameter.

Temporary Wood Truss Spans Gap in Steel Bridge

By L. R. Walker

Inspector, Arizona Highway Department, Palo Verde, Arizona

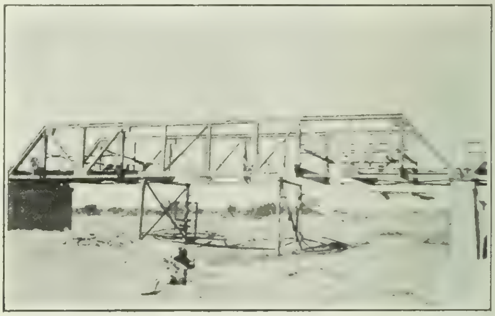
During the construction of a steel bridge carrying the Phoenix-Yuma Highway across the Hassayampa River, 45 miles west of Phoenix, Arizona, a novel use was made of a wooden truss.

The bridge consisted of two 90-ft. pony truss spans connecting 150 ft. of old pile-bent bridge with the opposite shore; the steel spans being supported on two concrete piers in the river bed and a reinforced-concrete abutment at the shore end. Each truss was composed of three sections weighing approximately 6,000 lb. each, and the floor cross-beams were 20-in. I-beams carrying an 18-ft. roadway. One span had been erected and on the other span construction had progressed to the point where a pier section had been placed in position, being supported at the outer end by cribbing consisting of 4 x 6 material, and tied together by three cross-beams; the balance of the sections being in the river bed ready to be raised in position.

From Job and Office

Hints that Cut Cost and Time

Ordinarily, the Hassayampa carries no water except a small amount of canal waste water; but like other dry rivers of the arid regions is subject to floods, generally of short duration, after a heavy rain. On Sept. 2, 1922, such a flood occurred, carrying a large amount of debris. This debris piled up against the old wooden bridge, thus tending to concentrate the current between the piers and creating a very high velocity at this point. The cribbing was soon carried out, dropping the pier sections into the river with the rest of the steel, all of which had now disappeared beneath the surface of the water.



WOOD TRUSS CONNECTS STEEL SECTIONS

When the flood subsided, all the steel, with the exception of a center section, was found buried in the river bed about 75 ft. downstream from the bridge site. As the lost section was 36 ft. long on the top chord, 18 ft. long on the bottom chord, and 10 ft. deep, no trouble was anticipated in finding it, but after a fruitless search embodying considerable expense and loss of time, it was decided to order a new section and proceed with the erection of the span.

Construction was again started on the span and it was shortly in place and bolted together ready for the middle section to be placed. To prevent the collapse of the span, in the event another flood carried out the falsework, a wood truss was made to fill in the gap pending the arrival of the new section. Riveting was then done over the rest of the span.

The wood truss was made from material the contractor had on hand at the job; the top chord being made of two pieces of 8 x 10-in. stuff spliced together, while the bottom chord was a piece of 10 x 12. They were tied together with three ¾-in. diameter rods; diagonals and posts were of 4 x 6-in. material. The ends of top and bottom chord were cut to fit inside the gusset plates and angles of the steel sections and were securely bolted to them, while the two end rods of the wood truss passed through the bottom plate of each section, thus drawing the wood truss tight against the steel.

While I do not know if this use of a wood truss is new, I have never seen or heard of one being used in this manner before. The wood truss was the suggestion of Merrill Butler, bridge engineer of the Arizona Highway Department. The contractor was A. W. Daniel, and the writer was state inspector on the work.

From Job and Office

For Contractor and Engineer

Materials for Dam Transported by Burros

By L. H. Dieterich

Construction Engineer, Arbuckle Dam, Lyons, Colo.

CONSTRUCTION of a concrete dam under extreme difficulty is under progress at an elevation of 11,300 ft. above sea level in Boulder County, near Longmont, Colorado. The dam is known as Arbuckle Dam No. 2 and when completed will form Arbuckle Reservoir No. 2. The stored water will be used to irrigate the sugar beet fields in St. Vrain valley near Longmont.

The dam is located above the timber line; consequently the construction season is very short, lasting usually from about July 14 to Sept. 10. Outside of this short season the snow and freezing weather make the mountain trails too dangerous to continue construction.

Cement is packed by mules for a distance of six miles up the mountain trails, each animal carrying two bags at a time. Gasoline, tools, lumber and steel reinforcement are supplied in the same manner. Crushed stone and sand are provided at the site, since these materials are of course available in any quantity desired. Power for crushing aggregate is supplied by a 25-hp. gasoline engine.

The laborious nature of this work is well illustrated by the fact that only about 2,000 sacks of cement are used each season, with other materials in proportion. Inasmuch as every two sacks require a round trip distance of 12 miles for one mule, it is apparent that if all the cement for one season were carried by one animal he would have to travel a distance of 12,000 miles.

The dam itself is 203 ft. long and 57 ft. high above the outlet tube. It is a gravity dam of the arch type. The concrete is a 1:2:3 mixture, with fair sized "plums" embedded in the concrete. One-inch twisted steel reinforcing bars are placed near the upstream and downstream faces of the dam, spaced one foot horizontally and vertically. Work was started in 1920 and has progressed each year as much as the difficult location and the short working season permitted. It is expected that the work will be finished in 1923, after 400 cu.yd. of additional concrete are placed.

The Arbuckle irrigation project is a locally owned enterprise. The writer, of Lyons, Colo., is the engineer in charge of construction.

MULES BEING PACKED FOR 6-MILE TRIP

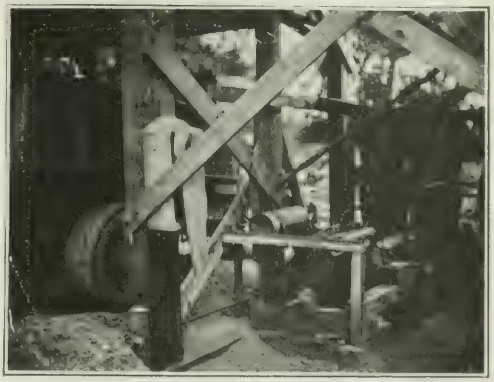
Note the gasoline tanks in the foreground. Cement, gasoline, lumber and steel reinforcing bars were carried over mountain trails in this fashion.

Gravel Screening Plant Operated by Truck Motor

By Paul L. Fetherston

Michigan Highway Department, Jackson, Mich.

THIS unique gravel screening plant is being operated by a highway contractor in Michigan with success. The gravel used in surfacing a trunk-line highway in that state must be of such size that it will all pass a screen having 1-in. openings and be largely retained on a ⅛-in. screen.



TRUCK MOTOR FURNISHES SCREENING PLANT POWER

Gravel pits are numerous but pit-run gravel will seldom meet with these specifications and as a result it must be screened and the undesirable constituents eliminated before it can be used as surfacing material.

It has been found that gravel containing stone larger than 1 in. in diameter will not wear evenly and will soon develop pits known as "chatter bumps" in the surface of the road, and also gravel containing too much sand and fine material will be easily rutted.

The screening plant shown here was designed by the contractor and it gave such good results that it has served as a model for other contractors in the district.

This plant is operated by a motor truck which is interchangeable with those used on the contractor's fleet of 5-ton trucks. A belt carries the power from the motor to the line shaft from which it is distributed to the elevator and screens. The elevator is made up of steel buckets mounted on a chain while the screens are of the ordinary belt-driven vibrating type.

The plant will handle 1,000 cu.yd. of raw material per day and is operated by two men aside from the foreman who has charge of the work. One man dumps the scrapers at the sump, while the other operates the gate valve which loads the trucks, keeps a record of the material when it is hauled out, and makes tests of the material to make sure that it will pass inspection.

The plant is put together in such a way that it can be dismantled in two days by a gang of eight men, and moved to a new location on five motor trucks.

From Job and Office

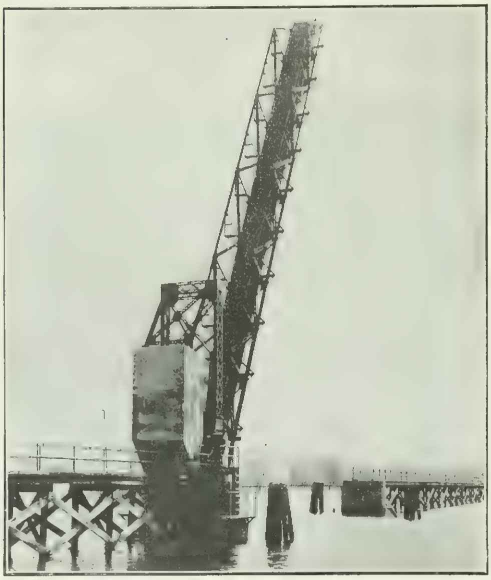
Hints that Cut Cost and Time

Footbridge With Bascule Draw

By P. J. Searles

Lieutenant, C. E. C., U. S. N., Indian Head, Md.

A RATHER unusual bridge for pedestrians only was built last year across Mattawoman Creek at the Naval Proving Grounds, Indian Head, Md. It is one of the few foot bridges with a bascule draw. The bridge, erected by the Kitler Elliott Co., has a length of 1,699.5 ft. between abutments and a width of 4 ft. 9 in. between handrails. The channel span is 106.5 ft. c. to c. of piers, the piers being 93 and 1,500 ft. from the abutments on the two sides of the creek.



BASCULE DRAW-BRIDGE FOR PEDESTRIANS

Pile bents are 15 ft. on centers, with 4-in. x 12-in. x 6-ft. caps across the two piers. The piers are cut so as to have 6-in. solid centers to which the caps are bolted with ⅞-in. galvanized bolts. Each bent is cross-braced with two 2-in. x 8-in. planks with the bottom of the braces 7 ft. below the top of the caps. The bents are braced against each other by 2-in. x 10-in. timbers, with the top 1 ft. and the bottom 7½ ft. below the top of the caps. The piles are creosoted.

The floorbeams, four in number, are 2-in. x 10-in. planks bridged 7½ ft. c. to c. and carrying a floor of 2-in. x 6-in. planks laid ½ in. apart. For the channel span steel instead of wood beams were used. The inside floorbeams are lapped 1 ft. and spiked, and the outside beams have a 2-in. x 8-in. splice 22 in. long. The channel span floor is 2 in. x 10 in. bolted to the angles, forming lower cross-bracing between the two trusses. Shore abutments and center piers are of concrete, resting on piles.

The pile driving could not be started because of the shallow water until a channel 40 ft. wide and 6 ft. deep was dredged so as to allow a piledriver to float. The piles ranged from 30 to 35 ft. in length for the abutments and about 50 ft. for the channel piers. Seven-pile dolphins were driven on each side of each pier for protecting the piers from ice and driftwood.

The draw, which is of the Strauss trunnion bascule type, was erected in the open position—76 deg. from the horizontal, or closed position. The concrete counterweight has a total weight of 170,000 lb. It has two pockets for adjusting weights. The draw is operated by a 220-volt 7.5-hp. a.c. motor with a torque of 80 lb. and a nominal running torque of 48.7 lb. A solenoid brake is provided to hold 80 lb. torque. The draw can be opened in 1½ minutes by motor and 3 minutes by two men operating a hand crank.

Scaffold Holds Long Reinforcing Bars

By G. W. McAlpin

Point Pleasant, W. Va.

WHEN concrete abutments were built for two bridges for the State Road Commission of West Virginia during the past season, some difficulty was experienced in placing reinforcing bars in proper position and holding them there while concreting operations went on. Due to the necessity of placing the bars before any concrete was poured for the footings, and due to the extreme length and limberness of the bars the contractor was forced to resort to use of scaffolding.

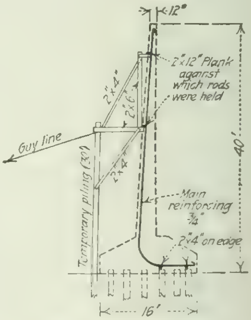


FIG. 1—REINFORCING SCAFFOLD DETAILS

This was accomplished by driving two temporary piles directly in the rear of the main abutment, and from these suspending the scaffold for the main walls and wings against which the rods could be supported. The horizontal part of the bars in the main wall rested upon 2x4-in. pieces securely spiked to the tops of the piling, while the vertical portion of the main bars

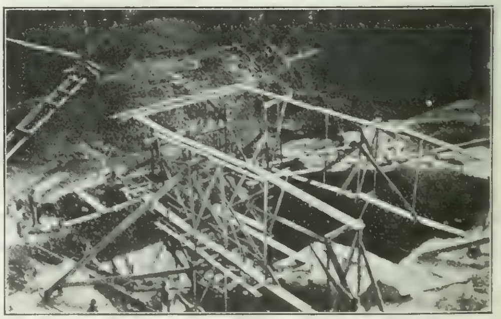


FIG. 2—SCAFFOLDING HOLDING BENT BARS IN PLACE

From Job and Office

For Contractor and Engineer

rested against 12x12-in. planks supported on the scaffold about $\frac{1}{3}$ and $\frac{2}{3}$ of the distance up from the footing.

By laying off the location of the bars on the 2x4 and 2x12-in. timbers and placing a nail at each point, exact alignment was assured. As each bar was put in place, it was set against the nail and the latter was then bent, holding the bar in place. The entire contract called for 82,760 lb. of reinforcement, with but 1,230 cu.yd. of concrete.

The work was done by Skene & Co., of Huntington, W. Va. H. J. Spelman is the division engineer for the State Road Commission.

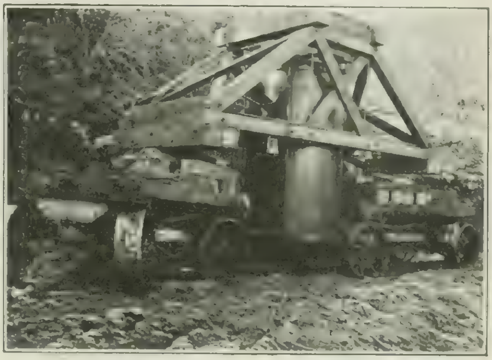
Heavy Load Transported More Safely When Suspended From Truss

IN BUILDING a series of hydro-electric plants on Pit River in California the Pacific Gas & Electric Co. was obliged to haul three transformers from their Bartle-Pit No. 1 R.R. across country to the Hat Creek power plants. The distance is about 14 miles over a mountain road with 14 per cent grades and many sharp curves. The transformers had to be delivered with the core in the tanks, which meant that they must be kept in an upright position. The transformers are 12 ft. high and shipping weight was slightly more than 13 tons.

The first transformer was loaded on a trailer and hauled in by caterpillar tractors. The gage of the trailer was 5½ ft. and its height 4 ft. 9 in. Hence the top of the tank as loaded was more than 18 ft. above ground and the center of gravity of the load was about 6 ft. above the trailer bed. Delivery was made safely but it required such painstaking effort and involved so much risk, time and expense, that it was determined to bring in the other two with some rig that would keep the center of gravity lower and make for easier handling.

Two trailers were therefore used in connection with a timber truss, as shown in the accompanying illustrations, which made it possible to suspend the load from above. This proved to be a most satisfactory arrangement and was used for moving two transformers without accident.

The truss was built of Oregon pine; contained 1,900 ft. b.m. and 865 lb. of bolts and plates. The total labor cost in putting it together was about $300. The two 12x12-in. transverse members of the truss, each carried two 1⅛-in. rods with the lower ends shaped into eyebolts and located so as to conform to the spacing of the four suspension rods of the transformer. Clevises were used to fasten the eyebolts of the truss to the eyes in the tops of the transformer suspension rods. The "draw-bar pull" did not go through the truss but was carried from forward to rear trailer by a tie rod running underneath the load.

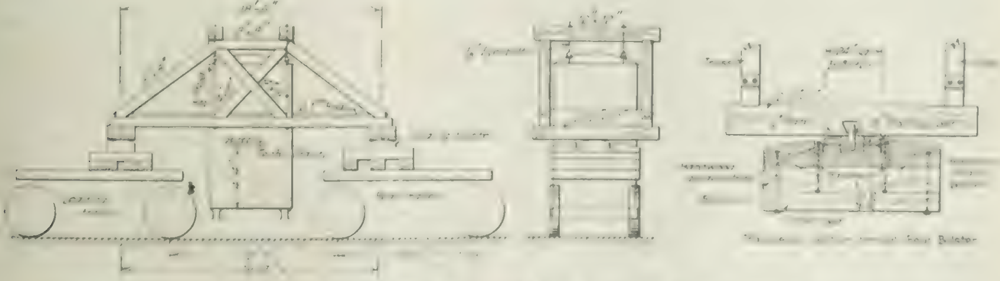


13-TON TRANSFORMER LOADED TO REMAIN UPRIGHT

With this rig two transformers were hauled 14 miles over a mountain road containing many sharp curves and grades up to 14 per cent. Transformers were moved without accident.

An important feature of the rig was that the bolsters on which the truss ends rested (see elevation) were curved so that unevenness of road surface would not rock the load. Hence the transformer remained upright or nearly so even when the road sloped sharply to one side. The upper king pin sockets were made as inverted cones to allow for tilting of the pins. The forward bolster was fixed and the rear bolster was built so it could slide forward and back enough to compensate (1) for the effect of the spring on the rear trailer draw-bar and (2) for the shortened distance between trailers in rounding curves.

The arrangement for loading these transformers was devised by James Martin, construction superintendent. O. W. Peterson is construction engineer in charge of the work.



TRUSS AND TRAILER ARRANGEMENT FOR CARRYING TRANSFORMER

This rig gives the [illegible] center of gravity, keeps the load upright [illegible] front and rear trailers [illegible] was used in the truss.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Los Angeles Not a Minor Port

Sir—An editorial appearing in *Engineering News-Record*, Dec. 21, 1922, p. 1054, refers to the port of Los Angeles as a minor port. A few facts regarding the Los Angeles harbor may be of interest and may serve to correct a wrong impression regarding the importance of the harbor and the amount of business handled by this port.

At the beginning of 1920, the total water commerce through the port averaged about 250,000 tons a month. In January, 1923, the commerce was approximately 1,400,000 tons per month. It is not believed that any other port on the Pacific coast has ever handled a total commerce of 1,000,000 tons in any one month. Fifty-one regular steamship lines carrying general cargoes now serve the port and these lines do not include tank steamer lines nor lumber carriers.

On March 14, seventeen tank steamers were in port to load oil and the total number of vessels in port that day were sixty. While the recent very large increase in tonnage handled is in part due to the tremendous oil development in the region tributary to Los Angeles, the general commerce of the port has been increasing at a very rapid rate.

Ralph J. Reed,
Chief Engineer, Union Oil Co., of California.

Los Angeles, Calif.,
March 19, 1923.

The Tacoma Skew Arch

Sir—The failure of the skew arch in Tacoma (*Engineering News-Record*, Feb. 22, 1923, p. 355) should provoke more than passing interest from the engineering profession. At the time this bridge was designed, about 1911, there was little published about the effect of the skew on the stresses and in fact literature on the subject is very meager at the present time.

By means of models it has been repeatedly shown that the thrust is greater at the obtuse corner (in plan) than at the acute. It naturally follows that the thrust may even reverse and become negative. In the case of the Tacoma bridge the failure clearly indicated this reversal. An examination of the structure showed it much clearer than the drawing accompanying the report. By cutting a piece of stiff paper in a diamond shape and fastening two opposite edges to the table so that it arches between, a model illustrative of the action can be obtained.

If, instead of taking the elevation view perpendicular to the spandrel wall, it is taken parallel to the lower roadway, the arch ring will appear in its true shape and span. With this view all loads (except from spandrel walls) will have no component in the direction of the line of sight. However, the force at the crown in the arch ring will have a component in this direction. This component varies with the design of bridge, angle of skew and load, but is not great enough to cause the thrust to pass through the center of the abutment.

It is a common fault in skew arch design to assume all forces, both internal and external, as acting parallel to the spandrel wall, i.e., to design the arch rib as it would appear in a view looking perpendicular to the spandrel wall and neglect all effect of skew. This neglects very important external loads as well as internal forces, with the result that skew arches are liable to show tension failures in the acute angle or compression failures in the obtuse. The external loads can be approximated or computed but the internal forces require the development of the elastic theory of the arch when skewed or the ability to foresee the results of such an analysis in a general way.

An examination of the Tacoma arch after the failure occurred, showed the effect of tension in this portion of the arch ring, together with earth thrust on the spandrel wall, pulling the broken rib from its neighbor. As the steel runs parallel to the spandrel wall, there was little provision to resist this tension. Owing to the solidity of the fill over the arch, the three ribs doubtless acted as a unit to some degree, otherwise tension failure would not have occurred across an entire rib.

Waddell in "De Pontibus" says "A skew bridge is a structure the building of which should always be avoided when it is practicable." After a great deal of study on the theory of the skew arch, the writer has come to the conclusion that Waddell was right, even if the remark was written before the days of reinforced concrete. However, this crossing presents a problem that would be hard to solve in any other way and doubtless this same condition arises at other times. All examples that can be obtained on this important problem should be made available to the engineering profession through its publications that designers may have data from which they can approximate the effect of the skew.

J. Charles Rathbun.

Seattle, Wash., March 21, 1923.

Riveting Painted Surfaces: Some Paint Knowledge Needed

Sir—The tests of riveting painted plates described in your March 8 number, p. 460, are open to the following criticisms:

Laboratory tests (these were such) should be made or supervised by a trained laboratory man—and paint tests especially by some one experienced in paint manufacture.

Mr. Greene says the paint was composed of 67 lb. of red lead to a gallon of boiled oil, plus a gallon of raw oil, plus ⅓ gallon drier. It has long been customary to describe red lead paints as containing so many pounds of red lead (meaning dry red lead) to a gallon of oil; but I think in this case it means 67 lb. paste red lead, which would contain about 62.6 lb. of dry red lead, and a little more than 0.56 gal. of oil. This would make the paint batch contain about 2½ gal of oil, and a third of a gallon of drier, and measure almost exactly 3¾ gal. This means that it contained about 21.7 lb. dry red lead to the gallon of vehicle or 24.4 lb. to each gallon of oil; a rather thin paint.

The important and significant thing is the great amount of drier. Such a paint ought not to have any drier, because the boiled oil contains enough for itself and the raw oil; and if it were all raw oil, five per cent of drier would be enough. Most painters know that a large excess of drier makes paint set up immediately and harden quickly; but what they do not know is that this sudden setting up is a sort of gelatinization, and this apparently dry paint holds the turpentine (which constitutes nearly all of the bulk of the drier) and lets it evaporate very slowly. Exposed to the air, it will in time disappear. The paint may not be as durable as it should be, but eventually the film will come to a stable condition.

But in this case, as soon as one coat was dry, another and another was put on, and, while the final three coats appeared to be dry and hard, probably half of the original turpentine was still in it; solidified turpentine is an article of commerce and is sold for china-painters as "fatty oil." When the hot rivet came close to this paint, if the temperature rose to 320 deg. F. the turpentine in it became a gas and, in blowing out, carried with it a good part of the not very hard linseed oil in which it was dissolved. That was the cause of the "boiling out" of the paint.

I repeat that you cannot harm pure linseed oil by heating it to 600 deg. for a few minutes, nor by heating to 550 deg. for several hours, and it does not boil at these temperatures. I do not doubt what Mr. Greene and Mr. Fickes say; nor that they tried faithfully to get at the facts; but they are not to blame for not knowing some of these things.

The important point is that in this experiment part of the turpentine which was in the drier remained in the film as a kind of solidified gas; and when heated, it became a true gas and forced its way out. It can easily be understood that even a little would make a great disturbance.

New York, March 22, 1923. A. H. Sabin.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Ceremonies in Connection with the breaking of ground for the construction of the Brooklyn shaft of the Brooklyn-Richmond freight and passenger tunnel will be held at Bay Ridge at 3 P. M. Saturday April 14.

New Cars and Locomotives, costing more than $17,000,000, which have just been ordered by the Southern Railway System, will nearly all be built at points on the Southern's lines. Fifty freight locomotives, 16 passenger locomotives, 5 dining cars, 3,070 box cars, 2,865 hopper-bottom coal cars, 2,000 gondola coal cars, and 200 stock cars are included in the order. All of them are contracted for delivery during the summer.

Investigation of Excessive Overhead charges upon reclamation projects under government control in the western states, according to an announcement of the Department of the Interior, is to be made by Assistant Secretary of the Interior D. W. Davis on a tour of personal inspection in which he will be accompanied by A. P. Davis, director, United States Reclamation Service. The two will leave Washington April 14.

Cities in Michigan May Incorporate as port districts hereafter under authority granted by an amendment to the state constitution approved by the voters of the state April 2. The measure had been defeated at two previous elections. A large favorable majority to the amendment was cast in Detroit in view of local interest in the proposed Port of Detroit.

The Chicago Zoning Ordinance, as prepared by a commission of twenty-one members which was appointed by the mayor in July, 1921, was adopted on April 5 by the unanimous vote of the Chicago city council. The chairman of the commission is Charles Bostrom, city building commissioner, and its zoning expert is Edward H. Bennett of Chicago.

Paralleling in a Measure the recent gift of Ambrose Swasey of Cleveland of $500,000, which made possible the organization of the Engineering Foundation, comes the bequest of a like sum to the furtherance of scientific study by Sir Alfred Yarrow to the Royal Society in London.

Probably the Longest of the Numerous minor railways which have been abandoned during the past few years on account of financial condition is the 234-mile line of the Chicago, Peoria & St. Louis Ry., extending from Pekin, Ill., to East St. Louis. The Interstate Commerce Commission has authorized the receivers to abandon the line, which will be sold either as a whole or in part and will probably cease to be an operated line. Negotiations for purchase by larger connecting lines have been unsuccessful.

Am. Soc. C. E. Again Rejects Affiliation In Federated Engineering Societies

Total Adverse Vote 581 More Than in 1920—Three Districts Report Favorable Plurality—Total Vote 5,753

In the letter ballot canvassed April 6 the American Society of Civil Engineers again decisively voted against affiliation with the Federated American Engineering Societies. The vote was 2,112 for membership and 3,641 against it. In only three districts was there reported a plurality in favor of affiliation, these being Districts 7, 9 and 11. In District 1 (New York) the total resident vote was 854, of which number 688 rejected the plan of affiliation.

AM. SOC. C.E. VOTE ON PROPOSAL TO JOIN FEDERATED AMERICAN ENGINEERING SOCIETIES

District	*1	**1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Yes....	25	166	84	107	143	134	87	276	167	184	109	191	102	84	108	145	2,112
No ..	84	688	331	211	292	254	214	144	186	154	203	189	124	209	158	200	3,641
Plurality for ...	..	...	...	...	...	...	...	132	..	30	.	2		.	.	.	164
Plurality against	59	522	247	104	149	120	127	..	19	.	94		22	125	50	55	1,693

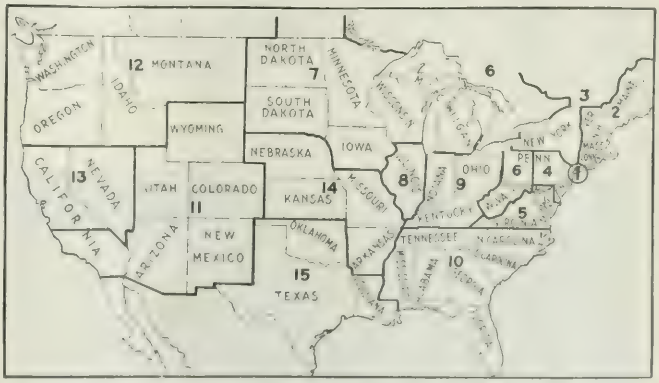
*Foreign ** Resident. Total Vote: 5,753. Total Plurality Against 1,529.

COMPARISON OF 1920 AND 1923 VOTE

	1920	1923	Difference
No	3,278	3,641	+363
Yes . .	2,330	2,112	—218
Total................	5,608	5,753	145
Negative plurality......	948	1,529	581

In 1920 defeated in 9 of the 13 districts.
In 1923 defeated in 12 of the 15 districts.

The accompanying map indicates how the country is divided into districts. In the table at the left is given the comparison of votes canvassed in 1920 and 1923. Since 1920 two new districts have been added.



MAP SHOWING AM. SOC. C. E. DISTRICTS

Higher Court Holds N. Y. Dwelling Exemption Law Valid

The Appellate Division of the New York State Supreme Court in a decision handed down April 6 reversed the decision of the lower court and declared constitutional the act passed by a special session of the New York Legislature in 1920, authorizing the municipalities of the state to exempt low-cost dwellings and apartment houses from taxation for a period of ten years, provided that construction was begun prior to April 1, 1920. The decision of the lower court was given in *Engineering News-Record* March 29, p. 598. The Appellate Division in a unanimous decision put the tax exemption in the same class as other emergency legislation to relieve the housing situation passed by the special session of the New York Legislature in 1920 and sweepingly over-ruled the opinion of the lower court that (1) the tax exemption law delegated the powers of the Legislature and (2) gave special exemption from taxation because the act was permissive and some cities might while others might not accept its provisions. Whether another appeal will be taken has not been announced.

Spokane Engineers Discuss Licensing Bill

At a recent meeting of the Associated Engineers of Spokane considerable discussion was had of the bill before the Washington Legislature which provides for the registration of all engineers practising in the state. However, no recommendation was made in view of positive action taken by the local sections of the American Institute of Mining and Metallurgical Engineers and of the American Society of Civil Engineers. The former organization memorialized the state legislature with unqualified opposition to every form of registration and licensing of engineers as being contrary to American ideals of Freedom. The memorial deplored the attempt at license and characterized any legislation of the sort as an insult to the profession.

The local section of the Am.Soc.C.E. favored the bill as the lesser of evils inasmuch as the demand for registration and licensing seems to be the tendency of the times. The civils are reported to have considered the bill harmless outside of the heavy initial fee charged, and are reputed to have expressed the opinion that should they oppose this particular bill something worse might be presented.

Members of the local sections of the American Institute of Electrical Engineers and of the American Society of Mechanical Engineers have proven noncommittal.

The proposed Washington bill as passed in the house allows licenses to those practising within the state who register within six months after the bill becomes effective. An initial fee of $20 is required and $1 per year thereafter. Penalties are provided for calling oneself an engineer if not registered, and excludes from court work or state work those who are not registered.

Chicago Engineer Reinstated

The Chicago Board of Local Improvements has recently reinstated John B. Hittell, as chief engineer of streets. He was suspended Dec. 10, 1915, by the board as a result of a letter from the Civil Service Commission directing his suspension pending an investigation of the methods employed in awarding paving contracts. No investigation was held of Mr. Hittell's conduct but he did not get back his position.

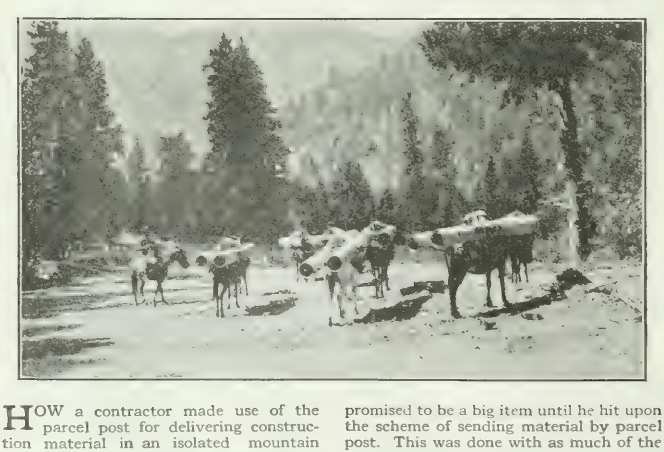
He asked a year's leave of absence which was granted on condition that he submit his resignation (as a formality so the commission held at the time). At the end of the year the commission refused to reinstate him.

Finally a successful suit was brought in the Cook County Circuit Court which was carried by the city to the Appellate Court. The latter upheld the Circuit Court which was directed to mandamus the Civil Service Commission to restore Mr. Hittell to his former position with payment for back salary.

Mississippi River Bridge to Be Built by Twin Cities Jointly

C. M. Babcock, state highway commissioner of Minnesota, is chairman of a commission of five members created by the legislature of that state to direct the construction of a concrete bridge over the Mississippi River between St. Paul and Minneapolis near the government high dam. Other members of the commission are the presidents of the city councils and the city engineers, G. M. Shepard, St. Paul, N. W. Elsberg, Minneapolis. By the enabling act, which has been signed by the governor, each city is authorized to issue up to $800,000 for the project. The bridge is part of a joint Twin Cities program to serve the proposed Ford Motor Co. plant at the high dam with traffic facilities.

Contractor Ships Culvert Pipe by Parcel Post Mules



How a contractor made use of the parcel post for delivering construction material in an isolated mountain country is told in the accompanying picture. In his contract for work on the Klamath River Forest road, in California, the contractor was faced with a serious problem in distributing his culvert material in advance of the building of any sort of highway. The cost of transportation promised to be a big item until he hit upon the scheme of sending material by parcel post. This was done with as much of the stuff as seemed necessary and feasible. The picture shows parcel post mules making their way over the mountains loaded with corrugated iron culvert pipe. The new road penetrates a region which is inhabited by Indians living practically in the primitive fashion.

Port Authority Takes First Step to Develop Its Plan

On April 5 in response to a summons from the Interstate Commerce Commission, the representatives of the trunk railroads having terminals at the Port of New York, appeared before the Interstate Commerce Commission and the Port of New York Authority, sitting concurrently, to show cause why certain portions of their lines located along the New Jersey waterfront at New York should not be consolidated into one railroad as outlined in the Port Authority's plan for the development of the Port of New York, and called on that plan the New Jersey Inner Belt Line, Marginal Railroad No. 13.

The first part of the hearing lasted until the afternoon of April 7, and was devoted to the presentation of the case on the part of the Port Authority by counsel, by the examination of witnesses and by exhibits. The counsel for the Port Authority in presenting the case took the attitude that according to the law which created it, the Port Authority must first demonstrate to the Interstate Commerce Commission that the proposed belt line was both physically practical and economically desirable at this time, and that consequently the consideration of matters of policy and methods of operation would be a waste of the commissions' time until after it had decided the former question in the affirmative.

Marginal Belt Line No. 13 as called for in the approved plan for the development of the Port of New York is made up of 17 miles of existing railway tracks paralleling the New Jersey waterfront from Fort Lee on the north to Constable Hook on the south. The tracks in question are largely used now for interchange and interswitching and the Port Authority claims that the operation of them as a complete belt line serving all the railroads, industries and shipping interests along the New Jersey water-front can be effectuated without any new construction, that, in fact, such an arrangement was put into effect during the war.

Upon the conclusion of the presentation of the testimony by both sides the Port Authority will ask the Interstate Commerce Commission that if the Commission is of the opinion that the development of Marginal Railroad No. 13 is possible and economically desirable at this time, it will issue an order directing the railways concerned to take steps to create such a belt line.

The hearing adjourned on April 7 to allow the railroads to examine the testimony and exhibits before being called upon to reply.

Start Probe of Old New Jersey Highway Commission

Having confirmed Governor Silzer's appointment of the four-man, bipartisan highway commission, the New Jersey legislature will now probe the old highway commission, Attorney General Thomas F. McCran being delegated to conduct the investigation. The state has instituted suit in the Court of Chancery to recover $140,000 which, it is claimed, the state was mulcted of in the purchase of land for approaches to the proposed new $3,000,000 bridge between Perth Amboy and South Amboy.

Colorado Society Wants Local Engineer for Tunnel Board

W. M. McMechen, president of the Colorado Society of Engineers has addressed a letter to William P. Robinson, chairman of the Moffat Tunnel Commission urging the appointment of a local man as chief engineer for the commission. Part of the letter follows:

"As president of the Colorado Society of Engineers, I am directed to place before you, not only the protest of our society, but protests communicated to our secretary from prominent engineers of other state engineering bodies, against the appointment of an engineer from outside the state as chief engineer of the Moffat Tunnel Commission. The Colorado Society of Engineers, through the action of its president, wishes to go on record as being absolutely opposed to the importation of an engineer from outside the state, since it is possible to secure experienced and competent engineers in Colorado.

"The construction of the Moffat tunnel is peculiarly a Colorado project. It is a deliberate act by the citizens of the Moffat tunnel district to improve transportation facilities in a portion of the state whose future development depends upon the securing of better means of railroad communication.

"The Colorado Society of Engineers is not alone in taking this attitude. It is safe to say that the members of the other scientific and engineering societies of Colorado are practically united in their demand for the appointment of a Colorado man as chief engineer of the Moffat Tunnel Commission, and this statement rests upon the fact that a number of the most prominent engineers in Denver have communicated with the secretary of this society, and have expressed in positive terms their disapproval of the plan, known to be considered, of importing an Eastern man of the New York group.

"The secretary of the Colorado Society of Engineers has been informed that this proposal will be regarded by the engineering profession of the state as a direct reflection upon the profession and will be considered as a personal affront to its prominent members."

State Sanitary Engineers Meet in Washington, May 16-17

The fourth annual conference of state sanitary engineers will be held at Washington, D. C., May 16 and 17. Membership includes the chief sanitary engineers of state health departments and other chief sanitary engineering officials having charge of sanitary engineering work of the states, and three sanitary engineers of the United States Public Health Service. The meetings will be held at the United States Capitol Laboratory. A prominent part of the program includes a discussion on the proposed Treasury Department Water Standards, which will be opened by Surgeon A. J. McLaughlin of the United States Public Health Service. Most of the topics on the program relate to water supplies and allied matters, but sewage disposal and mosquito control, sanitation of bathing beaches, etc., will be up for discussion. Programs can be obtained from I. W. Mendelsohn, Assistant Sanitary Engineer, United States Public Health Service, Washington, D. C.

Col. Keller Resigns as D. C. Engineer Commissioner

Col. Charles Keller, a widely known officer of the Corps of Engineers, U. S. Army, who has served for the past two years as Engineer Commissioner of the District of Columbia, has resigned as a District Commissioner to undertake important duties in connection with hydro-electrical development on the Coast.

While Col. Keller is eligible for retirement, it is understood that he will ask at this time for a leave of absence only. It is understood that the Byllesby Engineering and Management Corp. has agreed to give him a five-year contract. Before signing the contract, however, and definitely retiring from the army, it is understood that Col. Keller prefers to familiarize himself more thoroughly with the character of the work he will be called upon to perform.

Throughout his engineering career, which began with his graduation at West Point, in 1890, Col. Keller has taken great interest in water-power development. As the representative of the War Department, he supervised most of the important installations at Niagara Falls and was the representative of the Department who assisted in the drafting of the Federal Water Power Act.

Hetch Hetchy Dam Is Now "O'Shaughnessy Dam"

The Board of Supervisors of San Francisco on March 26 adopted a resolution providing that the Hetch Hetchy Dam shall hereafter be designated as "O'Shaughnessy Dam" in honor of its builder. The resolution states that the dam is one of the largest structures of its kind in the world and will long endure as evidence of the knowledge and genius of its creator, M. M. O'Shaughnessy, city engineer of San Francisco.

The resolution provides "That as a monument of the great ability displayed in its creation and to perpetuate in the years to come the name of its builder said structure shall be designated and hereafter be known as O'Shaughnessy Dam" and also "that the Board of Public Works is hereby directed to have the aforesaid name suitably engraved upon the structure."

Michigan Joins Wisconsin in Lake-Level Suit Against Chicago

States attorneys and engineers of Wisconsin, Michigan, Minnesota and Indiana met March 19 and 20 in Chicago to discuss the suit started last year by Wisconsin against Illinois alleging lowered lake levels with damage to lake ports due to excessive withdrawel of water by the Sanitary District of Chicago. The purpose of the conference was to enlist the aid of three states to Wisconsin's suit. From reliable sources it is learned that Michigan was inclined to favor and join with Wisconsin, while the other two states were lukewarm on the proposition.

Three days previous to the attorneys' conference R. R. McCormick, editor of the *Chicago Tribune*, delivered an address in defense of the Sanitary District before the Western Society of Engineers.

Gen. William V. Judson Dies

Gen. William V. Judson, commander of the 38th Division during 1918, and later commander of the Port of Embarkation, New York, died in Florida recently aged 60 years. Gen. Judson was retired from the Corps of Engineers several months ago, his last official assignment having been division engineer of the Northwestern Division with headquarters in Chicago.

After two years at Harvard, Gen. Judson attended West Point, being graduated in 1888. He rose in the Corps until in May of 1917 he was made colonel. Soon after he was made a brigadier-general and placed in command of troops. Various stations which he occupied officially included membership on the Corps of Engineers Board of Rivers and Harbors, supervision of port improvement at Galveston and of Mississppi River improvements, instructor of military engineering at the U. S. Engineer School, and assistant to the Chief of Engineers.

During the Russo-Japanese War Gen. Judson was military attache with the Russian Army. Later he was placed in charge of the light-house construction and harbor improvements on Lake Michigan, which station preceded a term as engineer commissioner of the District of Columbia. He went to Russia in 1917 as a detached officer, but remained there in 1918 as military attaché and chief of the American Military Commission.

He was a member of the American Society of Civil Engineers and of various social clubs in Washington and Chicago.

New Sewage-Works Program Arranged for Philadelphia

To add borrowing capacity to Philadelphia by releasing an alleged commitment of $29,000,000 of expenditure to complete the far-looking sewage-disposal program authorized in 1915 by the State Department of Health, a revised program has been arranged between the city and the state department named under which the specific commitment against the city's borrowing capacity will be reduced to $9,000,000 to be expended at the rate of $2,250,000 a year during the next four years, provided that the electors approve a $9,000,000 loan to be submitted to them at an early date. The agreement provides for extensions of the time limit for the completion of sewage-works beyond the date stipulated in the 1915 permit and for still further extensions, all contingent upon due diligence in prosecuting construction now agreed on and in submitting plans to carry out by stages the full program of 1923.

The 1915 permit was based upon plans for three sewage-works, intercepting sewers and pumping plants estimated to cost [illegible]. After the city had been operating for six or seven years under the permit and had appropriated [illegible] to carry out the program, the city solicitor, last December, rendered an opinion that the remaining $29,075,000 called for by the program, most of which would not be expended for years to come, was a charge against the city's borrowing capacity. It is expected one of the three proposed sewage works will be completed this summer.

Colorado Signs River Pact

On April 2 Governor Sweet, of Colorado, signed the Colorado River pact which had been accepted by both houses of the Colorado Legislature. This leaves only the State of Arizona not signatory to the pact, which is between the States of California, Utah, Wyoming, New Mexico, Arizona, Colorado, and Nevada. As noted in these columns some weeks ago, the Arizona Legislature adjourned without ratifying the pact after a vote of 22 to 22 in the Assembly. It is now reported that the Governor of Arizona is trying to call an extra session for reconsideration of the treaty.

The whole subject of the Colorado River power development, it is now announced, will be taken up by the Federal Power Commission at a meeting to be held April 18. The Commission has advised the Governor of Colorado, according to a previous promise, that consideration is to be given the application of James B. Girand for a license to develop the project at Diamond Creek on the Colorado River. It was stated in the letter to the Colorado Governor that any license issued to Mr. Girand would carry with it a condition that the use of the water for power purposes would have to be subordinated to its use for irrigation.

This carries with it the intimation that the Commission may act on the Girand application at its forthcoming meeting.

It is fully expected that the discussion will include the whole Colorado River question. Any discussion of the Diamond Creek project carries with it the necessity of considering the Glen Canyon application of the Southern California Edison Co. It also is believed that the Flaming Gorge project of the Utah Power and Light Co. will be brought up, since that company is very anxious to utilize the coming field season to do the necessary drilling to establish foundation conditions. The Kremmling project of the Denver Gas and Electric Co. also is to be considered.

Baltimore & Ohio Starts a New Grain Elevator

The Baltimore & Ohio R.R. Co. has started the construction of a new grain elevator at its Locust Point Terminals, Baltimore, Md. The new elevator will have a capacity of 3,800,000 bushels and is so designed that storage bins for 6,000,000 bus. additional can be built as required. The elevator proper will be built of concrete. The grain handling equipment will be the most modern available including car dumpers, power shovels, grain cleaning and drying equipment, and a gallery system equipped with belt conveyors for the delivery of grain from the elevator to the ships. The total cost of the work, including the pier improvements and yard changes will be $5,500,000.

St. Paul Ry. to Serve Ford Plant

A 4½-mile branch or spur traversing the heart of the city of St. Paul, Minn., is expected to be built this year at a cost of $700,000 by the Chicago, Milwaukee & St. Paul Ry., in order to serve the Ford plant which is being arranged for near the high dam on the Mississippi River. An ordinance has been passed by the city giving the railway company permission to cross the streets at grade.

Burlington Ry. Has Big Program for 1923 Improvements

The 1923 program for improvement work on the Chicago, Burlington & Quincy R.R. aggregates $50,000,000, of which $25,000,000 is for additions and betterments, including equipment, and $25,000,000 for maintenance of way and structures. These figures compare with $19,370,000 and $20,769,379 respectively for 1922. In thus planning its work the railroad is not only providing for the business in sight but to some extent anticipating future developments. In this large program are the following items: About 30 miles of second track, including some realignment, $2,200,000; enlargement of yards, $800,000; shops, roundhouses and engine terminals, $1,300,000; water and coaling stations, $350,000; relaying rails, including 44,000 tons of new rails, $1,268,000; about 160 miles of automatic block signal installations, $420,000; replacing temporary bridges, $1,458,000, of which $860,000 will be for replacement in permanent form. As to equipment, sixty heavy freight locomotives and 7,300 cars have been ordered, to which will be added the purchase of 1,000 stock cars and 200 combination coal and construction cars. Arrangements are being made also for heavy repairs to 6,000 coal cars.

Fate of Water Supply Bills in New Jersey Legislature

To afford relief to municipalities and water companies in Union and Somerset Counties the New Jersey Legislature passed bills just before adjournment authorizing municipalities to contract for a water supply with combinations of local companies and giving cities in the counties named power to take over and enlarge the works of private companies. For months past the municipalities in the section indicated, including Elizabeth and Plainfield, have been much concerned over possible water shortages and some of the companies have pleaded financial inability to provide additional supplies under existing conditions.

A bill providing for a commission to join like commissions in New York and Pennsylvania in an investigation of the water resources of the Delaware River was passed, but its effectiveness is conditioned on an appropriation by the legislature—which presumably was included in the annual appropriation bills.

After long and bitter contention the status of the Bayonne project for taking a water supply from the Ramapo River and the jurisdiction of the State Board of Conservation and Development on the one hand and on the other that of the North Jersey District Water Supply Commission were left unchanged. The immediate intent of the bills at issue was to require Bayonne to get the approval of the district commission for its proposed dam on the Ramapo River, a tributary of the Passaic, and conduit therefrom to Bayonne. The state board has approved these plans. It was alleged that the East Jersey Water Co., which through an affiliated company now supplies water in bulk to Bayonne, worked against the legislation. Clyde Potts is engineer for the Bayonne project and was one of the storm centers in the legislative contest.

Illinois Waterway Project Halted

A court decision as to condemnation proceedings for the site of the proposed Starved Rock lock, near Utica, Ill., is reported as likely to seriously delay progress on the long-projected waterway to connect the Chicago drainage canal with the Illinois River. According to the decision of the local county court the state cannot bring condemnation suits until all towns along the route have approached the construction of the waterway. The case will now go to a higher court.

Starrett Demurs to Indictment on War-Fraud Charge

Indictments found against eight individuals in connection with war-time contracts have been attacked by William A. Starrett, one of the defendants, who has filed a demurrer charging the actions have been brought by the government purely as political procedure. The demurrer, filed in the District of Columbia Supreme Court, says that, inasmuch as the subject of the indictment was believed political, the criminal court had no jurisdiction.

Illinois Central Will Complete Chicago Freight Yard

Work is to be pushed vigorously on the new Markham freight yard of the Illinois Central R.R., at Chicago and it is expected to have the greater part of the yard in service before the end of 1923. This yard, just south of Harvey, Ill., 18½ miles from the Chicago passenger terminal will be the main-line freight terminal for the Chicago district, where inbound trains will be broken up and outbound trains made up. All movements north of this yard will be switching and transfer service. This freight terminal was begun in 1918 (see *Engineering News-Record*, Aug. 15, 1918, p. 313) but work has been delayed by various causes. However, about $2,500,000 has been spent, mainly on the filling to raise the site to grade. The sum of $6,000,000 will be required for completion.

For northbound and southbound traffic there will be two separate units, each consisting (for the present construction) of a 10-track receiving yard, a 10-track departure yard and a classification yard with hump for gravity switching. The northbound classification yard will have sixty tracks for 2,400 cars and the southbound yard will have forty tracks for 2,000 cars. Double the number of tracks in each yard is provided for by the general plans. In addition there will be an engine terminal and a transfer station for rehandling L.C.L. freight.

Since the project was started it has been decided to elevate the main line along the west side of the yard in order to eliminate all grade crossings, including the crossing of the Grand Trunk Ry. and Baltimore & Ohio R.R., at Harvey, where a new passenger station will be built. This Harvey improvement will require about 1,000,000 cu.ft. of filling and will cost about $1,200,000.

The design and construction of this freight terminal yard are under the direction of F. L. Thompson, chief engineer, Illinois Central R.R.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Spring Meeting, New Orleans, La., April 18-20.

NATIONAL CONFERENCE ON CITY PLANNING, New York; Fifteenth Conference, Baltimore, April 30-May 2.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

NATIONAL FIRE PROTECTION ASSOCIATION; Boston; Annual Meeting, Chicago, May 8-10.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Detroit, Mich., May 21-25.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

The Northeastern Section of the American Society of Civil Engineers, Boston, will be addressed April 30, on "The Use of the Airplane in Topographic Mapping" by Col. C. H. Birdseye, chief topographic engineer of the U. S. Geological Survey.

Personal Notes

Prof. Hudson B. Hastings, formerly of Bowdoin College and of Reed College, Portland, Ore., has been elected to the chair of administrative engineering at Yale University. This course was organized in the Sheffield Scientific School four years ago and sprang out of the belief that there was an increasing demand for young men of ability trained so that they would be able to start their careers not on the purely technical side but more directly on the administrative or executive side. It was also recognized that a broad, sound training in the principles of economics and related subjects is a valuable asset to a man in administrative work. Prof. Hastings will assume his duties at the beginning of the next academic year.

Martin A. Preston, chief engineer and secretary-treasurer of Brown, Preston & Derrick, Inc., architects and engineers of Detroit, Michigan, has disposed of his interest and resigned as an officer and director of the corporation. Mr. Preston has not definitely determined upon his future activities but advises that they will be along engineering and construction lines.

Birger F. Burman has resigned as chief engineer of the New England Oil Refining Co. He leaves at the time of completion of an extensive building program inaugurated about two years ago when he became connected with the company. Formerly he was for several years connected with the Atlantic Refining Co. (to a large extent rebuilding the Pittsburgh refinery), and with the Jones & Laughlin Steel Co., at Pittsburgh. No announcement has been made of his plans for the future.

H. V. Lucas has been appointed as vice-president of the Harrison Construction Co. Inc., contractors and engineers with offices in Virginia Railway & Power Building, Richmond, Va.

Henry E. Elrod, consulting engineer of Dallas, Texas, who recently moved to Santa Monica, Calif., because of ill health, has been acting as consulting sanitary engineer to that city. Aside from that he is doing some consulting work, specializing in sanitary engineering with particular reference to sewage and garbage disposal.

Hazen & Whipple, civil engineers, New York City, announce the removal of their offices to 25 West 43rd St.

J. Harold Rapp Co. is a new engineering firm established in Pittsburgh, Pa., with headquarters at 636 Penn Ave. The firm will carry on a business of structural engineering, making designs for industrial plants, etc. Officers of the company are: J. Harold Rapp, president; Raymond E. Lightner, vice-president; William J. Erdner, treasurer, and Albert T. Eyler, secretary.

L. M. Edwards, for the past three years superintendent of the Paradise Irrigation District, Butte County, Calif., has resigned and J. A. Alley, of Paradise, Calif., named to fill the vacancy.

Ray Klein, former secretary of the Oregon State Highway Commission, Salem, Ore., has been appointed State Highway Engineer effective April 1, 1923. He will still continue as secretary for the commission. He succeeds Herbert Nunn, recently resigned.

E. R. Gray, city engineer of Hamilton, Ont., will resign April 15 in order to take a position as manager of the park board of Hamilton. W. L. McFaul, now assistant city engineer, has been appointed by the city council to succeed Mr. Gray.

Luther R. Tillotson has been appointed state highway engineer of Kansas by Governor Davis to succeed M. W. Watson, who recently resigned. Mr. Tillotson is a graduate of Kansas University. He was a captain overseas in the 110th Engineers and has been connected with road machinery and materials companies since leaving the service.

Edward H. Sargent, formerly associated with the Bureau of Water Power in the New York state engineer's office, has been appointed engineer for the Hudson River Regulating District.

Hector MacNeil, assistant engineer of the Canadian National Rys., has been named resident engineer, Division Four, of the Longlac-Nakina cutoff.

David Elwell has been appointed manager of the New York office of Lockwood, Greene & Co., to succeed Gen. W. H. Rose, whose resignation was announced in these columns last week. Mr. Elwell is a graduate of Boston "Tech," and has served the Edison Electric Illuminating Co. of Boston; the Westinghouse Electric & Manufacturing Co., at East Pittsburgh; was superintendent on electrifications of the New York division of the N. Y., N. H., & H. R.R.; and for four years was sales engineer for the Westinghouse company in New York. He has been in the New York office of Lockwood, Greene & Co., since 1920, having been transferred there from the Boston office.

Obituary

Fred A. Murray, chief engineer of the Porto Rico Irrigation Service, stationed at Guayama, Porto Rico, was shot and killed in his office the latter part of March by a discharged native employee. Mr. Murray had been chief engineer of the Porto Rico Irrigation Service during the past three years, having previously served for several years as assistant chief engineer.

Edward F. Flaherty, construction engineer, of Hollywood, Cal., died April 1, aged 46 years. He was at one time assistant to the chief engineer of the Santa Fe R.R. He was a member of the American Society of Civil Engineers.

Col. J. B. Breathitt, aged 79, for six years a railroad commissioner of Missouri, his native state, died in Tucson, Ariz., April 2. For 15 years he was commercial agent of the Southern Pacific R. R. of Mexico.

H. H. Stoek, professor of mining engineering at the University of Illinois, died suddenly March 1. After graduating from Lehigh University in 1887 he became assistant engineer of the Susquehanna Coal Co., returning to the university in 1900 as an instructor. In 1903 he became editor of *Mines and Minerals* and in 1909 he went to the University of Illinois as professor of mining engineering.

Thomas M. Vinton, one of the pioneers in reinforced-concrete construction in the East and formerly of the firm of Tucker & Vinton, New York City, died in Mazatlan, Mexico, recently, where he had gone last year for his health. He was 48 years of age. Mr. Vinton, after leaving Massachusetts Institute of Technology, engaged in various engineering and construction work in New York, having been a timekeeper on the Mills Hotel No. 1, one of the first reinforced-concrete buildings in New York City. Practically his entire professional career was connected with concrete work. At the time of his death he was not active in business, but up until last summer he had been with the Trout Concrete Tile Corp., manufacturers of concrete products.

Walter Hunter, civil engineer and associate engineer of the California State Highway Commission, was killed April 1 by a stroke of lightning while standing in front of the Stockton (Calif.) Golf and Country Clubhouse, with a steel golf club in his hand. Mr. Hunter had served as Stockton's city engineer for several years before taking the state position. He was active in reclamation and flood-control work and was assisting in planning Stockton's proposed new harbor.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Advice Given on Proper Care of Concrete Paving Mixer

"Clean it—Tighten it—Grease it." These are the instructions which Burton Franklin, general Southern agent for the Multi-Foote concrete paving mixer, has issued in the form of a printed folder showing how a contractor, by proper care, can make his paving mixer last longer and do more work.

The modern paver, Mr. Franklin states, is built to mix more than 2 tons of material to a batch and is a machine of many parts and many bearings. Every night the accumulation of dirt and cement should be removed. A few minutes with the hose will do this work easier and better than if the machine is left for several days until the concrete hardens. Every night and also at noon during hot weather the inside of the mixing drum should be cleaned by turning within it for a few minutes a small quantity of stone with a liberal amount of water.

Loose bolts and nuts should be tightened. This job shrould be a daily duty. A loose bearing does its evil work throughout the whole machine and often the first sign of trouble appears in a part far removed from the loose bearing.

Oiling and greasing should be attended to regularly. On the Multi-Foote paver there are about 60 places that require oil and grease and if any of them is neglected the machine will not function properly. It is better to oil too much than too little.

Winners Announced in Shovel Company's Prize Contest

To Herman Huebscher, general contractor, St. Paul, Minn., has been awarded the first prize of $100 and a gold watch in the contest conducted by the Erie Steam Shovel Co., Erie, Pa., for the best upkeep cost data on power shovel operation. The board of judges consisted of Arthur S. Bent, of Bent Brothers, general contractors, Los Angeles; Halbert P. Gillette, editor, "Engineering and Contracting"; and Arthur C. Vicary, vice-president of the Erie Company. Second and third prizes, consisting of watches and $50 and $25, respectively, were won by A. B. Cox, assistant general manager, Novaculite Co., Olive Branch, Ill., and F. J. Chaplin, of W. A. Gould & Bro., Brisbin, Pa. Seventeen other prizes ranging from $20 to $5 were awarded. The contest, calling for statements of experience as to the operating costs of power shovel work, drew about 300 entrants.

Construction Equipment Exported

Figures from the U. S. Department of Commerce indicate the following exports of construction equipment for the month of January, 1923: 31 concrete mixers valued at $23,624; 29 conveyors of the bucket, chain or belt type, valued at $24,229; other exports of road-making and construction equipment, not classified, 400,000 lb. at $63,600.

Featuring of Record Runs Elicits Further Comment

Supplementing the discussion in last week's issue (p. 643) other equipment manufacturers this week state the policies of their organizations.—EDITOR.

By MORGAN RAMSAY
Assistant to President,
Bay City Dredge Works, Bay City, Mich.

IT HAS always been the policy of this company to refrain from mentioning record runs either in advertising, or articles for publication. We occasionally have referred to records made by Bay City equipment when in actual conversation with interested parties; in such cases the underlying conditions can then be thoroughly explained.

Our policy is to be conservative rather than to claim records, as we believe it makes a greater hit with the contractor or engineer to find that a machine actually does more than was claimed for it, than to find it does *just* what he had expected or what was promised. There is no doubt but that the contractor or engineer can easily get the wrong impression of a machine and its possibilities by reading record-run publicity.

As a matter of fact, a record run does not necessarily mean a thing, when all of the elements entering into it are concerned. There are practically no two construction jobs, particularly in the drainage and excavation field, which are similar, or which can be handled in connection with similar labor, weather or soil conditions, all of which are factors which assist or hinder record yardage.

By H. B. BUSHNELL
Sales Engineer,
Western Wheeled Scraper Co., Aurora, Ill.

IT HAS always been the policy of the Western Wheeled Scraper Co. to refrain from publishing or using in advertising matter any data or statement that could in any way work to the disadvantage of the contractor.

The use of cost data in an advertisement is scarcely ever complete enough to be of real service and is dangerous in the hands of the inexperienced operator.

Production records based upon the actual working conditions, and truthfully stated, give information of value if properly presented. If, however, these records are based upon special speed tests, where the conditions are ideal, and where days are taken to prepare for the tests—and other days spent to repair the outfit afterward—naturally such production are dangerous and misleading. Our advertising and general business policies are very conservative and do not sanction the use of production records that might be technically true and yet be misleading from a practical standpoint.

(To Be Continued Next Week)

To Confer on Fewer Grades of Asphalt for Road Work

Producers to Act with Dept. of Commerce in Industrial Waste Elimination Program

Washington Correspondence

As the result of interest in the subject stimulated by recent articles appearing in *Engineering News-Record*, the Division of Simplified Practice of the U. S. Department of Commerce, at the immediate suggestion of the Asphalt Association of New York City, has issued invitations to leading producers of asphalt and allied interests for a preliminary conference to be held in Washington April 24 to discuss a possible reduction in the variety of grades of asphalt for roads and pavements and other phases of co-operation as part of Secretary Hoover's program for the elimination of waste in industry.

Following the publication of the article above referred to, this journal called upon a number of the country's leading highway and paving engineers for their opinion as to the feasibility of securing more uniformity in specifications and reducing the thirty or more grades of asphalt ordinarily demanded to about seven. Almost without exception the asphalt users endorsed the project for fewer varieties.

This first meeting is primarily to secure agreement as to standards among the asphalt producers and at a later date a general conference, to include both producers and representatives of the state highway departments, the federal government, and city and county road and paving officials, is planned.

OTHER CONFERENCES CALLED

The division also has called a preliminary conference looking toward simplification in sewer pipe, drain tiles and other clay products, which will be held April 23. Among associations which will be represented are the Clay Products Association, the Eastern Clay Products Association, the American Society for Testing Materials and others.

A conference of face brick interests will be held May 11 by representatives of the Face Brick Manufacturers' Association, the Structural Service Committee of the American Institute of Architects and other interests, at the Simplified Practices Division to discuss the work of the manufacturers' association toward standardization. The association, through a recent survey, found 54 sizes of face brick being turned out, many with only slight variations, resulting in increased production costs.

DECISION ON HILLSIDE BRICK

The Standing Committee of the Paving Brick Conference, organized in 1922 when many varieties were eliminated, met at the Department of Commerce March 27 and as the result of the 1922 production chart which showed that it represented only 4.1 per cent of the output, voted to eliminate from the list of standards Hillside brick (repressed) 4 x 3½ x 8½ in. It was decided to call upon the American Engineering Standards Committee for an investigation into the value of the services of the various types of paving brick. A motion to eliminate two other sizes from the standard list was lost. The variety survey will be continued throughout 1923 by the National Paving Brick Manufacturers' Association.

Manufacturers Take Space for Water-Works Exhibit

With 50 per cent of the members of the Water Works Manufacturers' Association still to be heard from on April 6, about 75 per cent of the exhibit space available at the annual convention of the American Water Works Association in Detroit May 21-25 has been applied for, according to information received from George McKay, of the Leadite Co., Philadelphia, chairman of the Exhibit Committee. The number of exhibitors, to date, is 44, and indications are that late applicants for space cannot be accommodated. Among the products to be shown are valves, water meters, pipe joints, chlorinating apparatus, pumping equipment, and fittings of various types.

Special Train for Water-Works Convention at Detroit

The transportation committee of the American Water Works Association has arranged for a special train to Detroit for the annual convention in that city, May 21-25. It will leave New York at 2 p.m., May 20, over the Delaware, Lackawanna & Western R.R., arriving in Detroit via the Michigan Central R.R. May 21, at 7:10 a.m. Reservations should be made with the chairman of the transportation committee, Walter H. Van Winkle, 50 Church St., New York City.

Meter Specifications Adopted by N. E. W. W. Association

After minor changes and subject to approval of its sister association, the New England Water Works Association on March 13 adopted the specifications for current, compound and fire-service types of cold-water meters recommended by the Joint Committee of the American and New England Water Works Associations. Joint specifications for disk meters were adopted in 1921. Charles W. Sherman, of Metcalf & Eddy, Boston, is chairman of the Joint committee.

Business Notes

EGLESTON BROS. & CO., INC., dealers in iron and steel, including reinforcing bars, shapes, plates, galvanized sheets and tool steel, have moved from 166 South St., New York City, to their new plant at Borden Ave. and Mount St., Long Island City, where new buildings cover a site of about 1½ acres.

TRAYLOR-DEWEY CONTRACTING CO., Allentown, Pa., announces a re-incorporation under the name of the Cement-Gun Contracting Co. The firm will specialize in construction and repair with the cement gun and in addition is prepared to build reservoirs and other plain or reinforced-concrete structures.

CHARLES S. WILLIAMSON, vice-president of the Mead-Morrison Mfg. Co., died in Chicago, March 31. He was born at Cleveland, Ohio, in 1874 and was graduated from the Case School of Applied Science in 1895. He had experience with several mechanical engineering firms and specialized in the design of heavy machinery for material handling and conveying.

CANADIAN WESTINGHOUSE CO. LTD., of Hamilton, Ont., has received what is stated to be the largest single order for electric generators ever placed with a Canadian company. The contract calls for the construction of eight generators of the vertical water-wheel type for the power development plant at the outlet of Lake St. John on the Saguenay River in Quebec, which is being constructed by Sir William Price of Quebec and J. B. Duke of New York. Each generator will be of 30,000 k.v.a. capacity and their total production will be 300,000 hp.

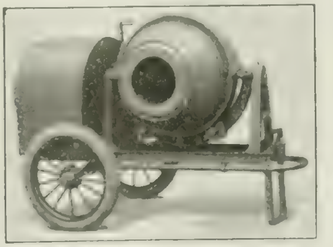
STEARNS MOTOR MANUFACTURING CO., Ludington, Mich., manufacturer of industrial engines used in the Bear tractor, Thew shovel, Universal crane, Lombard tractor, Overland crane, Henneue tractor, Hadfield-Penfield crane and locomotive, Stinson tractor, and others, announces the opening of a sales and service branch office in Detroit, at 3420 McDougal Ave. Paul J. Kraft, an engineer who has represented the Wheeler-Schebler Carburetor Co. for a number of years, will also have charge of the Stearns' Detroit office.

N. D. DOANE, chief chemist, Indianapolis Water Co., has resigned to join the sales staff of the Wayne Tank & Pump Co., in the water softening department. His headquarters are Old Colony Building, Chicago.

Equipment and Materials

Small Tilting Mixer Has Same Features as Larger Machine

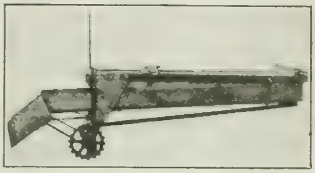
The same features of design that have characterized its larger mixers have been incorporated by the T. L. Smith Co., Milwaukee, in its new half-bag tilting mixer just placed on the market, as announced in last week's issue. This machine designated as No. 375, with a batch capacity of 3¾ cu.ft. of 1:3:6 mix with materials containing the usual 40 per cent voids, is equipped with the double-cone drum, central gear ring and roller track, and independent tilting frame. For the double-cone drum feature speedy discharge is claimed, the drum returning automatically to the mixing position as soon as the tilting lever is released.



The main drive gear and engine pinion of the new machine are machine cut and the bevel drive pinion is made of 40 per cent carbon electric steel. The power plant consists of a 1½ hp. Fuller & Johnson gas engine equipped with magneto and is completely housed. The mixer is built in two models, one equipped with two pressed steel wheels fitted with clincher rims for Ford 30 x 3½-in. pneumatic tires, and the other with four steel wheels, 24 in. in diameter and with 3-in. grooved treads. The two-wheeled model with pneumatic tires weighs only 1,100 lb. and is equipped with a hauling stub for attachment as a trailer, to an automobile or truck.

Feeder for Bucket Elevator Aids Unloading of Cars

To speed up the unloading of freight cars with bucket elevators the Good Roads Machinery Co., Kennett Square, Pa., has designed a feeder in the form of a steel box or covered chute 11 ft. 4 in. long, 20 in. deep and 32 in. wide, which is set under railroad tracks and at right angles to them as shown in the accompanying photograph. Crushed stone, sand, gravel or other material is discharged from the bottom of the railway cars into the trough of the feeder, which is slightly inclined and given an oscillating motion by an eccentric drive from the bottom of the elevator.



The top of the feeder consists of two flat steel gates set in slides to control the amount of opening. It is claimed that the feeder cannot be choked no matter how much material drops on top of the opening. This feeder is designed to meet the objections sometimes raised by railroad officials to the digging of large pits underneath their tracks to assist in car unloading. The ditch required for the feeder need never be deeper than 2 ft.

A. B. Wood Suction Pump Patent Upheld by Court

Validity of the A. B. Wood patent on the pumps designed by him for lifting water and sewage and for use in suction dredging where large solid objects like blocks of wood, stumps, etc., present themselves for passage through the pumps has been upheld by the United States Court of Appeals following appeals and cross-appeals from the District Court for the Southern District of Alabama (Atlantic, Gulf & Pacific Co. *vs.* Albert Baldwin Wood; decision filed March 1).

The decision holds that a dredge pump built and used by the company above named is an infringement on the Wood patent, even though the Wood pump mentioned in the suit had only two vanes, as compared with three in the alleged infringing pump and the vanes in the two pumps had other dissimilar features. One of the claims in the Wood patent, the higher court points out, is for a plurality of vanes. The lower court ruled that "Vanes K and Gaylord 4" infringed the Wood patent but that "Vane J with or without the lugs attached," did not. The higher court holds that all three vanes infringe the Wood patent.

Intrusion Waterproofing Process Injects Plastic Compounds

For the waterproofing of engineering structures such as tunnels, shafts, foundations, retaining walls, dams and reservoirs the Weber Engineering Corporation, New York City, has developed the "Intrusion" process in which a plastic compound is forced under air pressure from an injector to fill voids and form *behind* the structure a water seal, the feature of which is that it remains in a plastic state instead of setting up hard like cement grout. Among advantages claimed for the process are the cheapness of materials, as compared with the use of portland cement, and the fact that even under conditions where vibration or settlement tends to open up seams filled by the grouting process the plastic character of the material compound enables it automatically to close up any cracks or pores that might develop. The result is said to be equivalent to a membrane waterproofing on the outside of the structure with the additional advantage of a self-healing feature.

The method is especially applicable to conditions where the ground water contains impurities such as sulphur or salt in solution which might affect the hardening of a portland cement grout. Where conditions are suitable, however, a special clay compound is used, but the process may be employed with such filling materials as asphaltum or tar preparations, sulphur, paraffine, fluosilicates, used either hot or cold. For the application of the method an injector has been developed. It follows the general principle of a grouting machine, but has special features adapting it to the handling of a plastic material.

Carl Weber, who heads the organization bearing his name, has been engaged on the development of his intrusion waterproofing method for the past three and a half years. He was formerly president of the Cement-Gun Construction Company of Chicago, and is the founder and ex-president of the Weber Chimney Company. He is also a director of the Weber-Bau A. G. in Berlin, Germany. The process outlined has been applied to a variety of engineering structures both in this country and in Europe.

Publications from the Construction Industry

Bridges and Buildings—ANTHRACITE BRIDGE CO., Scranton, Pa., describes the design and construction of the South-to-East bridge at Scranton, in a 22-p. booklet. The bridge is of reinforced concrete with a total length of 460 ft. 8 in., and a clear span of 201 ft. 8 in. for the main arch. The company illustrates also some of its other types of construction, including industrial and business buildings.

Drill Steel Handbook — SULLIVAN MACHINERY CO., Chicago, has issued an 80-p. illustrated handbook dealing with the selection, heating, forging and tempering of rock drill steel. The text also contains instructions for the care and use of drill sharpeners and drill steel furnaces. The book contains a great deal of practical information and is of a size that fits in a coat pocket.

Steel Paving Guards—W. S. GOODWIN CO., INC., Baltimore, in a 31-p. illustrated booklet, shows how its steel guards may be employed to eliminate wear at the edges of pavements or along street-car rails. The guards, it is claimed, reinforce the paving base, hold the surface rigid and prevent lateral movement of the surfacing material.

Overhead Conveying System—CHISHOLM-MOORE MANUFACTURING CO., Cleveland, has issued two illustrated pamphlets describing its Atlas overhead track system for factory and shop transportation. The track is suspended from heavy steel hangers. Trolleys equipped with high-speed hoists are made in capacities of from ½ to 2 tons and with two, four, and eight wheels respectively. The overhead track may be fitted with two-way or three-way switches. About fourteen pages of one of the pamphlets are devoted to sketches of installation details.

Power Shovels—THEW SHOVEL CO., Lorain, Ohio, has just issued the first two folders of a series on power shovel construction. Each unit of the Thew shovel is discussed, beginning with the boom and including the turntable, truck, etc.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Production and Material Stocks in Eight Cities

Record Pig-Iron Output—Steel Ingot Rate Above March, 1920—Lumber Normal—Brick Stocks Lower

Iron and Steel—Pig-iron output during March reached a record total over 3,521,000 tons compared with the war time peak of over 3,508,000 tons in October, 1916. The steel industry is operating at better than 90 per cent of capacity as against 65 per cent one year ago. Steel ingot production during March proceeded at an annual rate of 45,000,000 tons, or somewhat above the record rate of March, 1920.

Actual tonnage figures reported by the American Iron and Steel Institute for the first quarter periods since 1921 are given as follows:

	1923	1922	1921
January..........	3,251,694	1,593,482	2,203,186
February.........	2,919,017	1,745,022	1,749,477
March...	3,402,007	2,370,751	1,570,978

Unfilled orders on hand, March 31, as reported by subsidiary companies of the United States Steel Corporation, amounted to 7,403,332 tons.

Lumber—Total production for the entire country as reported to the National Lumber Manufacturers' Association, reached 958,883,437 ft. for the four weeks ending March 24, as compared with 785,022,079 ft. during the four weeks ending February 24. March shipments of 1,051,222,605 ft., exceeded those of the preceding month by 70,369,967 ft., while orders totaling 940,072,143 ft. fell 102,580,797 ft. under February. Production now stands a trifle above normal with shipments 108 per cent and orders 92 per cent of normal production. Output was 20 per cent below normal during the week of Apr. 1, 1922.

Cement—Production began to increase in January, advancing from 7,704,000 bbl. to 8,085,000 in the following month. Shipments recovered from the seasonal slump in December, increasing from 4,858,000 bbl. that month to 5,419,000 in January and 5,963,000 in February of the current year. Reserve stocks at mills, however, began to increase in October with 4,000,000 bbl. on hand, advancing steadily to 13,592,000 bbl. available Mar. 1, 1923.

Brick—Reports from members of the Common Brick Manufacturers' Association of America show a marked increase in orders on the books with a slight falling off of stocks on hand. Due to weather conditions, fully one third of

Minimum Wage Act Invalid, Supreme Court Declares

In a decision announced April 9 and generally regarded as one of the most far-reaching that the court has ever made, the United States Supreme Court by a vote of 5 to 3, declared unconstitutional the law passed by Congress fixing the minimum wage for women and minor girls in the District of Columbia. Associate Justice Sutherland, in delivering the majority opinion of the court, maintained that the law interfered with the liberty of contract guaranteed under the constitution.

The majority opinion referred to the minimum wage act as follows: "The feature of this statute which, perhaps more than any other, puts upon it the stamp of invalidity is that it extracts from the employer an arbitrary payment for a purpose and upon a basis having no casual connection with his business or the contract or the work the employee engages to do. The declared basis is not the value of the service rendered, but the extraneous circumstances that the employee needs to get a prescribed sum of money to insure her subsistence, health and morals."

In conclusion the court pointed out that "if in the interests of public welfare the police power may be invoked to justify the fixing of a minimum wage it may, when the public welfare is thought to require it, be invoked to justify a maximum wage."

The decision, it is predicted, will establish a nation-wide precedent, inasmuch as minimum wage laws have been enacted by more than a dozen states, six of which, consisting of New York, California, Oregon, Kansas, Wisconsin and Washington, got permission to intervene in the foregoing case as "friends of the court."

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

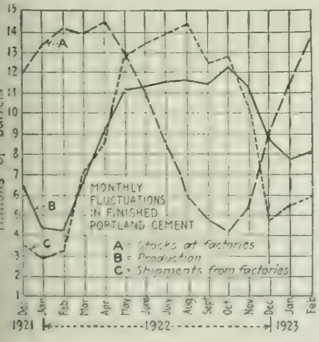
Stocks on hand in approximate figures, example: (Lumber, Minneapolis, 85,000,000 ft.); time required for delivery of carload lots to city job, example: (hollow til
Atlanta 5 days); and stocks on hand in general terms, example: (sewer pipe, Philadelphia, stocks low.)

	San Francisco	Los Angeles	Denver	Minneapolis	Detroit	Atlanta	New York	Philadelphia
Sewerpipe......	Plenty	Sufficient	Del. 24 hr., local plant	Good condition	Plenty up to 36 in.	Del. take 5 @ 7 days	Plenty of sizes 6 to 22 in., incl., shortage over 24 in.	Stocks low.
Cement........	Small reserve	No shortage	Normal	20,000 bbl.	Ample for present needs	40 cars	No shortage	Supply depleted.
Lime..........	Stocks low	Enough	Plenty	Ample	Well supplied from local and Ohio plants	40 cars	Enough, demand increasing	Fair quantity on hand.
Common brick..	Large quantities on hand	Ample	1,000,000	Plenty; shortage of face brick	Moderate supply in local yards	Plenty	Demand heavier than supply	No surplus
Hollow tile.....	Well supplied	No shortage	Stocks normal	Sufficient	Stocks Small	Del. take 5 days	Nearby plants; del. by water	Stocks low.
Lumber........	Big shipments being received	Heavy reserves 25 mi. from	Shortage at mills	Large for the season 85,000 M. ft.	Dealers' stocks moderate	Plenty	Del. take 6 @ 8 weeks from mill	Demand greater than available supply
Asphalt........	Extensive native reserves	Plenty	About 10 cars	Enough	Plenty; del. quick	Enough	Heavy reserves in N. J	Plentiful
Structural steel.	Good in spots	Enough in warehouses	Warehouse stocks sufficient	Meeting all demands	No shortage	3 @ 5 cars	Builders having difficulty in obtaining steel	Mills unable to make quick shipments

the plants in the Northern part of the country were closed during March. Burned brick on hand, as of March 1, totaled 185,094,000 as against 199,449,000; orders reached 302,905,000, compared with 238,486,000 for the month preceding.

San Francisco—Fairly well stocked with track supplies, metal lath, triangle mesh, black and blue annealed steel sheets. Small supplies of lime, cement and wire nails. Especially heavy stocks of lumber, asphalt and road oils; plenty of all other building materials.

Los Angeles—Heavy lumber reserves stored at harbor, 25 mi. from city. All lumber shipments by water from North; transported by truck to dealers yards. No wood blocks, paving stone or paving blocks used. No market for pine or hemlock.



Denver—Lumber stocks sufficient despite shortage at mills. About 1,000,000 common brick available.

Minneapolis—Face brick two or three weeks behind in deliveries. Cement stocks in good condition with 15,000 to 20,000 bbl. in warehouses. Dealers look for no difficulty in meeting materials demands except from transportation shortage. Lumber stocks unusually large for season; estimated 85,000,000 ft. in Twin City yards.

Detroit—Fair stocks in all sizes of sewer pipe up to 36-in.; small supply of larger pipe. Supply ample for present needs being received from nearby mills. Large orders for late delivery being declined by manufacturers. Ample supply of lime in warehouses and at Michigan and Ohio kilns. Moderate stocks of common brick in local yards. Small quantity of hollow tile at hand; large deliveries take several days. Moderate lumber stocks in dealers yards. Plenty of asphalt and structural steel.

Atlanta—About forty cars each of lime and cement; three to five cars of steel structurals on sidings. Sewer pipe deliveries take from five to seven days; hollow tile, five days. Plenty of brick, asphalt and lumber.

New York—Shortage of building sand during last few weeks. Common brick not coming into market fast enough to supply increasing demand. Builders also experiencing difficulty in obtaining structural steel from mills. Plenty of sewer pipe in warehouses in sizes up to 22-in.; shortage of sizes over 24-in. Sewer pipe is still frequently shipped in gondolas for want of other cars. Mill deliveries of pine lumber take two weeks longer than a month ago.

Philadelphia—Asphalt plentiful; sewer pipe and hollow tile stocks low. Fair supply of lime; no surplus of common brick. Lumber and cement subject to demand in excess of supply.

Railroads Prepare for Record Volume of Traffic

Plans to handle the greatest volume of traffic in the nation's history were decided upon at a meeting of railroad executives held in New York April 10. Since January 1, 1922, according to a report of the Car Service Division of the American Railway Association, railroads have authorized an expenditure of $1,540,000,000 for equipment and trackage; of this sum $440,000,000 was spent in 1922, leaving $1,100,000,000 available for the current year. The report, which was approved at a meeting of the Association of Railway Executives, indicates that car loading records will be broken repeatedly this year. Loadings of more than 1,000,000 cars weekly during thirteen weeks of this year are predicted.

In the formal statement issued after their meeting the railway executives urged that road and building construction be started as early in the season as possible; that cars be loaded to maximum capacity to bring the average up to 30 tons; and that the mileage per car per day be increased to 30 for the entire country. They also impressed on the public the desirability of storing coal during spring and summer and making shipments, where possible, during April, May, June and July to help decrease the usual congestion in September, October and November.

1923 Highway Activity To Exceed Previous Years, Says Roads Bureau

Highway construction will proceed during the coming season on a much more extensive scale than ever before, in the opinion of officials at the Bureau of Public Roads. Not only is the amount of Federal aid money available 30 per cent greater than the amount available last year, but there are large balances from previous years which will be put under contract from this time forward. A portion of that amount will be lost if it is not put under contract before July 1. Since it is improbable that any state will allow any of its Federal aid money to revert to the Treasury, it is expected that an unusual amount of work will be put under contract, particularly in the southern states.

If Florida catches up with the road-building program, it will have to put 900 per cent more road work under contract than was placed under contract last year.

Building Council Bill Passed by Indiana Legislature

The Senate bill designed to create a new state department to be known as the administrative building council of Indiana was passed by the House of Representatives of that state before the adjournment by a vote of 71 to 6. It passed the Senate previously by a vote of 27 to 16. It is expected the bill will be signed by the governor at an early date.

The bill invests the council with power to administer and enforce any and all laws now in force or to be enacted relative to the construction, repair, or maintenance of places of employment and public buildings as shall render the same safe and sanitary; and to ascertain and order such reasonable standards, rules, regulations and specifications of such places as shall be necessary to carry out the purposes of the act. It will give the commission authority over virtually every class of construction in the state except residential construction. It is considered to be the forerunner of a state building commission which will unify the building codes in the various cities and towns.

The chairman of the state industrial board, the secretary of the state board of health and the state fire marshal are to constitute the administrative committee of the council and twelve persons to be named by the governor are to constitute the advisory committee. On the advisory committee the governor must appoint three engineers, three contractors, three architects and three building mechanics from the names submitted, respectively, by the Indiana Engineering Society, Associated Building Contractors of Indiana, Indiana Society of Architects and jointly by the Indiana State Building Trades Council and the Indiana State Council of Carpenters. Members of the commission will receive no pay.

U. S. Steel Raises Wages of Day Labor 11 Per Cent

An 11-per cent increase in the wages of day labor in the plants of its manufacturing subsidiary companies, effective April 16, has been authorized by the United States Steel Corporation. The announcement was made following a special meeting of the finance committee of the corporation held in New York City April 9. It was also recommended to the manufacturing subsidiaries that "other wage rates in the manufacturing plants be equitably adjusted to become effective April 16, 1923."

The increase will effect about 200,000 workers, and will mean an advance to 40c. per hour as against the present rate of 36c. an hour for common labor. The present advance, it is estimated, will increase the company's weekly payroll by about $500,000. The action of the U. S. Steel Corporation, it is predicted, will mean a general upward movement of wages throughout the industry.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of April 5; the next, on May 3.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.44	$4.20	$4.50	+$3.30	$3.45	$3.95	+$3.70	+$4.10	$3.75
Structural rivets, 100 lb	4.00	4.85	5.25	3.75	4.00	5.15	4.75	4.50	+6.00
Reinforcing bars, ¾ in. up, 100 lb	3.34	4.10	3.15	+3.22½	3.35	3.97½	3.40	+4.10	+3.50
Steel pipe, black, 2½ to 6 in. lap, discount	51%	52%	45%	59½%	55-5%	38%	38.2@50.2%	45%	32.76
Cast-iron pipe, 6 in. and over, ton	—58.50	55.00	57.00	+57.20	60.50	+67.00	60.00	58.00	+60.00
Concreting Material:									
Cement without bags, bbl	2.70@2.80	+3.25	2.25	2.20	2.39	2.85	2.71	2.90	—2.68
Gravel, ¾ in., cu.yd	+2.25	+1.90	2.25	2.25	1.75	1.90	2.15	1.25	1.50
Sand, cu.yd	1.00	1.24	1.87½	2.25	1.00	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd	1.75	2.00	2.50	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	+65.00	+40.00	53.00	—60.00	+45.75	—42.75	39.00	30.00	95.00
Lime, finishing, hydrated, ton	16.80@17.10	23.00	22.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	3.00@3.25	—1.40	2.50	1.50	1.25	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	13.00	11.60	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	+.0893	.115	....	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1314	+.0893	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal	+1.13	+1.25	+1.32	+1.25	+1.29	+1.39	+1.34	.86	—1.16
Common Labor:									
Common labor, union, hour	+.45@.70	.35	.30@.50	......	....	.50@.55	.56¼	....	......
Common labor, non-union, hour	+.45@.70	.30	.30@.50	.72½	.35@.50	.35@.50	.50	.30@.70	.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine casing. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.00). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Owing to congestion in steel bar mills due to volume of new business, prices are somewhat higher this week at $2.50@$2.80 per 100 lb., Pittsburgh, on specified deliveries, against $2.50@$2.75, one week ago. Many producers are turning down new orders. Structural shapes quoted at $2.45@$2.70, f.o.b. mill; leading interests unable to handle new tonnages. Plates firm at $2.50@$2.75 on new business for prompt delivery. Railroad car material in heavy demand at plate mills. Steel shapes advanced 10c. per 100 lb. in Chicago, San Francisco and Seattle warehouses; bars, 10c. in Seattle, 12½c. in Chicago and 25c. per 100 lb. in Montreal, during last two weeks.

Wages of steel mill laborers will be increased 11 per cent, effective April 16, involving at least 200,000 men. The rate for this grade of labor was $2 per 10-hr. day in 1915, which was in turn advanced to $5.06 in 1920, dropping to $3 in 1921 and later increased to $3.60 in 1922. The latest advance brings the schedule to $4 per day, or 100 per cent above the 1915 rate.

Cast-iron pipe advanced $2 in Denver and $4 in Chicago; New York, however, reports decline of $3.50 per ton. Yellow pine timbers up $2 in New York and Atlanta; down 50c. per M ft. b.m. in Chicago. Douglas fir rose $1 in Minneapolis; but it declined somewhat in Denver.

Linseed oil rising steadily due to seed shortage. Advances reported as follows: San Francisco, 19c.; Dallas, 16c.; Denver, 14c.; Chicago, 10c.; Atlanta, 8c; Minneapolis, 7c. and New York 5c. per gal.

Gravel, ¾-in., advanced 25c. in New York and 15c. per cu. yd. in Atlanta, during last two weeks. Sand prices firm but unchanged in New York following recent period of adverse weather conditions and sustained demand.

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren, *Editor*
Frank C. Wight, *Managing Editor*

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A Regrettable Failure

DEEP as was the regret awakened by the first news of the disastrous tower collapse at Hartford, it was accompanied for the structural engineer by a sense of alarm resulting from the disturbing uncertainty concerning the causes of the failure. The latest reports set at rest such feelings of uncertainty, by revealing a most elementary cause—though in doing so they only sharpen the regret and sorrow at the deplorable loss of lives in the accident. Little doubt appears to be left by the investigations of the tower ruins that the most simple and best known of structural causes, lack of bracing, led to the collapse. Insufficient bracing has been known and feared since the earliest days of construction, and no engineer needs to learn from the Hartford case the lesson of keeping his structures well braced. But he may learn, and should mark it down imperishably in his conscience, that unceasing watchfulness over every detail of work is necessary if he is to carry out his responsibilities to the world. A single thoughtless or faulty decision may bring destruction. Physician or lawyer may err much more grievously and yet go their way in peace and esteem; the errors of the engineer rise up against him.

Making a Name Bad

IT HAS been amusing and rather flattering to the serious professional man to observe how extensively men in non-professional pursuits style themselves "engineer." To take a harmless instance: on our desk lies a letter written under the engraved caption of an "Advertising Engineer," which proud title means nothing more or less than "engineering advertising agent." But from being mildly amusing, as is interestingly sketched by a correspondent on page 604 of this issue, the matter is taking on or has already taken on a less pleasant aspect: to an ever-increasing extent the word "engineer" is tending to become a nondescript appendage carrying objectionable implications of fake and pretension—almost fraud. The engineering profession takes pride in the title of its calling, and inevitably resents all mischievous and misleading assumption of its class name. While it has up to now taken a tolerant, smiling attitude toward the abuse we suspect that the attitude is rapidly changing to one of active hostility. The fact remains that the title is the necessary designation of a large class of men engaged in responsible, difficult, professional work, and they can not long countenance its flagrant misuse, whether within or without the profession. For wrong or unworthy use within the profession remedies of law are available. Abuse on the part of non-professional men must be fought by engineers themselves, through group opposition. It will be only logical defence of its vital interests if the profession sets up the ethical principle that its members should conduct no business with pseudo-engineers.

State Road Funds

LAWS enacted this past winter leave only three states totally dependent on their county governments for funds for highway improvement. These three incorrigibles are Kansas, North Dakota and South Dakota, the first two being also rather notorious for their reactionary attitude generally toward centralized highway administration. As the division now stands, 23 states finance highways entirely through state funds and in 22 states the state fund is aided by direct contributions by counties or land benefit districts. Federal-aid legislation has to be credited in large measure for the improved conditions.

Construction Inflation

INFLATION of construction is a hazard that deserves very serious consideration at the present moment. At a conference last week in New York City of engineers, contractors and materials producers to consider ways and means for improving the construction situation it was agreed that this year, according to the best judgment of volumes, the country is attempting a program of some 200 per cent of normal at a cost approximating 150 per cent of what should be the normal. A condition of inflation will be the inevitable result, if this demand for immediate construction continues, and depression invariably follows inflation. There is a vast arrearage of construction to be met, but to attempt to do it too rapidly involves risk. It is doubtful if our productive resources will permit any such rate as twice the normal volume. Certainly, there will be, indeed there already is, an inflation of wages and prices. It seems by far the wiser course to spread the covering of arrears over a term of years. The conference in New York concluded that an annual program of 125 per cent of the normal was about correct. Whether or not it is exactly correct it indicates the only sane line of procedure with the conditions of the construction market as they are. The duty of initiative rests squarely upon the public which buys construction. The buyer must curtail his demands or he and the public with him will pay a cruel price in inflated costs.

British Refuse Disposal Changes

THE British high-temperature refuse disposal never handled so large a percentage of the refuse of British cities as it has been credited with by some. During and since the war, labor and other conditions have made this percentage still less. Coincidentally there has been a marked gain in (1) refuse sorting for the recovery of salable materials like paper, cloth, glass, leather and metal; (2) in screening for the recovery of unburned and partly burned coal; (3) pulverizing or shredding of the garbage and like wastes; and (4) the use of the disintegrated material and the sifted ashes for fertilizing and lightening the soil. Destructors are still kept in use at old plants and installed at plants of the newer type, but the bulk of material put through them is greatly reduced by the sorting and screening mentioned and what is sent to the destructor has a higher heat value than of old because it is not accompanied by a large mass of inert ash. There is also a material reduction in the work of stoking and in the volume of material that passes from the furnace for final disposal. Some of these points and others as well are illustrated by the practice at Newark, England, described elsewhere in this issue. The plant mentioned is only one of many that show a marked change in the trend of British refuse disposal methods. This change will bear watching here but too hasty conclusions should not be drawn from it in view of a variety of differences between British and American conditions.

Record Runs of Equipment

IN APPRAISING the value of equipment for construction work the best criterion is day-in-and-day-out performance, rather than the occasional and sensational record run covering only a short interval of time. This is the consensus of equipment manufacturers who have been expressing opinion on this subject for several weeks past in this journal's weekly department "From the Manufacturer's Point of View." From what has been said it is clear that the practice of featuring record runs works to the disadvantage both of the user and the maker of machinery. As a general rule, record performances are achieved under particularly favorable conditions but statements of the results attained are usually unaccompanied by any explanation of the conditions contributing to such performances. In the hands of an inexperienced contractor such records are extremely dangerous, for he may be led to base an estimate of the season's work upon the rate maintained during the record run. Many men have paid dearly for such optimism.

In the case of a machine like a concrete mixer on a highway contract, for example, many factors outside of the machine itself play a part. The mixer can attain its maximum output only if the supply of crushed stone, sand and cement is regular and ample, and this brings into the problem the operation of the motor truck train, the industrial railway and also the standard-gage railway. With the same mixer, therefore, the yardage on one day may be double that on another due to good or bad co-ordination of material supplies. The same condition arises in the case of a steam shovel. Obviously its output depends not merely on its own digging capacity, but upon the provision of an adequate supply of empty cars or trucks to take away the material excavated. Record performances covering only a brief interval of time, therefore, mean little, even when the full story is told. This is particularly true in the case of equipment or machinery which depends for its operation to a large extent upon the human element.

A slightly different case is that of a machine whose operation is largely automatic—for example, a stationary, electrically-driven pump. Here the conditions are much more constant than on an outside construction job and performance day by day can be measured and judged with a considerable degree of accuracy. In either case, however, it is the continued performance which really counts and which forms the only measure of serviceability upon which the user can rely.

Then, too, from the manufacturer's point of view, the featuring of a short-time record run has often proved a boomerang. Users of precisely the same equipment on other jobs immediately want to know why their machines are not performing up to the standard set by the record performance. It would, of course, be folly to attempt to kill pride in good performance. Credit should go where it is due. The point here made, however, is that continuity and regularity of service of contractors' equipment are far more useful as an index of performance than the sensational record which often proves to be merely a flash in the pan.

Economics of Highway Design

TWO opinions are held by engineers on the desirability of economic refinements in locating and designing public roads. One is exemplified by the article in this issue by O. L. Kipp; it is that an appreciable and an appreciated reduction in traffic costs follows and justifies careful determination of the economic location, alignment, length, grade, width, and surface of a highway. The opposing opinion, somewhat more intolerant, is that the average road user is too little concerned in vehicle-mile costs to justify expenditure to secure the last fraction of saving and that any other viewpoint is purely academic. An interesting question is involved.

The last opinion, perhaps the more common, is based on the conception of traffic as travel for recreation and business not involving the carriage of freight. Car-mile or ton-mile costs, with travelers of this class, are of secondary concern. Also this class of highway travel predominates; even in states of such heavy truck traffic as Massachusetts and Connecticut vehicle counts show from three to five times as many automobiles as freight carrying trucks. This excess of vehicles not operated specifically for profit from commodity carriage is certain to continue. So long as it continues there is sound reason to proceed slowly in adding to construction costs to reduce costs of vehicle operation to the ultimate minimum. Economics and public policy are both involved in this conclusion.

Taking the country over the thing that traffic today demands most is the greatest practicable mileage of public roads which can be traveled during the largest possible portion of the year. Until highway development has progressed well toward this attainment, other means of cutting down the costs of highway travel are in general secondary in importance. Whether or not the closet economist agrees with this statement it expresses exactly the attitude in the situation of the average road user. He wants more miles of well-built road rather than fewer miles of road perfected to reduce to a minimum the expense of vehicle operation. It is the primary function of the highway engineer to satisfy this want, whether or not it stands out in contradiction to economic principles. This is a fundamental of which sight cannot be lost or highway engineers will have to count with the reaction of the people against engineering direction of road policies.

It cannot be overlooked that in a chiefly non-income earning traffic there is little argument for extra expenditure in construction to reduce traffic costs. A different aspect of the problem is presented if the primary purpose of the highway is considered to be the carriage of freight for a profit. Then users exist in predominating numbers who count car-mile and ton-mile costs vital to their business and who also count extra cost of construction justified in any amount less than the capitalized value of the reduction in haulage costs which it effects. Here then is the second conception of highway traffic development—one which largely justifies the economics of location and design considered in Mr. Kipp's article.

Not including minor township roads, for which the answer is clear, the question is not whether all roads or whether any roads should be located and designed primarily to reduce traffic costs but it is: What roads warrant this undertaking? A certain few roads which do warrant it, because the traffic is in evidence, can be picked out in every state, but traffic surveys of wider scope than most states have conducted are necessary for any close traffic classification of main roads in a state-wide way. This assertion is proved by the returns, so far received, of the Connecticut traffic survey. In this state, where distances are short and all areas are highly developed and improved roads date back a generation, the survey shows clearly that general observation is a very poor indicator of either the character or the amount of travel. Obviously it is less perfect in the greater areas of the western and southern states.

There is nothing in the conditions indicated that should be taken as discouraging economic studies of highway design. Held in the least consideration they are formulating the problem and indicating where research is necessary in order to proceed with a solution. The article by Mr. Kipp is particularly useful in bringing out the need of determined facts. It is cheering to announce that research is gradually producing them.

For a Renaissance of Craftsmanship

OF FAR-REACHING importance is the work now being carried on by the Apprenticeship Commission of the New York Building Congress and by similar bodies in Boston, Philadelphia, Detroit, Cleveland and other large cities the country over. These commissions represent a joint effort on the part of the employers and the employees of the building industry to provide a continuing supply of competent mechanics through a systematic field and classroom training of apprentices, conducted under the supervision of both the employers and the building trades unions. A brief account of the procedure that has been followed in New York was published in *Engineering News-Record* of Jan. 11, 1923, since which time the operation of the plan has gone far to confirm the faith of all parties in the soundness of their joint undertaking.

The importance of this enterprise lies not alone in the bare fact that it provides for the training of a certain number of young men to become competent building craftsmen. It offers promise of other results that will be of even more fundamental and far-reaching significance. One of these, perhaps, is the co-operation that has already been realized between the building trades employers and the trades unions, both of whom have shown genuine industrial statesmanship in their handling of the many vexing problems that have arisen. This task, to which they have so successfully applied themselves, is a constructive work; and the more often we can draw together the representatives of organized labor and of the employers to conduct such an enterprise rather than to wrangle over their differences, the sooner shall we find growing in each of them that confidence in the other which alone can bring about complete understanding and co-operation.

Another worth-while result will be the preservation and transmission to a new generation of mechanics of the unwritten teachings that were current among the skilled of many crafts a generation ago, but which today are the heritage of a diminishing few. The soul of a craft resides in such teachings and traditions, and without a knowledge of them the craftsman is little more than a skilled laborer. By fostering these, the present enterprise may well contribute to a renaissance of craftsmanship at a time when many have almost been ready to give up hope.

But of even greater importance is the opportunity here offered to regain for the competent craftsman a measure of the standing and general esteem that in another day was at once his unquestioned right and his greatest pride. Of recent years the American born and educated boy has been reluctant to enlist in the ranks of the craftsmen. Too often he has succumbed to the lure of the white-collar job, bent upon the superior (?) social standing that he has associated with the office worker. Frequently, indeed, he has been willing to make this choice at an actual sacrifice in financial return, all for the sake of the intangibles he has believed to be involved.

Lately, however, this idea has been severely jolted and complacency has begun to waver. The mechanic has prospered while the lot of the white-collar worker has become less and less enviable. Today the young man is wondering, and in many cases it will take a slighter push than has been required heretofore for him to reach a decision favorable to the craft as against the clerical job. And we are inclined to think that that slight push may be developed by the work of the apprenticeship commissions, provided only that their members are alive to the human factors bound up with their enterprise.

The young men who complete successfully the prescribed courses in the classroom and the field should be imbued with the dignity of their calling, and the community in general should be taught to appreciate the essential worth of a competent craftsman. The commissions, in other words, must labor not only to *produce* craftsmen but also to *sell* them. And they must be sold both to themselves and to the public-at-large. Within the young journeyman must be instilled that pride of craft which alone can lead to the highest efficiency and achievement, and in the community must be instilled a new respect for the American mechanic. Through such a process only can we break down the artificial and unhealthy prejudice in favor of the white-collar job—all too often a non-productive job, of which industry already is saddled with an overplus.

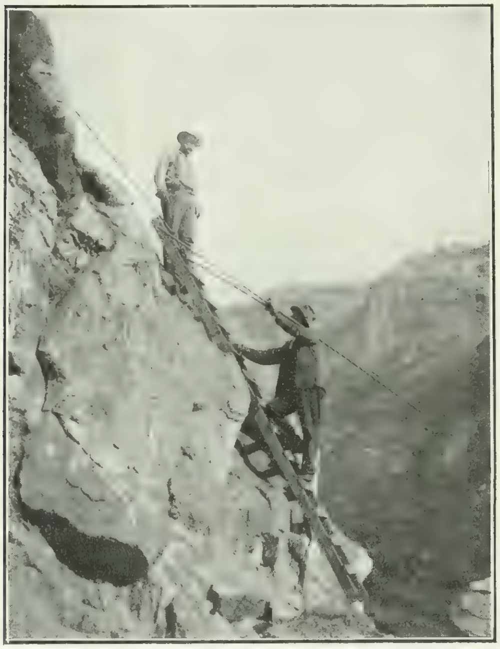
Given a supply of competent building mechanics having an honest pride in their crafts and in their craftsmanship; and given a general public imbued with the old-fashioned American respect for the competent craftsman, we need fear no dearth of skilled mechanics that will be a credit to themselves, to their trades, to their employers and to the community. Today the problem is not essentially one of wages; it hinges in large measure on the human element and will yield to treatment that holds that element in the forefront of consideration. Just such a treatment the apprenticeship commissions have it within their power to apply; and in this aspect of their work they will find the fullest measure of ultimate satisfaction and achievement in the work they are carrying forward so worthily.

Preliminary Developments On a Hydro-Electric Project

A 300,000-Hp. System on Kings River in California Begun With the Building of Camps, Roads, Bridges and Gauging Stations—Winter Quarters Maintained by Hydrographers

By H. K. Fox
San Joaquin Light & Power Corporation, Fresno, Calif.

ON THE north and west forks of the Kings River in California, the San Joaquin Light & Power Corporation has started work on the first unit in a chain of hydro-electric developments that will ultimately produce more than 300,000 hp. The main features of the development will be four storage reservoirs, ten diversion dams, 34 miles of tunnel and conduits, and seven power plants.



ROAD WORK ON THE CLIFFS IN KINGS RIVER CANYON
The ladder suspended by a rope is 300 ft. above the bottom of the canyon. Drilling is in progress on the face of the cliff below.

At the present rate of increase in power demand it may be necessary to develop the entire series of plants by 1930; however, in applying for the Federal Power Commission license, which was granted last year, the main construction program was divided into five parts, each including diversion dam, tunnel, penstocks, power house, etc., and with the construction program estimated as follows:

Development	Work To Start	Work Finished
Balch No. 1	May, 1922	June, 1925
Haas Plant	April, 1924	June, 1927
Kings River Plant	January, 1926	June, 1928
Balch No. 2	April, 1926	June, 1929
Farnham and Meyer Plants	April, 1927	June, 1930

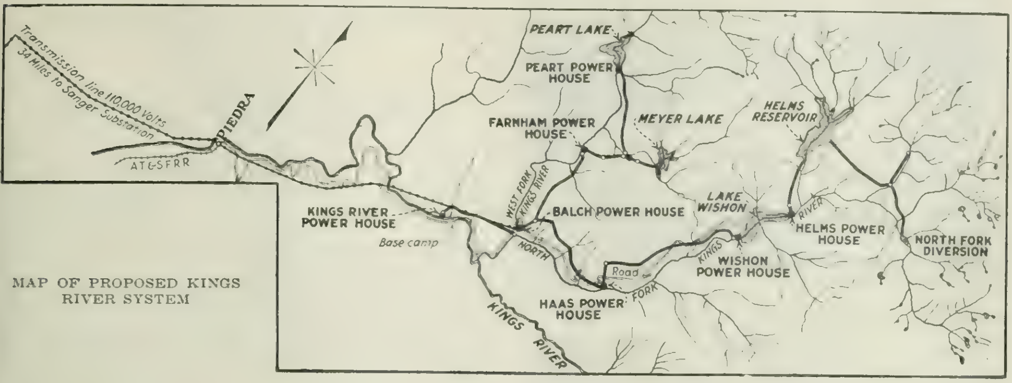
The remainder of the program which would be largely the development of more storage and additional power capacity will be made as power demands require.

Preliminary surveys and studies have been under way for some time and as early as 1919 about 100 engineers and surveyors were working through the area involved. In that year a very precise triangulation system was established to which all lines and topography could be tied; old trails were rebuilt and new ones constructed and eight tent camps were being maintained throughout the project.

ROAD UNDER CONSTRUCTION BETWEEN BALCH AND HAAS PLANTS
In two places trestles were cheaper than bench cuts. At one point a cut 100 ft. deep was made to provide a bench for the road 12 ft. wide.

While the surveys were being made stream gauging was started and six stations, built according to U. S. Geological Survey standards, are now in operation. Four hydrographers are kept the year round at elevations of over 8,000 ft. in the "snow country" for making continuous record of rain, snow and runoff conditions. In summer they are busy packing in supplies, getting up wood for the winter, and repairing the stations. During the winters, which come early and stay late at these altitudes, these men are isolated from the rest of the world for periods of two months without means of communication.

Actual construction thus far has been, and the major portion for some little time to come will be, in building roads and camps. Piedra, on the Santa Fe R.R., is the nearest point of rail delivery and all materials and supplies for the project must be hauled in by trucks or teams. The route is over a county road for the first 13 miles to Trimmer at which place the company built a bridge across the main Kings River. Beyond this crossing, 12 miles of road to the base camp was built many years ago by the original holders of the project. This was reconstructed by the company in 1921 and is now used by motor trucks. From this base camp freight has been delivered into the upper country by pack trains. A bridge across the main river at the base camp was built in 1921 with two 100-ft. span wood trusses designed for a 30-ton load. From this bridge



MAP OF PROPOSED KINGS RIVER SYSTEM

to Balch camp, a distance of 3½ miles, a narrow road was built. Work on the project was then discontinued until August, 1922.

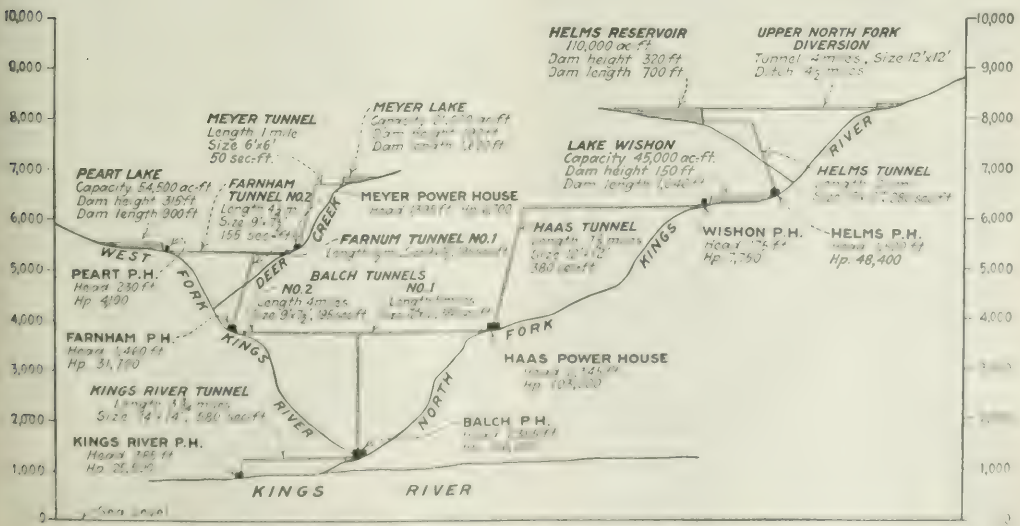
In resuming development last fall the first step was to build a bridge across the north fork in order to reach headquarters camp, known as Balch camp. Here a modern construction camp that can accommodate up to 300 men has been built and equipped with water and sewer systems, bath houses, public library, electric cooking equipment, etc. A good road has also been extended to points in the upper country.

From Balch camp the road rises on a uniform 6 per cent compensated grade; it is 12 ft. wide in cuts and 14 ft. on fills. In order to gain the necessary elevation it was located 1½ miles up the west fork and then brought back above the camp and up the north fork. The country is very rough and careful location was necessary in order to maintain a uniform grade without getting into costly work in the cliffs. At one point, however, crossing the face of a cliff could not be avoided, and here it is necessary to make a side cut 100 ft. deep in order to get a 12-ft. bench for the road. In two places along these cliffs it was decidedly cheaper to build trestles than to excavate the yardage necessary for making a bench cut.

Work on the road beyond Balch camp was started by station gangs and later day labor was used for the more difficult parts. Much of the material excavated is solid rock and loose boulders, but even in this ground good progress has been made.

Tent camps are located about every two miles on the line and supplied where necessary by pack trains. A temporary 18-in. gauge incline railway was built from Balch camp to a camp on the road line directly above, which made it possible to work almost the entire first three miles without using supply pack trains, and also made it possible to deliver gasoline driven air compressors so that work could be started on the 4,000-ft. section across the face of cliffs already referred to.

The road to this heavy cliff cut has now been completed and the incline abandoned. Work in the cliff will soon be finished and beyond that point a ¾-yard



SCHEMATIC ELEVATION OF PROPOSED KINGS RIVER SYSTEM

TYPICAL WINTER QUARTERS FOR THE HYDROGRAPHERS

steam shovel mounted on caterpillars will be used. This shovel is at present widening the road from Base camp to Balch camp. The slopes are so steep and rocky that teams and fresnos have been used only to a limited extent.

The work is being done under the direction of R. C. Starr with the writer as superintendent of construction, R. L. Bryant as resident engineer and J. D. McDougald as general foreman.

Determining Sub-Surface Water Flow Electrically and Chemically

BOTH chemistry and electricity were utilized in testing the underground flow of water at South Bend, Ind. In a paper on "Development of Well Water Supplies" at the recent meeting of the Indiana Water Supply and Sanitary Association, John W. Toyne described the procedure as follows:

A central 12-in. well surrounded by 2½-in. wells at a radius of 6 ft. were sunk to a depth of 155 ft. into gravel formation having the following characteristics:

30 per cent by volume retained on a No. 10 screen
25 per cent by volume retained on a No. 20 screen
40 per cent by volume retained on a No. 40 screen
17 per cent by volume retained on a No. 60 screen
7½ per cent by volume retained on a No. 80 screen
2½ per cent by volume retained on a No. 100 screen
1 per cent by volume retained on a No. 110 screen

After the wells were equipped with strainers to suit this formation, the central well was charged with 200 lb. of salt and basic fuchsin, and the surrounding wells were equipped with electro couples connected with the 110-volt lighting circuit through a sensitive ammeter. Current readings were taken hourly and to insure true sampling of the vein, 1 gal. of water was pumped from each well at the time of taking the readings. It was examined by comparison with the original samples for traces of color.

The time required for the flow of 5 ft. was 82 hours as evidenced by the drop in electrical resistance and positive traces of color. The direction of flow was found to be just north of true northwest.

While the result of this test is not conclusive, it is confirmation of my belief that the water supply enjoyed by the city of South Bend, is in no sense local in character, but a part of the general underground movement of water across northern Indiana toward Lake Michigan. This theory is further corroborated by the logs of some 200 wells in northern Indiana and northern Ohio with which I have come in contact in the past fifteen years.

The result of this test thoroughly justifies the development of the additional supply as economically sound and permanent. As to the safety of the supply from a sanitary standpoint, the surface flow is toward the St. Joseph river, or at almost exactly right angles to the lower flow and at sufficient velocity to indicate that a part at least, is supplied from the lower vein. The surface flow would have a tendency to maintain the purity of the supply to the wells by washing the surface contamination off into the river; in any event strata are covered by a deep slow-sand filter.

Treatment of Water Contaminated by Mine Drainage

By J. W. Ledoux
Consulting Engineer, Philadelphia, Pa.

Abstract of a paper read before the Pennsylvania Water Works Association

THE problem of providing public water supplies in that portion of Pennsylvania which is underlain with coal is becoming more difficult as mining development increases. According to the published statistics of coal deposits, the bituminous coal of Pennsylvania of productive commercial value covers an area of 14,200 sq.mi., but the area within the outcrops covers about 16,600 sq.mi. This area lies on the western slope of the Allegheny Mountains and comprises a solid block of coal territory, within which there are only about 600 sq.mi. in various patches that are above the possibility of coal mine drainage. The total population of this coal area is considerably over 3,000,000 inhabitants.

The coal seams all contain sulphur and iron, and the rock formations immediately in contact with the coal contain iron pyrites, or sulphide of iron. When these coal beds are left untouched, the streams draining the coal lands are usually not contaminated to any marked extent by sulphur water. As soon as they are broken by mining, the water flowing from the mines dissolves the sulphur and iron, becomes highly charged with sulphuric acid, and, if undiluted, will attack metals. Where the mine opening is below the ground-water level the water must be pumped out by means of wood-lined pumps through wood or cement-lined pipes. When the water reaches the small streams it colors them black or yellow, kills fish and vegetation, and if in material quantity makes the stream unfit for use as a water supply.

Five Methods of Treatment Summarized—Much study has been given to the problem of neutralizing mine water and making it fit for industrial use. Many experienced engineers and chemists have endeavored to solve the problem. The difficulty is so great that the usual outcome has been the adoption of a new and uncontaminated supply. [After reviewing various attempts to treat waters rendered acid by mine drainage and discussing certain possible methods, Mr. Ledoux concluded with the following summary of costs of five methods.—EDITOR.]

1. By far the cheapest process is neutralization by lime and the softening by soda ash, but this would leave so much sodium sulphate in the water that it would be impracticable.

2. Next in order of cost would be neutralization by lime, removal of two-thirds of the sulphate by heating the water to 356 deg. F., using heaters and boilers, and treating the remaining water with soda. The final water would contain about 270 p.p.m. of sodium sulphate. The cost would be about 15c. per thousand gallons.

3. Neutralization by lime and purification by means of multiple effect evaporators. The cost per thousand gallons would be about 32c., and this water would be free from all objectionable qualities.

4. Barium hydrate treatment. The resulting water would be free from all objections, but the cost would be 45c. per thousand gallons.

5. First removing two-thirds of the calcium sulphate by heat; then treating the water with barium hydrate. The resulting water would be free from all objections, but the cost would be approximately 28c. per thousand gallons.

The heat method has the advantage that its cost does not depend on the quantity of sulphates in the water, but by the chemical method the cost of chemicals, which is by far the largest item of expense, is directly proportional to the sulphates in the water. Therefore in the present state of the art it is the writer's judgment that there is no simple and economical method of purifying mine water to a sufficient extent to make it suitable for general use.

The writer believes that the method which offers the most promise is barium hydrate for the reason that the precipitate, barium sulphate, may be marketable at a price sufficient to pay the cost of treatment. Practicable safeguards can be put into effect, the writer thinks, to prevent the slight danger of poisoning incidental to this method.

Economic Study of Highway Design and Location

Considering Distance, Grades, Alignment, Width and Surface in Respect to Cheap Operation of Motor Vehicles

Condensed from a paper presented at the annual meeting of the Minnesota Federation of Architectural and Engineering Societies.

By O. L. Kipp
Construction Engineer,
State Highway Department of Minnesota, St. Paul, Minn.

In economic highway location the first consideration is to secure the shortest line possible commensurate with other governing factors. Counting the cost of operation only and making no allowance for saving in time, the value of highway distance saved is approximately 10c. per vehicle-mile. On this basis the saving of one mile in the length of a road, assuming an operating period of 250 days per year, would be as follows:

Cars per Day	Saving per Day	Saving per Year	Capitalized Value at 5%
100	$10	$2,500	$50,000
1,000	$100	$25,000	$500,000
10,000	$1,000	$250,000	$5,000,000

It will be seen from these figures that the reduction of distance to a minimum is amply justified even though the traffic may be comparatively light. With extremely heavy traffic the theoretical amount which might be expended in order to save distance becomes almost unlimited. In seeking to save distance the necessity of serving intermediate communities, towns and cities cannot be disregarded. An effort must therefore be made to appraise the relative volume of traffic from such intermediate communities, or between such towns and cities, as compared with through traffic.

Economic highway location requires also that proper consideration be given to the topography of the country. Under this phase of the problem the following are the main features requiring consideration:

1. Other things being equal the location should be chosen over a route offering the best soil conditions.

Open porous soils should be chosen in preference to heavy sticky soils; firm ground in preference to swamps with deep soundings, and earth excavation in preference to loose or solid rock. These are not governing features but must be kept in mind and given due consideration.

2. The location should be chosen to provide economic grades.

This subject has been investigated at the Iowa Engineering Experiment Station. From this investigation a tentative conclusion is reached that the maximum economic grades are approximately as follows:

	Descending					
Length feet	300	500	1,000	2,000	3,000	7,000
Commercial, grade P. C.	7	5	3½	2.8	2.6	
Automobile grade P. C.	12	10	5½	4.2	3.3	
	Ascending					
Commercial grade P. C.	10	7½	6	5.3	5	4.8
Automobile grade P. C.		13	10	8.5	8	7.3

It appears that descending traffic requires for economic operation considerably lower gradients than are required for ascending traffic.

It is considered that the growing importance of commercial highway traffic justifies the selection of 5 per cent as the standard maximum grade on the trunk highways and primary state aid roads of Minnesota. Special conditions may justify occasional exceptions to this standard. While steeper grades of less than 500 ft. in length might be theoretically economical, yet it appears that ordinarily the additional cost of locating and designing the layout to obtain 5 per cent as a maximum grade is so small as to justify disregarding any theoretical economy involved.

Providing the location is selected so that no change is required the establishment of easy grades is one of the most prominent features of highway construction. Alterations in grade as well as in alignment after a highway has been in service for a period of years can seldom be made without damage to improvements adjacent to the road. The initial establishment of easy grades should therefore be given careful study both in location and design, and the easiest grades consistent with cost of construction should be adopted.

3. In co-ordination with the matter of grade selection is the elimination of *rise* and *fall*.

Such elimination is evidently valuable providing the distance is not increased. In the *Engineering News-Record* July 22, 1920, p. 171, Wilson G. Harger develops the principle that there is less potential energy wasted on a light grade than on a heavy grade and that the actual saving in operating cost by eliminating a foot of rise and fall over a hill is less important on light grades than on heavy grades. The following tables are taken verbatim or adapted from Mr. Harger's article:

DISTANCE EQUIVALENT TO ENERGY SAVED PER FOOT OF RISE

1-foot rise on 10 per cent grade = 40 ft. of level distance
1-foot rise on 5 per cent grade = 20 ft. of level distance
1-foot rise on 2 per cent grade = 5 ft. of level distance.

Referring to the table previously given for the value of saving in distance, the following table is derived:

CAPITALIZED VALUE OF SAVING 1 FT. OF RISE AND FALL WITHOUT INCREASING DISTANCE

(Based on car-mile operating cost of 10c. per mile)

Vehicles per Day (250 days per Year)	Yearly Saving			5% Capitalized Yearly Saving		
Grades P. C.	10	5	2	10	5	2
100	$19	9.50	2.40	$380	$190	$47.50
1,000	190	95	24	3,800	1,900	475
10,000	1,900	950	240	38,000	19,000	4,750

4. The cost of right-of-way must receive its due consideration in determining the location.

Where other factors are involved to any great extent it is necessary to guard against the tendency to give undue weight to saving right-of-way costs. Economy in this direction is most easily appreciated by the layman and particularly by the local interests more or less directly affected by location. There is a tendency—and in many cases more than a tendency—for pressure from this source to give to this phase of highway location undue importance.

5. The cost of structures required for stream crossings and railroad grade separations is frequently a deciding factor in determining the definite location of a highway.

Frequently the most satisfactory solution of this problem cannot be obtained without data based on several preliminary trial lines. Other factors being equal square crossings of streams and railways are desirable. It seldom happens, however, that other factors are equal, and in a large percentage of cases skew crossings provide the most economic layout. The cost of the structure alone, for the same length of clear span on a line normal to the stream or railroad, varies as follows:

90 deg.	100%
74 deg.	103.5%
60 deg.	115.5%
45 deg.	141.4%

Crossings of less than 45 deg. are seldom necessary as ordinarily this angle can be obtained by a modification of alignment involving a slight increase in curvature.

The growing importance of railway grade crossing eliminations has within the past few years brought this factor into prominence in highway location. In many cases it takes precedence over all other factors and justifies abandoning old lines of travel in order that a location may be selected eliminating crossings entirely. In other cases where the crossing must be made it involves a departure from a natural location to a line affording the best possible support for an overhead crossing or to a low line permitting an underpass. A locating engineer's instinct for the selection of routes where the topography affords easy grades and slight curvature must be modified in many cases by the necessity of striking into comparatively rough terrain where opportunity for a separation of grades is naturally afforded.

6. The question of alignment enters more or less directly into all other factors of economic highway construction.

The exact economic value of good alignment with easy curvature from an operating standpoint has not been determined for motor vehicles. Improved alignment ordinarily results in a saving of distance which can be evaluated as previously indicated. Where hard surfacing will be required in the near future the saving in surfacing costs alone frequently would justify an improvement in alignment. For instance, at one point on Trunk Highway No. 1, there is at present a half-mile jog which involves two right-angle turns. By following a diagonal location requiring six acres of new right-of-way a saving in distance of approximately a quarter of a mile is effected, and the pavement area is reduced approximately 2,800 sq.yd. At $2.50 per square yard this reduced the paving cost $7,000. This would provide a very liberal allowance for right-of-way purchase and still show a profit without considering the operating saving, which based on 1,000 cars per day, would amount to $25 per day, and a capitalized value of $125,000.

The importance from the standpoint of pavement area, of reducing curvature where topographic features permit, is shown by the following comparison, the paving areas being taken between common points on the tangents:

	Right of Way	Pavement Area
90 deg Angle		
20 deg curve	1,536 acres	3,203 6 sq.yd.
7 deg curve	4,260 acres	2,571 4 sq yd.
Difference (taking all of corner)	2,724 acres (more)	632.2 sq.yd. (less)
60 deg. Angle		
20 deg curve	1,384 acres	1,946 3 sq.yd.
7 deg. curve	1,299 acres	1,714.2 sq.yd.
Difference (4 rods only)	.085 acres (less)	232.1 sq.yd. (less)
30 deg. Angle		
20 deg. curve	0.658 acres	929.1 sq.yd.
7 deg. curve	0.649 acres	857.2 sq.yd.
Difference (4 rods only)	.009 acres (less)	71.9 sq.yd. (less)

The real value of well balanced alignment cannot be determined by the foregoing methods in many cases. Frequently there may be no economic justification for improving curvature other than the added safety and comfort to traffic and the desirability of balancing the design. For instance, why spend from $20,000 to $100,000 in effecting a railway grade separation for the sake of safety, and save a few thousand dollars by the use of cramped alignment in the approaches and thereby create, it may be, as great a hazard as the one which has been eliminated at so great an expense.

Width of Roadway—There is a tendency toward the choice of too narrow a roadway. The saving in excavation, assuming level cross-sections, is not directly proportional to the width of roadway. The following table illustrates the variation in yardage for various widths assuming the same profile and level cross-sections. The 30-ft. roadway yardage has been shown as 100 per cent as this is the standard trunk highway width in Minnesota and the yardage assumed is our present approximate average for this width:

Width of roadway, feet	30	24	20
Cu.yd. per mile	13,325	11,100	9,625
Yardage, per cent	100	83.3	72.3
Traffic capacity	100	50	25

The traffic capacity percentage has been chosen empirically, but it approaches closely to a true comparison. In view of these figures and the excessive cost of obtaining additional width at a later date it would appear that too many township roads are 20 ft. wide when they should be 24 ft., too many state aid roads 24 ft. wide when they should be 30 ft. and, by the same token, perhaps many trunk highways should be 40 ft. instead of 30 ft. It must be remembered that the subgrade is the foundation for future highway development and it is not economy to design it in such a manner that it will require rebuilding or expensive remodeling within a comparatively short period.

Substantial grading, where proper location has been obtained, is economical also on account of the greatly improved drainage and snow protection which may be obtained through the use of wide side-ditch sections. These may ordinarily be used without increasing the gradients or the rise and fall materially. Where rock excavation is not encountered the following minimum ditch widths and depths are being used on Minnesota truck highway plans:

Centerline Cut Below Natural Ground	Minimum Ditch Width at Grade	Minimum Cut Width At Grade, 30 ft. Roadway	Min. Depth Of Ditch
Less than 4 ft.	16 ft.	62 ft.	3½ ft.
4 to 8 ft.	13 ft.	56 ft.	2½ ft.
Over 8 ft	10 ft	50 ft	2 ft.

Such ditch sections naturally result in a considerable yardage of excavation per mile. It must be remembered, however, that the cost of the grading per mile, where the work is finished to definite gradients and cross-sections, is by no means proportional to the yardage per mile. The combined cost per mile of finishing and of moving the outfit on and off of the work and from one camp site to another on the work, together with general overhead charges, are practically the same per mile on light work as on heavy work. The sum of these items amounts to approximately $900 per mile on trunk highway work. On the other hand greater efficiency of operation is obtained as the yardage per mile is increased. On account of these facts the following table applies very closely, the various other governing factors being equal:

COST OF GRADING PER MILE

Cu.Yd. per Mi.	Overhead per Yd.	Moving Dirt per Yd.	Total Rate per Cu.Yd.	Cost per Mile	Increase In Ydge %	Increase In Cost, %
3,000	$0.30	.50	$0.80	2,400 00	. .	. .
6,000	.15	.35	.50	3,000.00	100	25
9,000	10	.30	.40	3,600.00	200	50
12,000	.075	.275	.35	4,200.00	300	75
15,000	06	.24	.30	4,500.00	400	87.5
25,000	04	.20	.24	6,000 00	833	150

Types of Surfacing—By improving the type of road surface various economies in motor vehicle operation are effected, such as, a reduction in fuel consumption, a reduction in tire upkeep and a reduction in general car maintenance costs. The cost of road surface maintenance also varies with the type of surfacing.

Considering first the saving in gasoline the following data are taken from a paper by Fred R. White, Chief Engineer of the Iowa State Highway Commission:

COST IN SAVING IN FUEL PER MILE

Type of Surface	Ton-Mile Cost	Aver. Cost Per Vehicle-Mile	Annual Cost Per Mile, 100 Vehicles Per Day, 300 Day Year	Annual Cost Per Mile, 1,000 Vehicles Per Day, 300 Day Year
Earth	1.71c	2.33c	$699	$6,990
Gravel	1.15c	1.56c	468	4,680
Concrete	.77c	1.05c	315	3,150

	By Gravel Surface On Earth Road		By Concrete Surface On Earth Road	
	100 Cars	1,000 Cars	100 Cars	1,000 Cars
Annual saving	231	2,310	384	3,840
Capitalized value	4,620	46,200	7,680	76,800

To pay 5 per cent interest on bonds and retire them in fifteen years requires an annual payment of 10 per cent of the amount of the bonds. Disregarding any difference in maintenance cost the saving in fuel alone with an average traffic of 151 vehicles would pay for gravel surfacing at Minnesota's average cost of $3,500 per mile. Other savings would fully cover any added cost in maintenance on the gravel surface.

Gravel surfacing on Minnesota state aid roads costs on the average $2,300 per mile, which would be paid for by fuel saving of 100 cars per day. Assuming township gravel surfacing road costs to be $1,500 per mile the saving in fuel consumption on an average of 65 vehicles per day would pay for such surfacing.

In considering the saving in operating costs as between a gravel surface and a concrete surface there are three major items to be taken into account, namely, maintenance, fuel consumption and tire upkeep.

In regard to maintenance expense Minnesota Highway Department records show that the maintenance on the concrete road surface between Anoka and St. Cloud amounted to an average cost of $86.37 with an average daily traffic of 1202 cars. On Trunk Highway No. 1 between White Bear and Carlton, which has a gravel surface, the average traffic was 1,151 cars per day and the average maintenance cost per mile was $862.52. Assuming these costs would be relative to the amount of traffic and reducing them to the basis of 1,000 vehicles per day, we find that an average traffic of 1,000 vehicles per day could be carried on a concrete surfaced road with a maintenance cost of $72 per mile, while to carry the same traffic on a gravel surfaced road would require an annual expenditure of $750 per mile. The difference in the cost of maintenance for an average traffic of 1,000 vehicles per day is therefore $678 in favor of the concrete surfacing.

The saving in fuel consumption as previously given on an average traffic of 1,000 vehicles per day is $1,530. The saving on tires over a concrete surface as compared with costs on gravel surfaced road has been shown by actual records to average 1c. per vehicle mile. This on the basis of 1,000 vehicles per day amounts to an annual saving of $3,000. The total of these three items is $5,208, which represents the annual saving by an average traffic of 1,000 vehicles per day over a concrete surfaced road as compared with the cost of the same traffic over a gravel surfaced road.

Assuming $20,000 per mile as the difference between the cost of gravel surfacing and the cost of concrete surfacing it requires an annual expenditure of $2,000 to cover interest and sinking fund charges. On the basis of the saving in maintenance, gas consumption and tire upkeep of $5,208 per year for 1,000 vehicles per day, the saving in operation cost on 384 vehicles per day would pay for the cost of the pavement. On the basis of the saving in maintenance and gas consumption only the saving in operation cost on 906 vehicles per day would pay for the cost of the paving.

Some "Engineers" I Have Known

By a Civil Engineer

I HAVE been much interested in the controversy over the use of the term "sales engineer" to describe a salesman who sells engineering products. I wonder, however, that no one has as yet done justice to the numerous tribe of "engineers" of one sort or another that infest the land. If it were not for the injury that is done to the name of a splendid profession, the individuals responsible for this sort of thing would simply make themselves ludicrous, but it must be remembered that one perfectly good word, i.e. "professor," has already become considerable of a joke through its application to all sorts of practitioners of all sorts of arts.

Not long ago, for example, a New York newspaper, under a head "Body Engineers Now Important," held forth to the extent of nearly a column. When I first saw the head I thought this was a new engineering title for quack doctors, but upon reading into the article I found that the "body engineer" is the designer of automobile bodies. The article itself, of course, was simply a "puff" or "write-up" for a specific automobile manufacturer, in the course of which it is explained that the "body engineer" devotes all of his time "to the improvement of the body, of the locks, the door and window fittings, and everything that concerns the comfort and beauty of the car." Another of the fifty-seven varieties is the "publicity engineer." A newspaper article refers, for example, to the "publicity engineer" for a theatrical company. This, of course, is our old friend, the press agent, exalted to a "professional" plane. Still another specimen is the "milk engineer." Just exactly what his function may be I have not been able to make out, as I saw the title used on the corner card of an envelope.

Another instance recently reported to me was that of the "income engineer," who turns out to be no less a personage than our old friend, the insurance agent, who doubtless derives much "swank" and effects many entrances that he might not otherwise enjoy through the use of his neatly engraved card bearing his name and his title, "Income Engineer." I have before me also a newspaper or magazine clipping which contains an advertisement for an "Institute" which conducts a course in dress designing and dressmaking. This advertisement features the genius of Emily, who built up "a most lucrative business" by "following out a tip from the Institute to use original advertising methods." She styled herself "clothes engineer," and accordingly hung out her shingle bearing the initials C. E. after her name. Probably others will be inspired to follow Emily's example. Not long ago a Middle West department store advertised, with considerable éclat, the services of its "window-shade engineer" who would be at the service of its patrons.

An unusually interesting case not long ago consumed considerable space in the principal New York newspapers, when the Society of Professional Automobile Engineers formally opened its club house in that city. This brand of engineers, be it understood, comprises chauffeurs in private employment. But let the president of the society explain. According to the newspapers he announced that "the organization was conducting a nation-wide campaign to eliminate the term chauffeur from usage and substitute 'automobile engineer.'" "There is a great difference between an automobile driver and an automobile engineer," he said. "Our organization is composed of professional operators of automobiles in private employment. It aims to place the profession on a higher plane and to protect its members from increasing laws levied on operation of automobiles." Taxicab chauffeurs, it is said, are not eligible for membership. Perish the thought!

The climax is capped, perhaps, by still another variety that recently took a full page in a magazine to tell of a "New Profession That Pays from $3,000 to $15,000 a Year." "An enormous untouched field," continues the advertisement. "No competition, a tremendous demand, no capital required. Can be learned in from two to six weeks. . . . This new profession offers its followers a position of dignity and independence, a free rein for initiative, and those other recognized advantages enjoyed only by professional men. Yet there is no long period of training and study extending over years, no poorly paid period of apprenticeship, as is the case with doctors, lawyers, and followers of the old-line professions. And best of all, there is practically *no competition*. This is one reason why those men who are now practicing this new profession are actually making more money than the average doctor, lawyer, architect or engineer."

This fortunate individual is the "exterminating engineer," who through his "knowledge of technical methods and special formulas" devotes his professional activities to "the scientific exterminating of insects, vermin and parasites." Shades of Watt, Smeaton and Noble! Little did the humble doughboy, attentively "reading his shirt" during the long winter evenings in French trenches, realize that he was founding a new profession! The exterminating engineer, we are told, has "no difficulty in getting business," but he is "not dependent solely upon his individual efforts"; for the new profession is backed by a "co-operative organization whose membership consists of men trained in the profession, The Exterminating Engineers of America." This organization, which maintains its headquarters in New York City, teaches men by mail and graduates them "in from two to six weeks as 'exterminating engineers.'" Then it helps finance them in business, appointing them its representatives in their own communities. The Exterminating Engineers of America, we are told, "are always on the lookout for live, progressive men to become affiliated with them. The membership fee is ridiculously low—a man can actually become established in business for himself as an Exterminating Engineer," at a lower outlay of money than the average freshman in college has to pay for text-books and supplies alone." An advertisement for this same outfit in *The Literary Digest* tells us that it is a "national organization carrying on movement started by U. S. Department of Agriculture and Forestry."

And so it goes. These are only a few. Doubtless others of your readers have discovered other varieties and could contribute a specimen or two to this engineering Chamber of Horrors.

All this has a humorous aspect, of course, as is exemplified by James J. Montague in the following verses:

"No longer little Micky Hare,
Whose ways are mild and meek,
Will keep my clothing in repair
For fifty cents a week.
He now demands a larger sum,
Which I esteem too dear,
For lately Michael has become
A Pressing Engineer.

"The days when Tonio Dorio
Would clip and trim my lawn
And make my kitchen garden grow,
For ten a month are gone.
He now is making wads of pelf,
Takes contracts by the year,
And, on his billheads styles himself,
A Mowing Engineer.

"The lads from Greece who cleaned my shoes,
Once in a cheaper time,
Now with a haughty scowl refuse
My little proffered dime.
One sees them by appointment now,
They've risen, it appears,
And have become, so they avow,
Shoe Surface Engineers.

"Old 'Rastus Johnson comes no more
To take the cans away,
Or knocks upon the kitchen door
To seek his weekly pay.
He's found a means of getting his—
The dusky profiteer—
His card informs me that he is
A Garbage Engineer."

But we as engineers are painfully aware of another side that sooner or later may be of embarrassing, if not serious, consequence to us. What are we going to do about it? I do not know. For the present, I am simply a—"Fed-up Engineer."

Railway Accidents and Track Work

Three accidents noted in the summary of the Interstate Commerce Commission (Bureau of Safety) for the last quarter of 1922 are of interest in connection with track maintenance and work-train operation.

Work-Train Protection—The dangers incident to work-trains operating on main lines and the necessity of adequate protection for such trains are illustrated by two accidents. On the Florida East Coast Ry., on Nov. 2, the flagman of a work train was told to hold a regular train until 1:25 p.m. in order that the work train might get clear of the main line, but he claimed that the time stated was 1:15. As a result of the misunderstanding of verbal orders a collision occurred, causing three deaths and the injury of eleven employees. On the Southern Ry. at Sadieville, Ky., Nov. 14, the engineman of a freight train passed a block signal indicating "stop" and caused a collision resulting in the death of one man. It is pointed out that the engineman not only disobeyed the signal (which he saw) but disregarded the rules that permit passing such signals under certain conditions.

Broken Guard Rail—Absence of a frog guard rail, which had been broken by a train, caused another train to mount the frog and leave the track at West Bend, Wis., on the Chicago & Northwestern Ry., Dec. 14. One man was killed. The 15-ft. 100-lb. guard rail had been broken into fragments, but it was not determined what caused this or what train did the damage.

Diesel-Engine-Driven Centrifugal Pumps Irrigate 50,000 Acres in India

By J. A. Colaco
College of Engineering, Guindy, Madras, India

The irrigation systems connected with the Godavari and Kistna Rivers constitute the largest of their kind in India, and have involved the construction of some of the most remarkable engineering works in that country. Of these the Divi pumping station is probably the most interesting, not so much on account of its magnitude but rather because by successfully adopting pumping for the purpose of large-scale irrigation it made a new departure in this field of engineering in India.

The Kistna River rises in the western Ghats at a height of 4,000 ft. above the sea and traverses the whole width of the South Indian Peninsula before discharging into the Bay of Bengal. About 40 miles s.s.east of a place known as Berwada where an anicut has been built across the river, the Kistna divides into two branches, the Puligadda and the Nagaya, between which is inclosed the island of Divi, 105 sq. miles in extent. It had been the purpose of the Madras Government for several years to make these rich deltaic lands available for cultivation by means of water drawn from the Kistna Eastern Delta Bank Canal by carrying the same over an aqueduct to be built across the smaller Puligadda branch. But this scheme was not carried into effect in view of the more accessible areas to be irrigated on the mainland itself.

The Divi pumping project works consist of a pumping station placed about a mile from the head of the island where the river water remains fresh and where the level of the country is sufficient for the main canal to command the whole area to be irrigated. The distributing system consists of a main canal about two miles in length bifurcating at the Avanigadda regulator and thereafter spreading into a network of distributaries irrigating about 50,000 acres of land. Statistics for recent years show the average area irrigated as about 30,000 acres, yielding a gross revenue of 117,000 rupees. The net revenue is 69,500 rupees which works out at 3.64 per cent on a capital outlay of 1,906,290 rupees ($635,000).

Pumping Plant—The pumping station is situated centrally on a supply or loop channel cut across the width of the island and connecting the two branches of the river. The maximum lift when the river is low is 17 ft. The pumping plant consists of eight sets of 160-b.hp. two-cylinder Diesel engines each direct coupled to a 39-in. centrifugal pump by flexible coupling to allow for slight settlement of foundations or unequal wear of the pump and engine bearings. The pumps are arranged in two rows of four units each with space for a ninth unit, and the suctions draw from two parallel culverts under the engine house, with intakes from the loop channel.

The pump delivery is into two masonry concrete channels running parallel to the engine house on either side and each of these leads to a 10-ft. Venturi meter with a throat ratio of 1 to 3 discharging 500 sec.-ft. with a head of 3 in. There are in addition two combined recorders and counters in the meter house each registering up to 2,250,000 cu.ft. per hour, these being connected with the outside of the meter pressure chambers by passages through which the pressure pipes are carried.

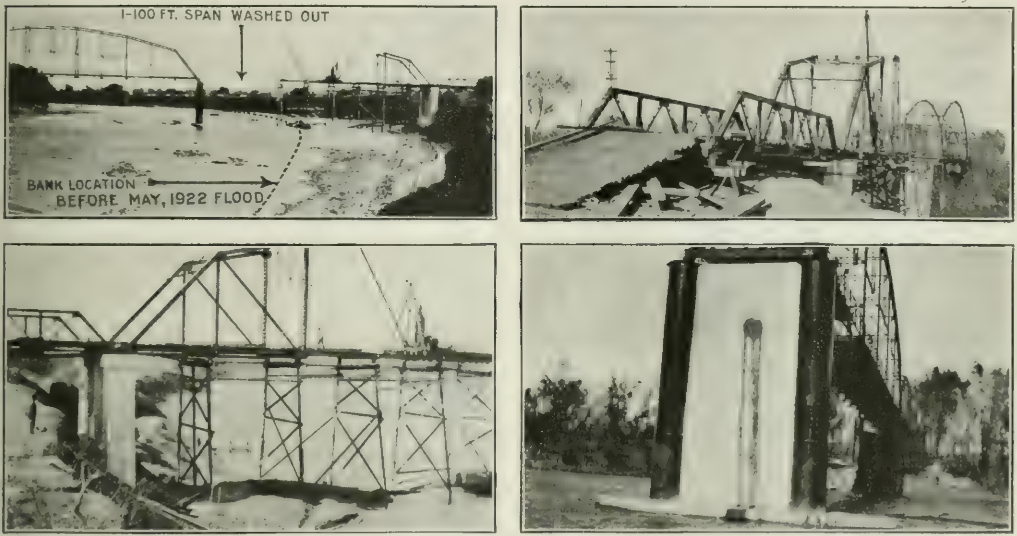
The cost of irrigating each acre of cultivable land fluctuates rather heavily, being dependent to a large extent on rainfall conditions. It varied from about 1.15 rupees in a rainy year to 1.54 rupees in a dry year.

Lengthening Bridge After Caving of Bank in Flood

Washout Caused 200-Ft. Gap Where 100-Ft. Span Had Been—Replaced by One 200-Ft. and One 60-Ft. Span

By B. H. Faber
County Engineer, Columbus, Tex.

CAVING of the south bank of the Colorado River at Columbus, Tex., just where the main highway from Columbus to La Grange crosses, destroyed the end span of the bridge on May 5 last year and cut more than 100 ft. into the bank. In reconstructing the destroyed part of the bridge it was necessary to lengthen the structure to take care of the increased width of the river. As in many such cases, the washout was due to inadequate foundations. It is expected to prevent future scour of the bank by building a current deflector upstream of the bridge to divert the current away from the concave bank.


1-100 FT. SPAN WASHED OUT
BANK LOCATION BEFORE MAY, 1922 FLOOD

LENGTHENING COLORADO RIVER BRIDGE AT COLUMBUS, TEX., AFTER WASHOUT OF MAY, 1922

The pier carrying the south end of the 240-ft. channel span, lower right-hand view, was weakened by scour of the rock at its downstream side, causing the ½-in. steel web between the 5-ft. cylinders to buckle. This web has been protected by 24-in. concrete encasement. Future scour will be prevented by protection work above the bridge.

Fast work marked the reconstruction, a 60-ft. and a 200-ft. steel span being erected in ten working days, between Dec. 15 and Dec. 31, 1922, although riveting the spans took two or three weeks longer. An interesting job of underpinning also had to be done, because of scour under the main river pier.

The bank of the Colorado River at this point is about 30 ft. high, the upper 15 ft. being clay while the lower 15 ft. is river sand, overlying a sand rock suitable for foundations. The south bank is the concave side, but the abutments at this end of the crossing have not been carried down into the rock. Beginning at the north bank the crossing consisted of three 180-ft. spans, which cross a sandbar or flood plain, a 240-ft. channel span, and a 100-ft. span. The washout of the south abutment carried out the 100-ft. span and, with continuing wash of the flood, a gap of 200 ft. or more was opened up between the south bank and the channel span. It was therefore necessary to provide a 200-ft. span and a 60-ft. shore span and to close the gap next to the channel span.

The new south shore pier, 49 ft. high, is a concrete pier set well into the sand rock. The south end of the 60-ft. shore span rests on a creosoted pile abutment. The new steel spans, built by the Austin Bros. Bridge Co., Dallas, were erected by light derrick travelers on pile and framed bent falsework. Their erection was completed on Dec. 31, as already noted.

Investigation of the south pier of the channel span, which consisted of two 5-ft. circular steel cylinders 20 ft. apart, sunk about 7 ft. into the rock and connected by a ½-in. steel plate web, showed that this web had buckled and that the downstream part of the foundation had been weakened by scour of the sand rock. To repair the damage a concrete base 11 ft. wide by 44 ft. long, pointed at both ends and faced with a steel nosing at the upstream end, was built around the bottom of the pier, to above low-water level. The steel web of the pier was incased in a 24-in. concrete web. The cost of this pier repair work, carried out by B. Fitzpatrick, of Columbus, was about $2,000. The rest of the reconstruction cost about $21,000.

It is now planned to resurface the deck of the bridge with a 4-in. creosoted floor of 3 x 4-in. x 18-ft. timbers, with an asphalt surface. Protection work will also be built above the bridge to divert the current to the center of the river as protection against future scour of the concave south bank.

During the time the bridge was out of service the county maintained a ferry across the river between La Grange and Columbus

Economic Aspects of Treated Ties for Railway Track

Supply and Demand of Preservatives Discussed by Wood Preservers—Machine Boring and Facing—Spike Corrosion

THE relations of preservative treatment to the use of wood railway ties were presented from different points of view at the annual meeting of the American Wood Preservers Association and abstracts of three reports on this general subject are given below.

Boring and Adzing Ties Before Treatment—By boring spike holes and machine-facing the rail seats of ties before treatment there will not only be less chance of exposing lightly treated surfaces but there will be a deeper penetration of the preservative at the parts subject to wear. In this way increased life may be obtained at a cost that is nominal in comparison with the results. The mechanical operations may even be economical for untreated ties. These are the main points of a report based on replies to an inquiry.

Spike holes bored by machine are reported by different engineers to give better penetration of the preservative, a better grip on the spike, less damage by spiking and more accurate vertical position of the spikes. The holes are bored usually through the ties. One engineer suggests round spikes in bored holes of slightly less diameter than the spike. On the other hand, bored holes may cause trouble in widening gage and laying heavier and wider rails, or on roads where rails of numerous different base widths are used. However, one reply considers that prebored holes are desirable in any case, even if it is necessary to plug certain holes and rebore the ties in the track. Rail seats adzed or dressed by machine to a level surface for the rail or tie-plate give a better bearing, especially with hewed ties, which rarely have a plane surface. For sawed ties, however, the adzing might form an undesirable pocket to hold moisture, but would be necessary if rails are to be laid in canted position instead of vertical. One suggestion is that tie-plates should be secured rigidly to the tie by fastenings independent of the rail spikes.

Although both operations tend to material increase in life of ties they should be supplemented by the use of tie-plates to protect the wood from mechanical wear. Thus, one engineer refers to ties which last only four or five years untreated, eight years treated, and fifteen years when treated and tie-plated. The conclusion presented is that the largest return on the cost of treatment will be obtained by putting the ties through a boring and adzing plant before treatment and then protecting them with tie-plates of sufficient size and weight to distribute the load and prevent the rail from cutting and crushing the wood.

Prospects of the Tie-Treatment Situation—Although creosote oil is generally considered as the most effective preservative for timber, the increasing use of treated timber without corresponding increase in the production or importation of this oil has developed a situation which appears to necessitate the mixture of other suitable oils with creosote and also the use of other preservatives. In a paper by E. B. Fulks, of the Arkansas Preservative Co., St. Louis, Mo., it was stated that in 1921 there were used 48,000,000 gal. of domestic creosote oil and 28,000,000 gal. of imported oil, while there is little prospect of any material increase in the supply for several years. The use of creosote in 1909 was 83 per cent for ties and 17 per cent for other materials, but by 1921 these proportions had changed to 55 and 45 per cent respectively. It is estimated, therefore, that the supply will be sufficient for treating only 15,000,000 to 25,000,000 ties per year, while the railways will require from 60,000,000 to 75,000,000 treated ties, or about 55 per cent of their annual tie consumption.

Since the production of creosote oil (as a by-product) is controlled by factors independent of its supply and demand, the solution of this problem as suggested by Mr. Fulks is to restrict the use of creosote to situations where it is clearly necessary (as for permanent structures or in wet ground) and to use zinc-chloride more extensively where it is evident that it will give satisfactory results. He admits that the latter will not preserve the wood for so long a time as creosote, but considers that it will increase the life sufficiently to yield a good return on the cost of treatment. Further, he suggests that a comprehensive study of the use of zinc-chloride, such as has been made in regard to creosote, would develop improvements which would increase the value of the zinc-chloride treatment.

Corrosion of Track Spikes—That the use of zinc-chloride as a tie preservative has little or no relation to the corrosion of spikes in railway track is the conclusion of another committee's report. Of twenty-six railways which have experienced this corrosion where zinc-treated ties are used, only five reported this action as occurring in such ties only. Other factors in corrosion, as noted by the report, are the chemical composition of the spikes, electrolysis, brine dripping from refrigerator cars, cinder ballast, and the collection of water around the spike. Damage which appears similar to corrosion may result from mechanical wear at the contact of rail and spike. While the zinc-chloride treatment of times seems to hasten corrosion of spikes there are equally authentic cases where, under practically the same service conditions, no appreciable corrosion has occurred. In other cases, fully as much corrosion has occurred with spikes in untreated ties. It is therefore concluded that the situation is not serious and that where excessive corrosion is noted it would be well to look for causes other than the zinc-chloride.

A Concrete Roof-Slab Failure

By Dr. E. G. Friedrich
Berlin, Germany

SOME weeks ago a fatal accident occurred in the Mosse Building, in Berlin, during the work of adding several stories to the height of the building. The addition is of reinforced-concrete construction, as are the floors of the four-story old building below. The two additional stories had been completed and the roof slab was poured. When the forms of the roof slab were removed part of the slab failed, and the falling masses broke through the two completed new floors below as well as the floors of the four stories of the old building. The old building was in continued service; fourteen persons were killed in the collapse and many seriously injured.

The accident points out once more that the roof slab in reinforced-concrete construction is apt to receive less attention than it requires. The safety factor of the roof slab is always less than that of floor slabs, because it is designed chiefly for dead-load. At the time forms are struck it is subjected to stresses approaching the final working stresses, which is not true in the case of floor slabs because of the absence of the live-load for which they are designed. Weather influences also are likely to affect a roof slab more than a floor slab.

Two changes in building practice are suggested by this accident. The first is to change the customary vague requirements to observe special caution in removing forms from slabs designed for small or no live-load. Repeated accidents have shown that this requirement is not sufficient, and that a definite minimum time should be specified, with a view to assuring safe strength of the slab at time of removing forms, under all conditions. This would call for a period of time two or three times as great as that necessary for floor slabs. The second change called for is the provision of special protection in the case of construction work over a building which continues in use.

Engineers Appointed to Retrace Oklahoma-Texas Boundary

Disputed Claims to Oil Lands in Big Bend Area to Be Settled in Accordance with Recent Supreme Court Decision

IN ACCORDANCE with a decision rendered in January by the United States Supreme Court, engineers who are to retrace the boundary between the states of Oklahoma and Texas, following the provisions laid down in that decree, have been appointed. These engineers are Arthur D. Kidder and Arthur L. Stiles, cadastral engineers, who have been requested by the court to locate the south bank of the Red River as it existed in 1821, which, under the court's decision, will be made the boundary between the two states.

Mr. Kidder is the associate supervisor of surveys of the General Land Office. He is the author of the Standard Field Tables used by the General Land Office and is editor-in-chief of the Board which is engaged in revising the manual of instructions for surveying the public lands of the United States. He is vice-chairman of the Board of Surveys and Maps of the Federal Government. The Supreme Court of Texas has based its opinion in a number of important suits on boundary surveys he has made, as has the Supreme Court of the United States, and in no case has the accuracy of boundaries been questioned. Since 1919 Mr. Kidder has been in general charge of surveying and mapping in the Red River area.

Mr. Stiles, the other commissioner, is the state reclamation engineer of Texas. He began work with the Topographic Branch of the United States Geological Survey in 1894. He surveyed the Glacier National Park and a large area in the Black Hills. He was in charge of the highly difficult boundary surveying in the Chisos Mountains of Texas in the Big Bend area of the Rio Grande, and he mapped the Fort Leavenworth area for the War Department; and has to his credit the surveying of the Sierra de Diablo in Texas and Jackson's Hole in Montana.

In 1909, Mr. Stiles was invited by the Governor of Texas to take charge of the levee and drainage work for the state. He organized that work and has been in charge of it ever since. Since the inception of the Red River litigation he has been in charge of engineering work in that connection for Texas.

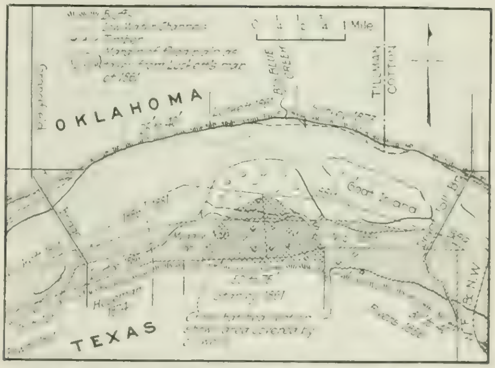
Retracing the state boundary has been made necessary through the placement on disputed ground of valuable oil wells. In accordance with the judgment of the court, only the Big Bend area of the Red River is to be immediately resurveyed.

The case before the Supreme Court involved the shifting channel of the Red River along its 600-mile course between the two states. Dispute as to the exact location of the state line was caused by the constant changes of the channel within the confines of the wide bluffs on the two sides. For much of the distance these bluffs are from 1½ to 1¾ miles apart, while the normal width of the river is slight.

For many years there was no controversy as to the boundary because there was little or no value to the land within the now disputed territory. Discovery of oil, however, led to the dispute and development of the Burkburnett fields in Texas. A prospector found that the oil extended five or six miles northwest of the Big Bend region of the Red River. Immediate drilling was begun and claims to oil lands in the basin became a subject of bitter controversy. Both Texas and Oklahoma lay claim to the area and both states sought to protect the claims of their respective citizens. The dispute was carried to the Supreme Court, Oklahoma becoming the plaintiff and Texas the defendant. The United States intervened in behalf of the Indians on the north bank.

In the presentation of the case a vast quantity of engineering work was required. Old surveys dating back to 1861 and embracing many private and official surveys of later dates were collected by the General Land Office to indicate meanderings of the stream at various times. These maps never agreed as to the location of the stream at low water and none of them with surveys made by the government after the controversy arose.

Ecologists from the U. S. Forest Service were called upon to establish the age of trees which had grown up in the lowlands for the purpose of showing that certain parts of the bed had become practically permanent elevations. Another exhibit was the development map showing the extent and location of oil wells in the river bed, this map indicating the existence of more than 100 wells in the basin in the Big Bend region.



OIL WELLS IN DISPUTED BIG BEND AREA

In order to end temporarily the strife, pending settlement by the Supreme Court, that body took possession of the oil lands through the medium of a federal receiver. Operations were allowed to continue, the United States Government collecting the usual royalty of one-eighth of the proceeds from the sale of oil. Funds thus collected have been held awaiting judicial determination as to their ownership. That part of the court's decision referring to the disputed oil territory reads as follows:

> The valley land always has been dealt with as upland. The United States surveyed and disposed of that on the north side under its Public Land and Indian laws and Texas surveyed and disposed of that on the south side under her land laws. Both treated the cut banks as the river banks and carried their surveys to those banks, but not beyond. Patents were issued for practically all the land. Individuals freely sought and dealt with it as upland. Much of that on the south side was disposed of by Texas fifty years ago, some of it earlier. Thousands of acres on that side were improved, occupied and cultivated under those disposals, and a larger acreage was occupied and used under them for pasture. Through the long period covered by this course of action there never was any sug

> gestion that this valley land was part of the river bed, nor that the shifting elevations of sand within the river bed were the river banks, nor that the land on the south side belonged to the United States. Not until some land on the south side and part of the river bed were discovered to be valuable for oil was this unbroken course of action and opinion brought into question. However much the oil discovery may affect values, it has no bearing on the questions of boundary and title.
>
> Our conclusion is that the cut bank along the southerly side of the sand bed constitutes the south bank of the river and that the boundary is on and along that bank at the mean level of the water when it washes the bank without overflowing it.
>
> The boundary as it was in 1820 when the treaty became effective is the boundary of today, subject to the right application of the doctrines of erosion and accretion and of avulsion to any intervening changes.

The treaty referred to above is that which was made between the United States and Spanish possessions to the southwest in 1819.

In the early stages of the suit the chief point of difference between the parties was that Oklahoma and the United States were claiming the south bank of the river as the boundary, while Texas maintained that the boundary was in the middle of the stream. According to the court decision "that difference was disposed in an opinion delivered April 11, 1921, wherein this court recognized that in the earlier case of the United States vs. Texas it had been adjudged that the boundary, as fixed by the treaty, is along the south bank."

The Supreme Court held that as to the line in question the definition still controlled, having been reaffirmed on several occasions but never changed. The Supreme Court decision, therefore, concerned itself with just what constituted the south bank of the river.

Twelve per Cent of Society on Committees

The Western Society of Engineers has thirty-three committees with 305 members, 12 per cent of the membership. Five years ago it had twelve committees and only 38 members. To advertise the work of the society to its members a series of single-page leaflets on the aims, history and privileges is being mailed at regular intervals to the members. This information on committee work and the 53-year old library with its 14,000 books visited by nearly 10,000 people yearly afforded two topics. Another theme was on the society's efforts toward unity and progress in engineering circles in Chicago for 53 years. "Many plans for needed civic improvements," it was stated, "have developed as a result of the deliberations of its committees and meetings. The broadening influence of trained minds meeting to extend acquaintance and exchange ideas has not been the least of our society's contribution to the progress of the second largest city in America." On committee work the work is visualized thus: "The program committee arranged meetings this fall that broke all records for attendance. The finance committee's balance sheet would delight General Dawes. The short story committee is causing many an engineer to dream of four-figure checks from magazines. The amendments committee is alive to changes in our needs. Twice this fall the noon-day luncheon committee has secured nationally known speakers who filled large ballrooms with eager engineers. The public affairs committee with its nine sub-committees and fifty-six members is making the voice of engineers heard in public affairs. Committhe work offers invaluable opportunity for engineers."

Refuse Collection and Disposal at Newark, England

INTERESTING features of the system of refuse collection and disposal practiced by the Borough of Newark, England, are the use of light Ford trucks for collection, a screening and salvage plant, and contributions by the national government to both the capital charges on the screening and salvage plant and the operating expenses.

The collection is made by means of one-ton Ford trucks with light tipping bodies, according to *Municipal Engineering & the Sanitary Record* of March 8. With an average haul of 1½ miles the annual cost of collecting 4,289 long tons of house refuse is given as £1,667, including licenses, insurance and capital charges on the trucks. The total mileage of haul was 10,301. The average cost of collection per long ton was 7¾s. ($1.70 per short ton). The gasoline consumption for the trucks was 1 Imp. gal. for 9-mile average haul.

Nightsoil totaling 1,728 long tons was also collected with one-ton Ford chassis on which were mounted light tanks. The total expense for this service was £802 for labor, £224 for transport, and £30 for disinfectant, making a total of £1,056, or about £1.63 per long ton of nightsoil. (At normal exchange, $7.93 per long ton or $7.08 per short ton.) The haulage distance for nightsoil collection totaled 5,392 miles.

The entire house refuse of the borough is screened and salable material is picked out.

Apparently the 4,289 long tons of mixed refuse yield on screening 1,380 tons of combustible cinders (about 30 per cent) for the Journal named above states: "No fuel is purchased, because 250 tons of screened cinders per year suffice, leaving a cinder surplus of 1,180 tons, which will be used in a 'turbine' forced draught furnace now being fitted to one of the water-works boilers. On the reduced coal bill the council will save £558 annually (evidently on water-works coal bill).

The salvage plant and connected buildings were erected "chiefly by direct labor" at a cost of £4,600 ($22,400) "towards which the unemployment grants committee (of the national government) contributed 65 per cent of the interest and sinking fund for fifteen years." The main items in the £4,600 just mentioned are £1,576 for land and building, £2,614 for machinery, and £339 for roads. In addition the government sanctioned a later loan of £200 for a tin baler. The screening and salvage plant was put in operation late in 1922.

Apparently based on some three months' experience, the cost of operating these works averaged 5¼s. per long ton ($1.14 per short ton) towards which there is a government grant of 1s. per ton. Deducting this grant and 2½s. per ton (49c. per short ton) for reclaimed cinders, tin, bones, etc., reduces "the net actual cost of disposal to 1¾s. per ton, exactly the sum disbursed for labor."

Concrete Protects Against Aerial Bombs

According to a report recently issued by the British Fire Prevention Committee, in which the total number of air raids on London during the war is tabulated, a statement is made that with respect to air raid shelters examination of records shows that "a series of floors of concrete or reinforced concrete afford very considerable protection, and indeed on the lower floors absolute immunity against the average explosive bomb and almost entire protection on any floor against incendiary bombs."

Application of the Drop-Down Curve in Chicago Sewers

To Obtain the Desired Cover for the Aberdeen St. Sewer Through the Stock Yards, Drop in Sewer Was Introduced—Method of Design Given

By C. D. Hill
Engineer, Board of Local Improvements, City of Chicago

The article on the "Drop-Down Curve in Conduits" by Prof. H. E. Babbitt in *Engineering News-Record*, Dec. 21, 1922, p. 1067, should be of interest to engineers who are called upon to design large sewers to drain low-lying tracts of land, where it is important that the roof of the sewer be kept as low as possible in order to obtain sufficient covering and where the conditions make necessary very sluggish velocities in the sewer. Chicago is about to construct one of the largest special assessment sewers yet built with the outlet end reduced in size for nearly a mile by taking advantage of the drop-down curve.

The theory of the drop-down curve has been applied to a number of sewer designs in recent years but the advantages of the application of this theory to sewer design are probably best shown by the proposed Aberdeen St. sewer. This huge conduit is intended to drain an area of 4,500 acres, and will discharge into the 39th St. conduit near the line of Aberdeen St. extended. It will extend southward from the outlet through the Union Stock Yards for a distance of 5,900 ft. to W. 47th St. and thence will extend south for a distance of 2½ miles to 68th St., where it will turn to the west and to the south.

From the outlet to 68th St. the surface of the street is so low that it will be difficult to obtain sufficient covering over the sewer, and for the first mile from the outlet through the stockyards it will be necessary to carry railroad tracks supporting the heaviest freight locomotives over the sewer in places and alongside it in other places. Because of this difficulty it was determined to employ a horseshoe shape of sewer, with a vertical diameter equal to 0.8 of the horizontal diameter.

The estimated runoff from 4,500 acres is 550 sec.-ft. and the estimated runoff from 4,000 acres lying immediately south of W. 47th St. is 500 sec.-ft. These quantities indicated a sewer of 15 ft. horizontal diameter by 12 ft. high with a slope of 0.00028 through the stockyards and a sewer of 14 ft. horizontal diameter by 11.2 ft. high with the same slope south of W. 47th St., these sewers flowing full with a velocity slightly in excess of 4 ft. per second.

It is impossible to build a sewer of the size indicated through the stockyards and keep the top below the bottom of the ties of the railroad tracks without placing the invert so far below the level of the water in the conduit as to produce stagnation and sedimentation during dry weather.

The application of the theory of the drop-down curve to the problem showed that the continuation of the 14-ft. sewer through the yards would carry 550 sec.-ft. with a depth of approximately 4 ft. at the outlet and slightly over 8 ft. at 47th St. and with a velocity increasing from 5 ft. per second at 47th St. to 10 ft. per second at the outlet. Further study showed that with 500 ft. of water flowing through the sewer south of 47th St. the depth of water would increase not more than 6 in. in a distance of 4,700 ft. where it was proposed to reduce the size of the sewer. Because of these computations it was decided to be perfectly safe to continue the 14-ft. sewer all the way to the outlet and to reduce the vertical diameter from 11.2 to 10.5 feet.

In this case the saving is not so much due to the decrease in the amount of material in the sewer as it is to the decrease in the difficulty of building so large a sewer through the stockyards, which are fully occupied, and where it is necessary to maintain traffic and support railroad tracks and other roads and structures. There is in addition the great advantage of obtaining better hydraulic conditions in the sewer during times of no rain.

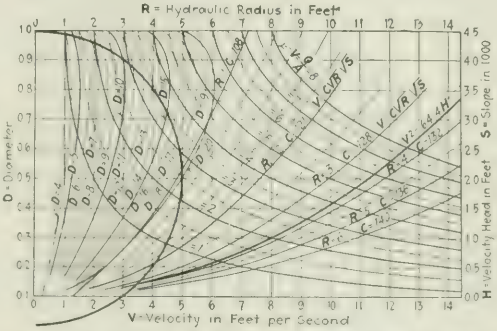


FIG. 1—HYDRAULIC ELEMENTS IN A CIRCULAR SEWER WITH UNIFORM DISCHARGE AND VARYING DEPTH

A great deal of computation is required to determine the drop-down curve under any particular set of conditions. The greater part of the work is made unnecessary by the use of a diagram, Fig. 1, a description of which by the author was published in *Municipal and County Engineering*, April, 1920, and a computation sheet as shown in the accompanying table. This table shows the computations used in the case of a circular sewer 10 ft. in diameter, with a slope of 0.24 ft. in 1,000 ft. discharging 314 sec-ft. The earlier description of Fig. 1 follows:

> The assumption is made that a constant volume of water is flowing through the sewer, that the depth of water near the outfall is a definite amount determined by local conditions, and that at an unknown distance from this point the depth of water is a definite amount slightly greater, the problem being to compute the distance. It is necessary to compute the wetted area at successive cross-sections of the sewer corresponding to assumed depths of water, to compute the hydraulic radius, the velocity, the velocity head and the corresponding slope at such cross-sections at each of which a definite depth is assumed, and from these elements to compute the distances between the successive cross-sections.
>
> The distance between two cross-sections multiplied by the slope of the sewer, plus the difference between the depths of water at the two cross-sections equals the differ-

ence between the elevations of the surface of the water at the two cross-sections. This difference must equal the head necessary to overcome the frictional losses due to the velocity between the stations, plus the difference between the velocity heads of the two cross-sections. This may be expressed:

$$LS_1 + (d_2 - d_1) = LS + (H_1 - H_2)$$

$$L = \frac{(d_2 - d_1) - (H_1 - H_2)}{S - S_1} = \frac{d' - H'}{S'}$$

By means of the diagram, Fig. 1, it is possible to read directly the hydraulic radius, the velocity, the velocity head and the corresponding slope for any cross-section through which an assumed volume of water is flowing at an assumed depth.

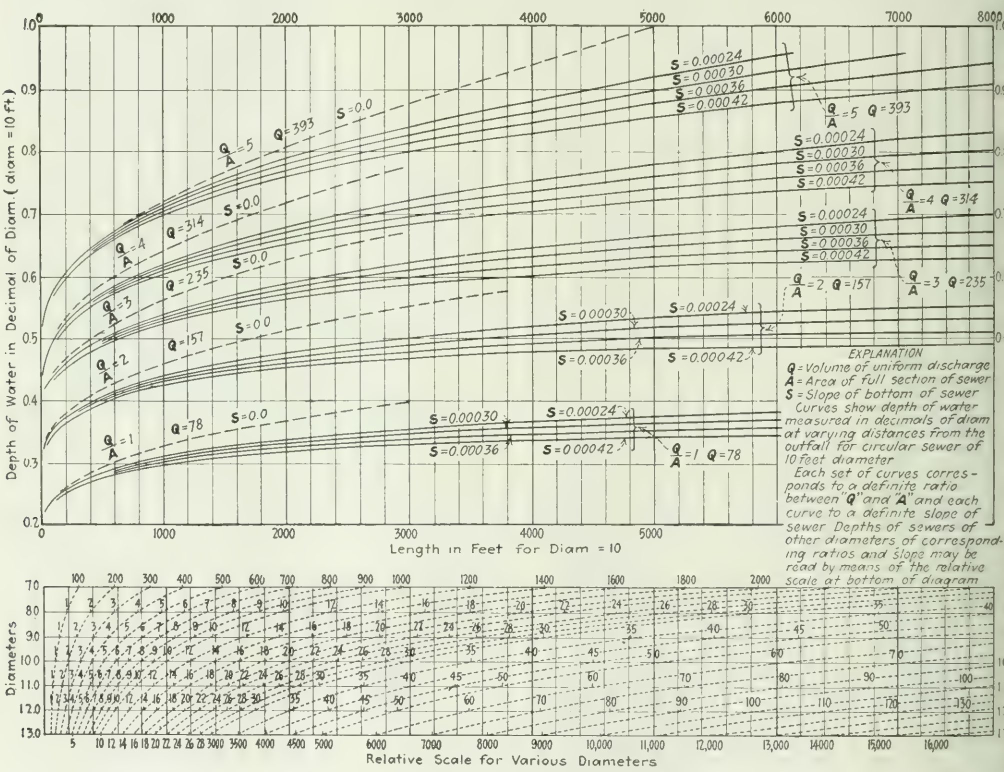
On the scale at the left margin of the diagram is read the assumed depth of water expressed in decimal parts of the diameter. On the scale at the top of the diagram is read the hydraulic radius of sewers of various diameter at any assumed depth of water, which is indicated by the intersection of the horizontal line corresponding to the depth and the curve corresponding to the diameter.

The curves, $V = Q/A = 2$, etc., show the velocities, read at the bottom of the diagram, of a constant volume flowing at varying depths corresponding to the velocity of the same volume flowing through the full bore of the sewer.

The intersection of the curve $V^2 = 64.4\ H$ with the velocity ordinate shows at the right margin of the diagram the velocity head corresponding to the velocity.

The curves $R = 2$, $C = 121$, $V = C\sqrt{R}\sqrt{S}$, etc., show the relationship between the velocity, hydraulic radius and slope; the first two being indicated by the velocity ordinate and the curve, the corresponding slope can be read at the right margin of the diagram. The value of C corresponding to each value of R is obtained by Kutter's formula with a value of $n = 0.014$.

The process of computation is outlined under the heading of the accompanying table. It is not necessary to begin the computation by assuming the depth at the outlet. A beginning can be made at any depth, and the distances computed to the adjacent sections each way. It is well to take cross-sections at regular, frequent intervals of depth, say 0.02 of the diameter. Constant increments in depth will cause regular variations in other hydraulic elements, which serves to check the accuracy of the work.



EXPLANATION
Q = Volume of uniform discharge
A = Area of full section of sewer
S = Slope of bottom of sewer

Curves show depth of water measured in decimals of diam at varying distances from the outfall for circular sewer of 10 feet diameter

Each set of curves corresponds to a definite ratio between "Q" and "A" and each curve to a definite slope of sewer. Depths of sewers of other diameters of corresponding ratios and slope may be read by means of the relative scale at bottom of diagram

FIG. 2—BACKWATER CURVE IN A 10-FT. CIRCULAR SEWER WITH RELATIVE SCALE FOR OTHER SIZES

The depth of water at the outlet can be readily determined with sufficient accuracy. Assume a depth, say 0.5 diameter; work down to a lower level until the distances between cross-sections become very small or a minus quantity. The control section is reached when the increment of the velocity head equals the decrement of the depth. As a matter of fact, in the case of a sewer having a free discharge, the depth of water at the actual outlet is of very little consequence, for the reason that the curve rises sharply and within a few feet.

In using the curve, Fig. 2, it is desired to know the depth of water at a distance of several thousand feet, or to find the distance from the outlet, where the depth of water will be 0.6 of the diameter or 0.7 of the diameter, or something of that sort. Computation shows that for sewers 10 ft. in diameter these distances are in the neighborhood of from 2,000 to 8,000 ft. The error in computing the distance would probably exceed 10 per cent. This error permits us to exclude from consideration short distances of 50 or 100 ft. that may lie between the actual outlet and the lowest section used in the computation.

Where a sewer is partially submerged at the outlet, and the water level of the stream or lake into which it discharges is known, that of course would determine the elevation at the outfall. In Chicago, all large sewers discharge into the Chicago River or the Main Channel of the Sanitary District of Chicago, and the elevation of the water seldom varies more than 1 ft. from city datum. In a few instances where sewers discharge into pumping stations, it is possible theoretically to maintain a fairly definite water level by means of pumps, although in times of big storms this is seldom done.

The accuracy of the method is naturally no greater than the accuracy of the usual methods of determining runoff of storm water and the capacity of sewers. The probable error in computing the capacity of a large sewer that is yet to be built would certainly exceed 5 per cent if it did not exceed 10 per cent. The method of determining the drop-down curve depends upon the assumption that a definite amount of water is flowing through the sewer. This is a condition that may be approximated at intervals of time of very uncertain frequency. The method employed ignores disturbing influences such as the discharge of water from lateral sewers and house drains and assumes the construction of a straight sewer perfectly cylindrical in cross-section and of a known uniform smoothness of surface.

On the diagram, Fig. 2, is shown a series of curves showing depth of water measured in decimals of diameter at varying distances from the outfall for a 10-ft. circular sewer. Each set of curves corresponds to a definite ratio between Q, the volume of discharge, and A, the cross-section area of the sewer, and each curve to a definite slope of the sewer.

The distances from the outfall of similar depths of sewers of other diameters of corresponding ratios and slope may be read with a rough approximation of accuracy by means of the relative scale at the bottom of the diagram.

Fig. 2 gives some idea of the extent and limitation of the drop-down curve. It shows that for velocities (flowing through the full bore of the sewer) exceeding 5 ft. per second the curve rises rapidly, and the length of the curve is rather short. It shows that with sewers of small diameter, 5 ft. or less, the curve is quite short unless the velocities are low.

While the diagram is not accurate for diameters other than 10 ft. it will serve to show the probable value of the application of the drop-down curve to any particular problem that comes within its limitation.

TABLE—DROP-DOWN CURVE COMPUTATION SHEET
UNIFORM DISCHARGE—VARYING DEPTH

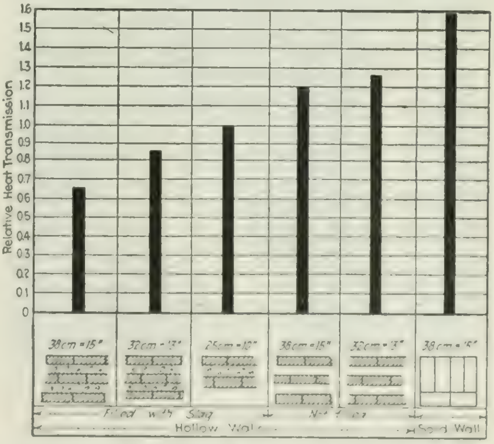
At the top of the table is recorded the diameter of the sewer in feet, the assumed volume of flow, the area of the full cross-section of the sewer, the velocity of the assumed volume flowing through the full bore of the sewer and the gradient or slope of the sewer. In the first column enter the assumed depth in decimal parts of the diameter for each cross-section; in the second column enter the same depth in feet; in the third column enter the difference in feet between the depths at successive cross-sections; in the fourth column enter the hydraulic radius corresponding to the depth at each cross-section; in the eighth column enter the velocity, equal to the volume divided by the wetted area, for each cross-section; in the fifth column enter the corresponding velocity head; in the sixth column enter the difference between the velocity heads at successive cross-sections; in the seventh column enter the difference between the quantities in the third and in the sixth columns; in the ninth column enter the hydraulic slope corresponding to the velocity and the hydraulic radius of each cross-section; in the tenth column enter the difference between the hydraulic slope and the slope of the sewer; in the eleventh column enter the computed distance between successive cross-sections; in the twelfth column enter the elevation of the bottom of the sewer at each cross-section, and in the thirteenth column enter the corresponding elevation of the surface of the water.

$D=10'$ $Q=314$ $A=78.5$ $V=\frac{Q}{A}=4$ per 1000' $S_1=.24$ $L=\frac{d'-H'}{S'}$

1	2	3	4	5	6	7	8	9	10	11	12	13
Depth											Elevation	
D	d	d_1	R	H	H_1	d_1-H_1	V	S	S'	L	Sewer	W. L.
42	4.2		2.22	1.60			10 06	3 00			—3.000	+1.2
		.40			.35	.05		2 60	2.36	21		
46	4.6		2.37	1.25			8 95	2 20				
		.40			.25	.15		1 92	1 68	90		
50	5.0		2 50	1 00			8.00	1 65		111	−2 974	
		.40			.185	215		1 42	1 18	182		
54	5 4		2 61	815			7 26	1 30		293	−2 93	2 47
		40			135	265		1 17	93	285		
58	5 8		2 72	68			6 63	1 04		578		
		40			11	29		94	70	414		
62	6 2		2 82	57			6 12	84		992	2 76	3 44

Hollow Brick Walls Save Heat

TESTS of the transmission of heat through solid and hollow brick walls made by Prof. W. Knoblauch in Munich are summarized in the diagram below. They show a reduction of heat transmission by the use of a hollow wall as against a solid wall of the same thickness of 20 to 25 per cent, and further reduction of heat transmission if the spaces in the hollow wall are filled with slag. Hollow brick wall construction is coming into use in Germany, the 13-in. wall thickness being most common, and as the diagram shows this 13-in. wall has a much lower heat loss than a 15-in. solid brick wall. Dr. E. G. Friedrich, of Berlin, reports that the cost of mason work in brick dwelling house construction is 30 per cent lower for hollow walls than for the old style solid walls, which in connection with the heat saving action is expected to bring about a rapid spread of the new form of construction.



HEAT TRANSMISSION THROUGH BRICK WALLS
From tests of Prof. Knoblauch, Munich.

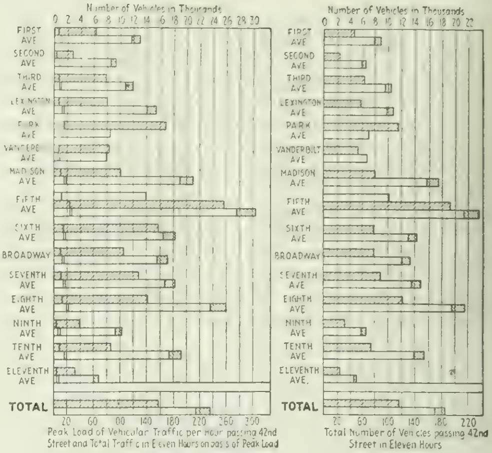
Arcades to Relieve Street Traffic —New York City

Plan for Widening Roadway to Include Present Sidewalks by Arcading First Story of Adjacent Buildings

By Arthur S. Tuttle
Chief Engineer, Board of Estimate and Apportionment, New York City

Extract from a report made March 28 to the Board of Estimate and Apportionment of New York City

As a substitute for the proposed plan of widening Vesey St. by taking land on the north side, the New York Telephone Realty Corporation, whose new building is planned to occupy the area proposed to be taken, has offered, without cost to the city, to arcade its first story, leaving the north sidewalk to be absorbed into the roadway. While the widening of Vesey St. has been considered as being wholly a local improvement, the proposition submitted, in so far as it relates to a method of accomplishing the widening, is of more than usual interest inasmuch as it presents an opportunity to illustrate the practicability of applying the arcading principle to other streets in the city where traffic congestion is pronounced and where relief under the usual method can only be applied at what might be deemed a prohibitive cost.



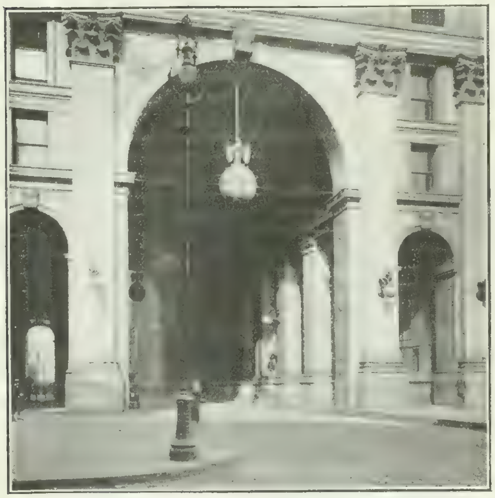
VEHICULAR TRAFFIC CROSSING FORTY-SECOND ST., NEW YORK CITY

White indicates traffic count taken Oct. 8, 1908, by Chief Engineer Board of Estimate and Apportionment (5th Ave. only) covering the period beginning 8:30 a.m. and ending 6:30 p.m. Charted to cover a period of 11 hours. Estimated as the total through traffic plus half the traffic entering and leaving 5th Ave. at 42nd Street.

Right hatching indicates traffic count taken July 30, 1920, by the President of the Borough of Manhattan covering the period beginning 8 a.m. and ending 7 p.m. This count included all vehicles passing between 42nd and 43rd Streets except at Broadway and 7th Ave., where the count was made between 41st and 42nd Streets.

Solid black indicates traffic count taken Dec. 20, 1922, by the Police Department 14th Inspection District, covering the period beginning 8 a.m. and ending 7 p.m. This includes only vehicles continuing across 42nd St. except at Vanderbilt Ave.

Left hatching indicates 10 per cent added to the Police count to cover estimated number of vehicles entering and leaving Avenues at 42nd St., this percentage being based on a study of the 1908 count.

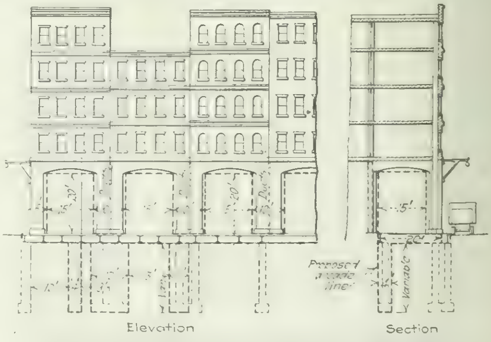


ARCADE CARRYING CHAMBERS ST. THROUGH MUNICIPAL BUILDING

Traffic counts on the line of all of the north and south avenues crossing 42d St., Manhattan, made on July 30, 1920, and on Dec. 20, 1922, together with a traffic count made at 5th Ave. and 42d St. in 1908, are shown in the accompanying drawings. With a traffic increase, even assumed to be at the present rate of 15 per cent, the seriousness of the situation which will obtain within the next few years becomes evident unless immediate steps are taken towards securing relief. Traffic congestion is also pronounced in certain streets in all of the other boroughs and it usually occurs in streets where land and building values are so high that relief through street widening can be secured only at very great expense.

As a means of providing relief in an effective way and one which would not involve the complete destruction of buildings or the withdrawal from taxation of large areas of great value, the arcade treatment has for a long time commended itself to your engineer, and with the thought more particularly in mind that for experimental purposes it might be applied to Nassau St., the width of which ranges from about 35 ft. to about 45 ft. and where congestion of pedestrian traffic is now so great each day that vehicular traffic is prohibited in the section between Spruce St. and Wall St. from 12 o'clock noon to 2 p.m. and from 5 p.m. to 6 p.m.

Few examples of sidewalk arcades are available in this country but the one through the Municipal Building on the line of Chambers St. conveys an excellent idea of the practicability of constructing such arcades without in any way detracting from the appearance of a building. The arcade effect is also well illustrated by the Madison Square Garden on the east side of Madison Ave. between East 26th St.

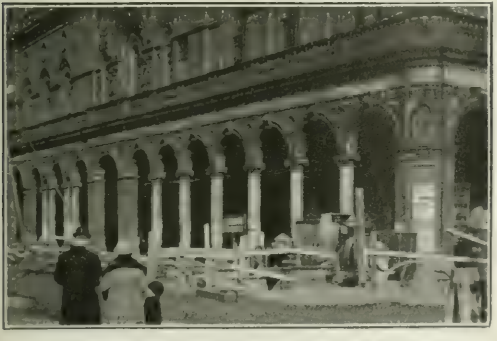


PROPOSED GENERAL PLAN FOR ARCADING BUILDINGS ON CONGESTED STREETS

PROPOSED ARCADE ON NORTH SIDE OF VESEY ST.

and East 27th St. This structure does not constitute a true arcade as there is no overhanging building, but the general effect is identical.

In order to indicate clearly the practicability of carrying out the arcade treatment under powers now enjoyed by the city, the accompanying drawing has been prepared, showing the general features of proposed street arcades and the extent of the public easements required to permit of their construction, and is intended to show the lines of separation between the public and private rights which would exist in the arcaded area. As indicated on the drawing, it is proposed, where conditions permit, to provide a width ranging from about 15 ft. to about 20 ft. for the arcaded area in streets where the depth of the lot is at right angles to the street line, and a width ranging from about 13 ft. to about 16 ft. in cases where the arcade would traverse the longer dimension of the lot, the rights to be taken by the city extending from a plane 3 ft. below the street grade to a plane adapted to the building development which has taken place or is expected to take place and shown on the sketch as 20 ft. above the street grade. The plan also shows the areas within the arcade which would be left in private use for the support of the overhanging building and the areas below the lower level of the arcade in which the city would have to take rights for the support of sidewalks in case it was not allowed to support them from walls or columns of the abutting building.



MADISON SQUARE GARDEN ARCADE FACING MADISON AVE.

In taking easement rights of this character it is assumed that the city would secure all necessary authority for improving and utilizing the space reserved for columns in the arcaded area pending their construction, as well as the right to install in them street lighting facilities, fire pressure hydrants, fire alarm and police telephone facilities and mail boxes.

An inspection of this plan should make it clear that ample rights may be acquired by the city for an arcade without seriously interfering with the private utilization of the areas above and below it, but it should be understood that to accomplish this without undue damage to improvements the arcaded area must be so laid out as to conform as far as possible with the structural details of existing buildings. The plan also shows that it is proposed to place the curb line 3 ft. outside of the building line or the exterior of the arcade. This is a somewhat greater distance than is usually provided but it is not believed to be excessive, as it will serve as a safety zone for pedestrians and insure the building columns against injury from passing vehicles, which project far over the curb line.

From a study of the table showing the intensity of the maximum hourly traffic crossing 42d St. it would appear that through the installation of arcades on the line of each of the intersecting streets, it would be practicable to increase the number of traffic lanes from 55 to about 105, thus nearly doubling their capacity. It does not seem probable that relief to anything like this extent could be accomplished in any other way at a cost as low as would be the case with this method.

$750,000,000 For Railways in India

Railway rehabilitation costing $750,000,000 is to be carried out on the railways of India during the five years 1923-1927, this program having been approved by the Railway Board. This includes new rolling-stock and the completion of some lines already under construction, but extensions will be subordinated to the improvement of existing lines which have run down as a result of the war and subsequent financial conditions.

The rehabilitation work includes second, third and fourth tracks on main lines, putting heavier spans on long plate-girder bridges, enlarging and building new freight yards, improving numerous stations and station yards, and providing new water and coaling stations. Four new shop plants are to cost from $10,000,000 to $17,500,000 each. In addition there will be an enormous amount of track work to put the lines in condition for heavier engines and traffic. This work will include the substitution of 95-lb. for 75-lb. rails and 60-lb. for 50-lb. rails on 5½-ft. and meter gage lines respectively. One of the most extensive improvements will be at Bombay, including four-tracking, electrification for suburban traffic and new passenger terminals for two trunk lines. The largest single item in bridge work will be the double-tracking of the bridge over the Sone River, which is nearly a mile in length and has twenty-eight spans of 162 ft. c. to c. of piers.

Removal of Bracing Held at Fault for Fuller Tower Collapse

Twisting Failure of Tank Legs Found Responsible By H. G. Balcom—Ties as Well as Bracing Removed—Engineers Arrested

By Prof. Carlton T. Bishop
Sheffield Scientific School, Yale University, New Haven

The arrest of three engineers followed the coroner's inquest into the collapse of the tower of the Fuller Brush Co., of Hartford, which occurred on March 31, as described in *Engineering News-Record* last week (p. 674). These engineers are held criminally responsible for the death of ten men, and a charge of manslaughter is preferred against them. They are: Paul Sheldon, treasurer, and George L. Mylchreest, secretary of the firm of Buck & Sheldon, consulting engineers and architects, of Hartford, and Edward J. Vaughn, an engineer in their employ. Each was released under bond of $5,000, and the case will probably be called at the June term of the criminal superior court, under the law which provides a maximum penalty of $1,000 fine or 15 years in prison, or both. It has not yet been decided who will bear the financial loss of $40,000, or whether the Aetna Insurance Co. or others will seek to recover damages resulting from the loss of life.

It has developed that not only all the diagonal bracing rods between the tank columns had been removed or disconnected, but also that the horizontal channels between the columns had been removed. This left no steel members to resist the thrust from the inclined columns, dependence being placed upon the brick walls and the reinforced-concrete floor with the reinforced-concrete coping or girdle just above the floor as illustrated in last week's issue. There is evidence that the five 1-in. steel rods in this coping were not distributed as shown in the plans but were all placed at an elevation near the bottoms of the upper grillage beams. There is no evidence that these rods were overlapped or fastened so as to resist the thrust effectively.

Investigators Report—Reports have been made by Coroner J. G. Calhoun, by H. G. Balcom, consulting engineer, to Buck & Sheldon, and by A. S. Lynch, consulting engineer, to the city supervisor of buildings. Mr. Balcom believes that the collapse began with a twisting motion of the tank and its supports. He therefore concludes that the removal of the rods was the sole cause, so it was unnecessary for him to mention the removal of the channels inasmuch as they would not have prevented this rotating motion. The coroner asserts that both the removal of the rods and the removal of the channels were major causes. Mr. Lynch mentions both the removal of the rods and the channels and also the wall section as important factors. He offers two theories as to where the collapse originated, one that the steel supports failed due to the removal of the rods and channels, the other that the walls spread because they were not strong enough to resist the thrust from the columns. He inclined toward the latter theory, but not because of poor construction. The wall fractures indicated good construction, and this was substantiated by tests made upon samples taken from the ruins. Both the brickwork and the concrete developed strengths of more than 2,200 lb. per square inch in compression before fracturing. The foundations of the tower were apparently satisfactory, no settlement having been found by the city engineer.

Report of H. G. Balcom—Mr. Balcom in his report states that when he reached the site, Monday afternoon, April 2, two days after the collapse, what remained of the west and north walls of the tower had been dynamited and the tank had been cut up into sections and taken out of the wreckage. He continues:

> I examined the brickwork of the portion of the tower that was standing, and I also examined the brick and concrete work and the reinforcement in the rubbish, and from the condition of all this I found that the material used and the workmanship employed was first-class in every particular. I have also had the design of the tower and the tank carefully checked and find that the same, as designed, was amply strong for the purpose for which it was intended. The workmanship and material in the tank also were good, and therefore the cause of the accident cannot in any way be attributed to any fault in this particular.
>
> From photographs of the tower taken after the accident occurred, it is clearly established that there was no failure whatever of three of the supports. The only support which was destroyed by the accident was the one on the southwest corner. I also found that at least four of the diagonal rods bracing the tank tower columns had been removed and placed on the roof of the main building. I was also told by Mr. Vaughn, the inspector for Buck & Sheldon, that the bottom connections of the remaining diagonal rods had been disconnected, thus making the rods useless as bracing. I found only one clevis connection of the diagonal rods on any of the columns. I carefully examined the connections where the rods were to attach to the columns and found no evidence whatever that would indicate that the rods were in place at the time of the accident.
>
> Analyzing the design, it is evident that the removal of the diagonal rods was absolutely dangerous and the only security against failure was the little help of the columns in bending, which could not be relied upon as of any material value, considering that the tank and its contents weighed nearly 250 tons.
>
> The failure without a doubt started by a slight twisting action of the tank on its support, which could continue but a short distance before absolute failure would start. This would have been entirely prevented if the diagonal rods had been in place. An evidence that this is what happened is shown by the fact that the left-hand column angle, as one faced the tank, in every case failed in tension, and the right-hand angle in every case failed in compression, indicating that the failure started by the tank starting to twist in a clock-wise direction. If the tank had failed due to the failure of the southwest support, the left-hand angle of the southeast column would have failed in compression instead of tension. Another evidence that there was a certain twisting of the tank is shown by the fact that the east side of the tank when it fell was turned toward the south.
>
> I therefore feel sure that this accident was caused solely by the taking out of the diagonal rods.

Coroner's Report—The coroner's report begins with a history of the collapse and a description of the tower including the statement that the design "was an approved and sufficient method which if completed would have made the tank perfectly safe, even though located in a tower at a height of 80 ft. from the ground." The report deals separately with the removal of the diagonals and the removal of the channel ties.

Concerning the removal of the diagonals, the report refers to the decision to use the space immediately underneath the tank as a salesmen's school-room, which was an afterthought on the part of the company. The engineers approved the proposal. The plan for the change included the addition of a ceiling just below the bottom of the tank, a new floor and other changes. The coroner says:

As the tension rods would project somewhat into the room and as one rod would interfere materially with the use of a new stairway, it was considered whether they could not be removed, and the decision was left to the engineers, who decided that they could. The official who made this decision was Mylchreest, and the order was communicated to Vaughn. The latter caused the rods to be removed on March 30.

Discussing separately the removal of the 4-in. channel struts or ties connecting the tank columns near their base, the coroner states that when these channels were to be put in place, three of the four were 9 in. short, and six extension plates were made to enable them to be connected. These channels, after being fastened in place,

were subsequently disconnected, and both Sheldon and Vaughn knew the fact and the reason for it, and the channel irons could not have been unfastened without their knowledge and orders.

One of the dangers to be guarded against in the installing of a tank of this character is that of a tendency to a sidewise or lateral movement. It must be guarded against in an outside tank absolutely, but even in an inside tank the walls of such a tower are not an absolute protection. There is some danger of this sort in a tank installed 80 ft. high. It was this danger that the channel irons and the tie rods in combination were designed to meet. They were both essential to the safety of the tank. I do not believe that either could be dispensed with safely. To remove the rods when the channel irons were unfastened was to make disaster certain.

The high winds that prevailed March 30th and 31st hastened the calamity. Without any way of resisting the lateral movement, deprived of the only safeguards intended and once installed to hold it safely, the sway began and in less than twenty-four hours the tank fell and with it went the lives of the workers who were underneath.

Following his arrest, Mr. Sheldon declared that prior to the time when the tank fell he had no knowledge whatsoever that the channel irons had been removed. He further expressed his opinion that the removal of the channel irons was in no sense the cause of the accident. The coroner has stated that Henry R. Buck, the other member of the firm of Buck & Sheldon, was not held individually responsible for the collapse because he had, "so far as I can find, nothing to do with the plans for the Fuller plant in any way."

Flushing Mains Anticipating Filtered Water

Anticipating the delivery of filtered water into the water mains of Detroit, Mich., the water department began flushing the system as early as August, 1921. The engineering bureau lays out flushing districts and during the summer gangs worked all night. Formerly every house affected was notified. Now newspaper notices give the location of the flushing gangs, although the foremen notifies hospitals and other consumers using large quantities before he begins work. During the year ending June 30, 1922, according to annual report of George H. Fenkell, superintendent and general manager, the entire 103 miles of low service system, 163 miles of the intermediate and 12 miles of the high service, had been flushed. Experiments to determine the efficiency of flushing were made by cutting into the mains. Inspection indicated that all loose dirt had been removed but that the barnacles and a layer of the more solid sediment on the bottom of the pipe remained.

Germicidal Effect of Acid Mine Drainage in Pennsylvania

Heavy Reduction of Total Bacteria and Gas Formers on Adding Acid Mine Water to Sewage —Confirmation by Field Tests

By W. L. Stevenson
Chief Engineer, Pennsylvania Department of Health,
Harrisburg, Pa.

Abstract of a paper read before the Pennsylvania Water Works Association.

INVESTIGATIONS made by the Pennsylvania Department of Health show that the acid drainage from coal mines exerts considerable germicidal action upon sewage and that streams heavily impregnated with acid mine drainage can receive, without creation of nuisance, far more untreated sewage than can normal or alkaline streams.

During the recent coal strike the coal washeries were shut down so that very little coal dust was present in the stream but the flow of acid mine drainage continued to be discharged. This condition afforded an excellent opportunity to make field investigations because the presence of sewage solids could be visibly observed in the streams. The Engineering Division of the Pennsylvania Department of Health, therefore, made field and laboratory investigations during May and June, 1922, along the Lackawanna River and in the North Branch of the Susquehanna River for a short distance below the mouth of the Lackawanna. This work was done under the general direction of C. A. Emerson, Jr., (at that time) chief engineer, F. E. Daniels, chief of the Laboratory Section and I. M. Glace, district engineer, by W. L. Long, chemist.

Laboratory Tests—Sewage was added in various proportions to typical samples of acid mine water. The sewage used had a total count of 6,000,000 bacteria per c.c. and gas formation was obtained from 1/1,000,000 c.c. samples. After only two hours contact with the acid mine water in ratios of one part of mine water and five parts of sewage the total count was reduced to 32,300 per c.c. and gas formation to 1/1,000 c.c. Two hours contact with a ratio of one to one reduced the total number to 3,600 and gas formation to 1/100 c.c. The flora surviving the disinfecting action were of a different character from those found in the undisinfected sewage. On the plates planted with the mixture of sewage and the higher concentrations of acid mine water most of the typical fecal lactose fermenters were absent. Gram positive cocci, spore forming bacilli and saphrophytic yeasts, molds and aerobic spreading forms were the only ones present.

Sewage obtained from a public sewer which received a small quantity of acid mine drainage was added to a typical mine water in various proportions. In this case the total number of bacteria had been reduced by the small amount of acid mine drainage in the sewer to 15,000 per c.c. but gas formation was obtained in 1/10,000 c.c. portion of sewage. In all ratios of mine drainage to sewage and with periods of contact of both one and three hours, total numbers of bacteria were reduced and gas formation almost eliminated.

The sewage used in these experiments had a turbidity which remained practically unchanged for several days. Its hydrogen-ion concentration was 6.4. The addition of one part of acid mine water to five parts of sewage changed the hydrogen-ion content to 5.3 and caused a flocculation and sedimentation of about 50 per cent of the original turbidity. The addition of one part of acid mine drainage to three parts of sewage gave a hydrogen-ion content of 4.4 and caused practically complete sedimentation of the suspended matter in one-half hour, producing a supernatant liquor of zero turbidity.

Finely ground anthracite coal was added to tap water and continued to remain in suspension. A series of concentrations were made varying from 0.1 gram to 10 grams of coal in 200 c.c. of water. The addition of an equal volume of acid mine water to all these samples caused precipitation of the fine coal within one hour. The presence of the coal had no effect upon the hydrogen-ion concentration of the sample.

From these data the conclusion may be drawn that acid mine drainage has an appreciable germicidal and clarifying action upon sewage.

Field Studies—In order that these laboratory studies might be confirmed by field investigations, an approximate study was made of the conditions existing in the Lackawanna River which drains a part of the anthracite coal region. In general, the river has sufficiently high velocities to maintain in suspension sewage solids and fine coal. The yearly average rate of discharge of the river at Moosic is reported as 570 sec.-ft., with normal August-October flows of 125 sec.-ft. and low flows occurring every three or four years for periods of from two to three months of about 100 sec.-ft., the minimum recorded rate of flow being 74 sec.-ft. There are about 130 collieries and an urban population of about 320,000 on the watershed.

The large water companies supplying this territory distribute about 50 m.g.d. of which a fourth is used in the coal industries, thus leaving about 37 m.g.d. for domestic and manufacturing purposes. Much of this is discharged to the river in the form of sewage through about 75 sewer outlets located along the river from Pittston to Forest City, including 48 outlets in Scranton. It is estimated that about 7 m.g.d. of sewage is discharged into the river above Scranton, about 14.5 at Scranton and about 2.5 between Scranton and the mouth of the river.

The amount of acidity reaching the river from mine drainage and leaching from culm banks is not known. It has been estimated that 23,000,000 gal. of drainage was pumped from the mines per nine-hour day in 1913. Comparing the acid and iron content of the typical mine drainage and of the Lackawanna River above Pittston indicates a ratio of 1 part of mine drainage to 6⅔ parts of stream flow but none of these data can be considered accurate.

In practically all cases where the sewer outlet is submerged beneath the water of the stream the sewage cannot be detected either by sight or smell at any time of the year. The only places where nuisance is noted, even at times of low stream flow, are at sewer outlets which discharge on the bank of the river above the water line.

On Sept. 10, 1922, a special inspection was made of the Lackawanna River from the center of Scranton to the downstream end of the city. The mines had not yet resumed operation and the sewage of Scranton and other towns upstream was visibly evident in the water of the stream. At sewer outlets and where the sewage was discharged on the bank the typical sewage odor was noted. But at no place was any offensive sewage odor noted from the stream itself. At this time the rate of flow of the Lackawanna River at Scranton was between 65 and 70 sec.-ft., and the river was carrying at the lower part of Scranton the sewage of about 170,000 persons. This represents only 0.4 sec.ft. diluting water per 1,000 persons contributing sewage, a totally inadequate ratio of ordinary diluting water to prevent creation of nuisance.

Samples of the water of the Lackawanna River were taken above and below Scranton and near the mouth of the river. Some were plated within three hours of time of collection and others kept for twenty hours in the ice box. Those plated promptly showed on the average about 2,500 total bacteria per c.c. on agar in 48 hr. at 37.5 deg. C., and the samples which were kept twenty hours were nearly sterile.

The sewage of the City of Hazleton is discharged into a small stream composed wholly of acid mine drainage. Samples of the combined sewage and acid mine drainage taken at a point where there had been about forty minutes contact showed a total bacterial content on agar in 48 hr. at 37.5 deg. C., of 1,490 per c.c.; 0.1 c.c. was the highest dilution in which gas formation was obtained. Samples allowed to stand in the laboratory for 18 hr. only showed 260 total numbers and gas in 1 c.c. Even in hot weather no nuisance from odors is reported from this flowing sewage and mine water.

These investigations have confirmed the policy of the Engineering Division of the Pennsylvania Department of Health adopted in July, 1920, worded as follows: "At points reasonably remote from water-works intakes, sewage may generally be discharged untreated into these streams, but preferably from the outlets of the several drainage areas into the main current of the stream so as to prevent local nuisance and to more efficiently distribute the sewage in the streams and thus take full advantage of the germicidal action of the acidity."

Serious Water-Borne Typhoid Outbreak at Cochrane, Ontario

TEMPORARY lowering of a "lake" storing spring water for the supply of Cochrane, Ont., so as to reverse the flow through the "lake" outlet and admit sewage-polluted water to the "lake" is the cause of the serious typhoid outbreak now prevailing at Cochrane, Ont., which has already resulted in 660 cases and 20 deaths. The following account of the outbreak has been supplied to this Journal by F. A. Dallyn, director Sanitary Engineering Division, Ontario Provincial Board of Health:

The water supply at Cochrane is taken from a series of springs, and there is an auxiliary supply from the overflow from these springs, known as Spring Lake. During the past winter, which was preceded by a dry fall, and possibly, also, owing to considerable railway construction going on in that area, the capacity of the municipal system has been taxed to the utmost, with the result that the level of Spring Lake was depressed below that of the drainage area outlet. This outlet, unfortunately, connects with a lake receiving sewage. The whole area was under a heavy sheet of ice and snow. It appears that the pump attendant did not realize just what hazard he was placing the municipality in by lowering the level of Spring Lake to three feet below that of Sewage Outlet Lake.

The possibility of some such accident was discussed with the municipality last year, and a by-law was passed to provide for expending a considerable sum for further reservoir capacity for the spring and for developing the springs somewhat further. Unfortunately, the town did not proceed with that work, nor with the purchase of a chlorine feed apparatus, which, also, was recommended.

I was in the area just one week before the outbreak was known to exist, and in view of some diarrhœa that was reported on as being contracted in Cochrane, I wired the office to secure a machine and to have one of our own engineers bring it up and install it. The machine was shipped two days later and was installed and in operation some three days before the local authorities realized that they had a typhoid epidemic on their hands.

At the present time the outbreak has reached some 660 cases with 20 deaths. There are sixty emergency nurses in the town and seven extra doctors attending to the sick. The hospital accommodation of the town is nominally listed at 60, so a considerable number of secondary cases may be expected before the outbreak is checked.

Besides supplying an engineer to develop an auxiliary supply from another lake and to make recommendations as to curtailing the supply to the railways, and to adjust the chlorine dosage, the Provincial Board of Health has supplied the municipality with ten nurses to supervise and assist the municipal authorities in the control of the outbreak.

Potential Power of Salmon River, Idaho

The U. S. Geological Survey has issued a report containing maps and descriptions of 23 sites along the Salmon River in Idaho at which, it is estimated, nearly 400,000 hp. could be developed at times of low-water flow and nearly twice that amount at times of medium flow. The project suggested for one of these sites contemplates the diversion of the flow of Salmon River into the Snake by means of a tunnel 8 miles long, which would create a head of 430 ft. The report is based upon an extensive investigation made during 1921.

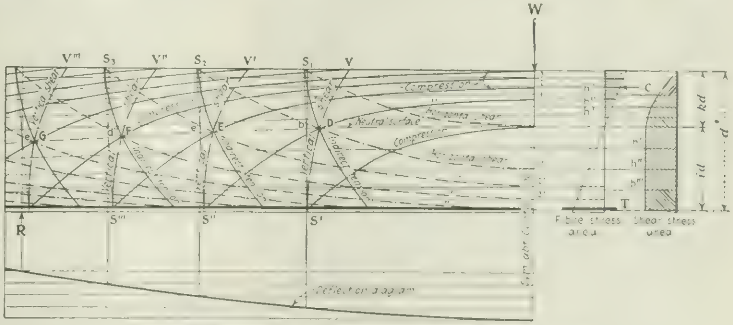
Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

"Elasticity and Strength of Materials"

Sir—The writer submits that some mis-statements appeared in *Engineering News-Record* of Feb. 15, p. 312, under the title "Two Books on Reinforced Concrete," covering the writer's "Elasticity and Strength of Materials," and the earlier work, "Concrete Steel Construction," by the late Dr. H. T. Eddy and the writer.

"The twisting moment recognized by elasticians is essentially a rotation of an axis normal to the plate about itself as the plate is deformed"; "such distortion is ignored in the text and the twist has no place in the analysis," the reviewer asserts, and hence concludes the analysis is difficult to understand and lacking in connected logic. The fact is that these very twists are portrayed in "Concrete Steel Construction," Figs. 26 and 32, pp. 89 and 100, and over 10 per cent of the 400-odd pages are devoted to the correlation of these self-same twists with those about a horiztonal axis according to Kirchoff's theorem and as we know torsion operates in the shaft. Now the horizontal shears in vertical planes which produce this twist change sign in passing normal planes of symmetry and principal curvature, and it is by the application of this fundamental principle that the true bending moment is separated from the total applied moment, which embodies both bending and twisting couples.



STRESS LINES IN A REINFORCED-CONCRETE BEAM
(From advance sheets of Section II of "Elasticity and Strength of Materials.")

"Lateral deformation is absolutely untranslatable into stress," the reviewer says, the shades of Kelvin, Rankine, and Dr. Hooke to the contrary notwithstanding. Then he proceeds by informing us that an action similar to the lateral deformation occurs in a flat slab, and by restraining (?) this deformation the resisting power of the slab increases, notwithstanding its untranslatableness into stress.

"It must be remembered that no one has yet presented a successful solution of flat slab action." The authors, he says, are correct in emphasizing the difference between beam action and plate action but they fall into serious error in attempting to place the onus on the twisting moment. Here apparently is to be found the crux of the question. Plate action is the combined resistance of torsion and bending. Torsion or warping in a plate develops rotational shear strain of equal intensity about two orthogonal axes simultaneously, therein differing from bending or beam resistance. Torsion and bending each supply half the resistance, and while these resistances intermingle in the plate of ordinary thickness they may be separated or segregated into zones of diverse action in the simple experiment outlined in "Natural Philosophy," by Thomson and Tait.

By reducing the thickness to that of a very thin plate the length of the vertical element becomes so short that its torsional rigidity is far greater than the bending rigidity. Accordingly, the thin square plate suspended at opposite corners by vertical silk threads and loaded in like manner by light equal loads at the other corners will present the unique phenomena under twist and moment of half the plate remaining "infinitely nearly plane" (Kelvin) and the four corners only bending in cylindrical curvature. The areas of segregated twist are unbent. The areas of segregated bending stress are bent, a relation that can be explained by the analysis of Turner and Eddy.

With such defective grasp of the treatment his conclusion that the authors build a type that proves an apparent economy to the owner and seems to meet the qualitative requirement of flat slab action, for which in his opinion no successful mathematical solution has yet been presented, seems as far as one could logically expect him to go in his approval.

The confusion of ideas in the assertion that the spirit in which the books are written is that of justification of the mode of design of the patented mushroom slab when said slab is not mentioned anywhere in the text of the book "Elasticity and Strength of Materials" is difficult to account for in these dry Volsteadian days, and a like confusion appears in the vision of Eddy's unpardonable error.

"It is noted that the equality between vertical and horizontal shear is not valid" and without noting what the definitions are, that are carefully defined by symbol, phrase, and equation, he illogically inserts other and different definitions of his own and holds Eddy up as a blunderer on the basis of his diverse use of terms. The vertical shear S discussed by Eddy is defined as $S = \Sigma W$, i.e., vertical shear force producing clockwise rotation viewing the left half of the beam. And the elastic horizontal shearing distortion measures the magnitude of the horizontal shearing stress, an internal shear strain producing anti-clockwise rotation, other than and different from the external vertical shear force. Proportionality between the two at the support may, but generally does not, occur.

The difficulty with the engineer and the theoretical writer as well is that approximate assumptions are too often treated as exact, leading to the multifarious errors of our Joint Committee on Concrete and the unfounded belief in that wonderful efficiency of the tensile stress in the concrete—after the embedment of steel.

A little diagrammatic analysis of these stresses shows that the curves of tensile stresses in the homogeneous beam have been displaced by curves of greatest shear (see drawing), and when the plate in all its phases has been worked out in the same detail such conflict of ideas as exhibited by the reviewer will be, let us hope, less commonly encountered.

He compliments Turner on the clear analysis of residual strain but hits the scientific thermodynamic foundation of the analysis he labels as clear. He fails to note the distinction between the kinetic and static moduli. Elastic strain is related proportionally to kinetic action; thereafter thermal change of radiation produces the static condition. In no other way than by this distinction may the variation in elastic coefficients caused by states of residual strain be investigated or rationally analyzed.

Fairness to Mr. Paaswell requires the frank statement that the writer regards his ideas of flat slabs as being about two generatios in advance of those of our Joint Committee. A more careful reading of the subject matter would undoubtedly dispel some of his doubts.

Minneapolis, Feb. 21. C. A. P. TURNER,
C. A. P. Turner Co., Consulting Engineers.

A British and an Indian Textbook

WATERWORKS FOR URBAN AND RURAL DISTRICTS: With Notes on the Supply for Mansions and Isolated Buildings—By Henry C. Adams, M. Inst. C. E., etc., Consulting Engineer. London and New York: Isaac Pitman & Sons: Cloth; 6x8 in.; pp. 230; 115 illustrations including three folding plates. 15s. $4.50.

ELEMENTARY SANITARY ENGINEERING IN INDIA: A Text-Book for Indian Sanitary Inspectors and others interested in the application of the science of sanitary engineering to tropical conditions—By George Bransby Williams, M. Inst. C. E., etc., Chief Engineer, Public Health Department, Government of Bengal. Second and Entirely Revised Edition. Calcutta and Simla: Thacker, Spink & Co. Cloth; 6x9 in.; pp. 124; 122 line cuts and half tones. Rs 6; 8s.

Of these two books the one on water-works by Mr. Adams is designed primarily as a textbook for students of engineering and the one on sanitary engineering is intended chiefly for the use of "candidates for posts as sanitary inspectors in Bengal," men with little or no previous experience in engineering. Mr. Adams reviews concisely and ably but quite briefly the theory and practice of water-works design. Mr. Williams treats of water supply, drainage, sewerage, sewage disposal, and building design. He also devotes a few pages to plans, drawings, mensuration, surveying and leveling. His volume contains many illustrations.

Both books seem well calculated to serve their purpose. Although neither has American users in mind each contains information regarding British and Indian conditions and practices that are of interest to broad-looking engineering and sanitarians in any part of the world. Mr. Williams, writing in India, seems to be more familiar with some phases of American water-works practice than does Mr. Adams writing in England, but this is a common difference between British engineers in the mother country and in the colonies. Finally, the book by Mr. Adams, like some of our best American textbooks, is serviceable to a considerable degree as an engineering reference book in its field, in so far as the subject can be covered within so narrow space limits.

Depreciation and Rate Making

REVIEWED BY LEONARD METCALF
Of Metcalf & Eddy, Boston, Mass.

RATE MAKING FOR PUBLIC UTILITIES—By Lamar Lyndon New York and London: McGraw-Hill Book Co. Cloth; 6x8 in.; pp. 209; 2 graphs. $2.

DEPRECIATION OF PUBLIC UTILITY PROPERTIES: Its Relation to Fair Value and Changes in the Level of Prices—By Henry Earle Riggs, M. Am. Inst. Consulting Engineers, M. Am. Soc. C. E. Professor of Civil Engineering, University of Michigan. New York and London: McGraw-Hill Book Co. Cloth; 6x8 in.; pp. 211. $2.

The difference in point of view of the authors of these two books is interesting. Lyndon states in his preface: "This book is intended to point out the logical and mathematically exact conclusions for each and every factor which enters into the consideration of valuation and rate-making and, without an assumption of omniscience, these conclusions appear to the author to be "unescapable." Riggs, on the other hand, says: "This work has been done as a part of a sincere attempt to find that middle ground of absolute fairness and justice which must be determined before the public utility issue may be considered as reasonably settled . . . The attempt is here made to trace briefly the history of regulation of utilities, to present, as the writer sees it, the true conception of 'Depreciation,' as that word has been used in valuation and regulation practice, and to point out certain important conclusions of the courts with which every one engaged in valuation work ought to be familiar . . . . The decisions are arranged in chronological order, since in that way they clearly show the drift of legal opinion as the subject of valuation has developed."

Lyndon says in his chapter on Reproduction: "The subject of valuation of public utilities is comparatively new and most of the present court decisions on this subject can be regarded as merely tentative. Certainly it is to be hoped that this is the case because most of them are contrary to logic and good business judgment." On the other hand, he commends highly the work of "the public service commissions, largely made up of experts in engineering and economics who have been especially trained for such investigations and for all kinds of valuation and rate cases constantly before them, and should, therefore, be best fitted to determine these questions" . . . Riggs, on the other hand, unfolds a beautiful story of progress by courts and commissions toward a fair solution of the problem, indicating what he believes to be the proper solution but frankly recognizing the uncertainty and so presenting his evidence that the reader may draw his own conclusions fairly.

In his discussion upon Depreciation, Lyndon treats the amortization of displaced equipment as return of investment to the owners—"they are not bound to reinvest these funds in any new machinery to serve a later generation of consumers unless they elect to do so."

Riggs on the other hand, constantly lays emphasis upon the continuing property—"the property so built is one instrument of service, and it is that property as a whole which must be considered and not the materials and machines and labor that enter into it . . . Property in maximum economic condition for service is the only thing which can be secured by investment. It must be kept in that condition by replacement of parts as they wear out. The obligation is to maintain. The manner of accounting for replacement is a matter of detail, not of principle."

Lyndon presents his subject in thirteen chapters covering The General Theory of Rate-Making; Depreciation, which it will be interesting for the reader to compare with Riggs' presentation; Reproduction, which he characterizes as highly speculative and in which he criticizes caustically the use of percentages in determining various overhead costs, although this is the practically uniform custom of engineers and contractors in their daily practice and operating experience; Valuation by the Historic Cost Method, which appeals to him as the soundest of all procedures; Intangible Values; Modifications of Capital Account; Rate of Return; Operating Costs; Increase in Population of Cities; and four chapters on Rate-Making for Gas Supply, Electrical Supply, Electric Railways and Telephone Service.

The book contains some inaccurate statements borne of the author's bias in favor of original cost as a basis of rating, rather than fair value as interpreted heretofore by the United States Supreme Court. His interpretations of the law and its intent are often not the interpretations of the higher courts. He fails to recognize that the courts are, in fact, but the exponents or interpreters of centuries of experience.

On the other hand, his discussion of a method of determining the rate is clearly and concisely presented. The treatment is necessarily elementary and didactic, no evidence being submitted indicating the fair range of basic variation of the units assumed by him. While some of the comments made will be challenged by experienced rate-makers, the presentation is interesting and suggestive.

Riggs, too, presents his subject in thirteen chapters followed by a valuable Appendix on Depreciation in the decisions of the Supreme Court and of the United States Courts. He covers successively Problems of Regulation; Investment in Public Utility Properties; The Interest of the Rate Payer in the Property; Operating Expenses, in which he points out the important differences between those which can be charged directly without causing any material fluctuation of ratio of operating expenses to gross earnings and those which cannot be so charged without violent fluctuation of the operating ratio, and he suggests the substitution for the word "Depreciation" of "Reserve or Allowance for Replacement or Retirement." In the next three chapters upon War Period Price Fluctuations, Fair Value and the Rate of Return, and Fluctuating Prices and Accounting Allowances for Replacement, he presents clearly the disturbing effect of the war upon methods of valuation, the apparent conflict in decisions and outlines the present issues.

Then follows a chapter on Supreme Court Decisions bearing on Depreciation and a discussion upon Divergent views as to the Propriety of Accounting Reserves. In Chapter 10, "The Uncertain Character of Depreciation Estimates" is discussed, and in Chapters 11, 12 and 13, upon Depreciation—Loss of Value which Should Be Deducted, Obsolescence and Conclusion, the author presents his constructive view as to the fair treatment of this important subject.

In the Appendix the decisions of the courts are well arranged in three periods: (1) Early Decisions Bearing on Depreciation Prior to the Adoption of Uniform Accounting; (2) Decisions Bearing on Depreciation Following the Adoption of Uniform Accounting; (3) 1914 to 1922—the Period of War and Fluctuating Prices.

Riggs' book is a masterly presentation of the subject of Depreciation Allowance and Accounting as it stands today before the courts and commissions. It is clear and judicial and will be found helpful whether one agrees fully or not with the author's views as to the probable outcome of the future. The book will be found suggestive and useful by courts, administrators and engineers.

Excavating Equipment

THE ENGINEERING OF EXCAVATION—By George B. Massey, M. Am. Soc. C.E., Western Soc. Engrs., A. A. E., Consulting Engineer, Vice-President, Randolph-Perkins Co. New York: John Wiley & Sons, Inc. Cloth; 6x9 in.; pp. 376; 196 half tones and line cuts, some of the latter on folding plates. $6. 30s. net.

On reading its title one pictures a rather broader treatment of its subject than this book gives. Only minor attention is given to organizing and planning excavating operations, on the economics of haulage, on the characteristics of materials and their management to facilitate excavation and removal, on drainage, on service operations and on plant selection, operation and maintenance. In the chapters on steam shovels and dragline excavators more engineering information is supplied than in any of the other chapters. These are largely descriptions of excavating machines except that the chapters on dredges discuss design and construction and describe equipment in a comprehensive manner.

There are twenty chapters. Of these the first five, relating to steam shovel and dragline work, occupy about 100 pages. Though devoted more than some might wish to descriptions of machines, these chapters contain much of value on selection, types of cuts, track arrangements, operation plans, performance, crews, and upkeep. The following six chapters on dry-land dredges, trench excavators, buckets, transportation, hydraulicking and drilling and blasting are all brief, aggregating 43 pages, and are almost exclusively descriptions of machines. The excavating engineer or superintendent, not a tyro at his work, will gain little from this part of the book. The succeeding seven chapters, occupying 165 pages, relate to dredge design and construction and in them the author shows his interest and qualification.

Dredges are discussed largely from the viewpoint of structure and equipment. There are chapters on hydraulic dredges, dipper dredges, bucket dredges, clam-shell dredges, scows and barges, and two chapters on dredge hull construction. Drawings and specifications for both hulls and machinery are very complete. Performance records are given in a number of instances. There is a chapter on boilers, fuel, wire rope and one of 16 pages on "application of machinery to work," containing miscellaneous useful information and suggestions.

Government and Taxation

POLITICS: An Original Investigation Into The Essential Elements and Inherent Defects Common to All Present Forms of Government Together With a Proposal for a Political System Which Will Automatically Produce the Best Government Possible in Any Given Community—By Frank Exline. New York: E. P. Dutton & Co. Cloth; 6x8 in.; pp. 226. $2.

COUNTY AND TOWNSHIP GOVERNMENT IN THE UNITED STATES—By Kirk H. Porter, Ph.D., Assistant Professor of Political Science, State University of Ohio. New York: The Macmillan Co. Cloth; 6x8 in.; pp. 361. $2.25.

LOOSE LEAF DIGEST OF CITY MANAGER CHARTERS—By Robert Treat Crane, LL.B., Ph.D., Professor of Political Science and Director of the Bureau of Government, University of Michigan. New York: National Municipal League. 7x9 in.; pp. 200.

PUBLIC FINANCE—By M. E. Robinson, Fellow and Lecturer of Newnham College, Cambridge. With an Introduction by J. M. Keynes. [Cambridge Economic Handbooks]. New York: Harcourt, Brace & Co. Cloth, 5x8 in.; pp. 172. $1.25.

Four recent books presenting many important phases of government and public finance may be conveniently noticed together. Each contains facts and opinions that should appeal to any wide-awake engineer who is trying to keep abreast of the important governmental problems of the day, on the proper solution of some of which, at least, his bread and butter and even his welfare and that of his family may depend.

Mr. Exline in his "Politics" first presents a searching analysis of the science of government in which he reaches the conclusion that social and political justice can be secured only by government by law rather than by men; that just laws and their just interpretation must be based on reason rather than majority rule or power; and that all the functions of government—legislative, administrative and judicial—can be properly performed only by the selection of legislators and officials in accordance with their fitness for their respective tasks. He then outlines an elaborate system of examination or tests which, at least by implication, is designed to classify every adult person according to fitness for one or another place in the industrial and political spheres. In the application of the results of these tests no one would be allowed participation in any governmental function who has not qualified under some one of the *four* departments of government, Mr. Exline having added the department of *selection* to those of legislation, administration and judicial. The book is a strange compound of (1) logical analysis of government and (2) a scheme of reform based on an utter lack of recognition of the state of public opinion in general and of the individual human equation in particular. Nevertheless the book deserves careful attention because many of its fundamental ideas are sound while those that will seem unsound or impracticable—at least before the millenium—are profoundly suggestive. Even the visionary scheme for governmental reform—the elaborate ponderosity of which we have not attempted to outline—is based on the sound principles of fitness for governmental tasks to be undertaken, however humble, and on expert service.

Of a far different sort is Professor Porter's "County and Township Government," a book primarily descriptive in character, but not without statement of fundamental objects and principles, as well as suggestions for needed reforms. As adequately as could be expected without tedious detail, the volume pictures county and township government in the 48 commonwealths of the Union, both present and by way of origins.

Still closer to actual government than the book just outlined is Professor Crane's Loose Leaf Digest of City Manager Charters. The volume gives a page each to 166 city charters, besides which there are 24 pp. of Statistical Analysis and Comment and 5 pp. on The Manager Plan. The scheme for each city is to give the 1910 and 1920 populations, date of adoption of the manager charter, and main facts as the council, mayor, manager, administrative service and popular control by the initiative, referendum and recall.

For the most part, Professor Robinson's brief and readable essay on Public Finance deals with taxation, but it takes up borrowing as well. As is natural for a Cambridge University professor, the book is written largely from the British viewpoint, but few British authors show as much familiarity with American conditions as does this one. After an opening chapter on Expenditure and Revenue, the author considers taxation in relation to: Equity, practical problems, production, distribution, etc. There are chapters on local and on war finance, the post-war debt burden, both international and internal, and on future policies as to war debts, taxation and expenditures. In so small a volume it is impossible to give the wealth of historical and other data, and the weighing of theory and results of experience presented in the voluminous Essays in Taxation, by Prof. E. R. A. Seligman (see these columns, July 20, 1922, p. 115), but Professor Robinson's book has the advantage of brevity and homogeneity while that of Professor Seligman, valuable as it is, is a collection of essays, some overlapping others, and many not brought up to the date of the latest edition.

An Engineer a Century Ahead of His Time

ROBERT FULTON AND THE SUBMARINE—By Wm. Barclay Parsons. New York: Columbia University Press. Cloth; 7x10 in.; pp. 154; self-portrait frontispiece and other plates, mostly reproductions of Fulton's drawings. $4.

Robert Fulton's submarine, full details of which are now first made public, was a century ahead of its time. This was true politically for reasons that need not be gone into here, and technically because, although the submarine was well under control and proved capable of destroying a boat provided for the purpose, manpower only was available for under-water propulsion and a century was to elapse before mechanical power suitable to the purpose would be available.

Fulton went to England in the latter part of the eighteenth century as an artist; worked there as such but gradually turned to canal engineering; went to France to push small-canal construction; then plunged into submarine invention, construction and promotion. It was the rising power and ruthlessness of Napoleon that crushed Fulton's hopes both for his submarine and for the French Republic and finally turned him to England, to crush which country he had worked so ardently on his submarine. Under a salary of £200 a month from England, no petty fee even for those days, and with expense money as well, Fulton carried the submarine much farther for England than he had done for France.

By the irony of fate, only six days after Fulton and his submarine blew up the brig "Dorothea" in the presence of Pitt and others "came the great event that made secure England's control of the sea. Oct. 21 [1805], Nelson destroyed the combined French and Spanish fleets in the decisive battle of Trafalgar. After that England had no need of submarines, torpedoes or Fulton."

After a disappointing year spent in trying to get what he considered to be a just settlement with England, Fulton returned to the United States and, in due time, achieved a success with his steamboat that had, perhaps fortunately for the welfare of humanity during the next hundred years, been denied him with the submarine. He left in England a full description of his submarine, and this, after more than a century, General Parsons reprints in his book, together with reproductions of a full set of drawings made by Fulton.

In bringing Fulton's "Descriptions" into print and telling not merely the story of Fulton's submarine in sufficient detail but also other interesting facts regarding Fulton as an engineer and as a man deeply concerned in the progress of humanity through the engineering and industrial arts, General Parsons has rendered a real service.

PUBLICATIONS RECEIVED

Notes on Pamphlets and Reports

Tests of Road Building Rock from many states, made in 1916-21, are tabulated in a 52-p. pamphlet issued by the United States Bureau of Public Roads.

Port and Terminal, a magazine devoted to harbor matters, has been selected by the board of directors of the Society of Terminal Engineers of New York as the official organ of the society.

A Mathematical Study in Terrestrial Magnetism (62 pp.) by George Hartnell, has been published by the United States Coast and Geodetic Survey under the title, Horizontal Intensity Variometers.

Experimental Towboats, a letter from the Chief of Engineers to the Secretary of War consisting of reports on tests of heavy freight transportation on the Mississippi River, has appeared as House Document 108 (195 pp.).

City Planning and Zoning Progress in the United States down to April of this year is shown by states and cities in two pamphlets issued by the National Conference on City Planning (Flavell Shurtleff, secretary, 130 E. 22nd St., New York City).

Metered Water Rates for Detroit, by George H. Fenkell, general manager Detroit (Mich.) Water-Works, is a revised and corrected edition of a similar pamphlet issued last year. Besides a brief on proper meter charges for Detroit the pamphlet (68 pp.) contains citations from various authorities on the proper basis of charging for water.

American Engineering Standards Committee (29 West 39th St., New York) has issued its 1923 Year Book, giving the report of the committee up to date. It includes a history of the body, the methods of operation, rules of procedure, standardization projects under way, and standards actually adopted.

Activated-Sludge Studies by the Division of Sanitary Engineering of the Ontario Provincial Board of Health fill about thirty pages of the 1921 report of the board (Toronto, Ont.) and with some studies of fly control and of sanitation of swimming pools make up Bulletin No. 8 of the division. There are papers on fertilizing values of, on iron in, and on gas evolved in the digestion of, activated sludge.

Foreign Affairs, the new quarterly published by the Council on Foreign Relations, Inc. (25 W. 43d St., New York) has issued its third number. Senator Underwood's idea of the tariff as a factor in foreign trade; Professor Allyn Young on the United States and reparations; A. C. Bedford on the world oil situation; the Mexican difficulties, Germany, Pan-Islamism and Russia's economic policy make up the major part of the book, which promises to contain much of interest to those engineers who want to keep in touch with foreign conditions.

The Committee of Marine Piling Investigations of the National Research Council, has issued in separate form its contribution to the report of the Committee on Wood Preservation of the American Railway Engineering Association submitted at the March convention of the latter. The pamphlet goes quite elaborately into the subject of marine borers, including biological studies, service tests, and notes on experiences in various parts of the United States. It is by far the most elaborate study recently made into the habits and actions of these marine pests.

The Mississippi River Flood Situation is taken up in four recent pamphlets. The first, by the United States Weather Bureau (Supplement No. 22, Monthly Weather Review) is a hydrologic record of the spring floods of 1922. A report by (then) Major C. S. Smith, Corps of Engineers, U. S. Army, on the surveys for spillways at or near New Orleans, La., made in 1914, has been issued by the Mississippi River Commission, whose annual report for 1922 includes a statement on the floods of that year. A fourth pamphlet is a government document (House of Representatives Committee on Flood Control) giving the record of the hearings on the Mississippi flood control bill passed by the last Congress.

New Books and Revised Editions

THE DOCK AND HARBOUR AUTHORITIES' DIRECTORY. Being a List of Members of the Docks and Harbours Throughout the World and of Their Principal Officials. London: The Dock and Harbour Authority. Flexible; 5x7 in.; pp. 193. 10½s. net.

Covers about 30 dock or harbor boards in the United States as against 16 in the 1922 issue, besides hundreds elsewhere.

ELASTICITY AND STRENGTH OF MATERIALS USED IN ENGINEERING CONSTRUCTION: Section II, Theory of Flexure—By C. A. P. Turner, M. Am. Soc. C. E., Consulting Engineer. Minneapolis, Minn.: The Author. Cloth; 6x9 in.; pp. 108; illustrated. $5.

FOUR LECTURES ON RELATIVITY AND SPACE—By Charles Proteus Steinmetz, A.M., Ph.D., Past-President, American Institute of Electric Engineers. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 126; 32 line cuts and halftones on cards in pocket. $2.

LEHRBUCH DES HOCHBAUES—Herausgegeben von Esselborn. 3. bis 8. Auflage. Erster Band: Grundbau, Steinkonstruktionen, Holzkonstruktionen, Eisenkonstruketionen, Eisenbetonkonstruktionen. Bearbeitet von L. Brennecke, B. Kossmann, G. Ruth, H. Steinberger, R. Weder. Leipzig: Wilhelm Engelmann. Cloth; 8x10 in.; pp. 835; 2,342 line cuts.

The first edition was reviewed in this section of *Engineering News*, Oct. 15, 1908, and the second and much enlarged edition was briefly noted by Leon S. Moisseiff, Aug. 14, 1914. The present edition seems to be somewhat reduced in size.

MARKET MILK—By Ernest Kelly, In Charge, Market Milk Investigations, Dairy Division, Bureau of Animal Industry, Department of Agriculture, and Clarence E. Clement, Market Milk Specialist, Dairy Division, Etc. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6x9 in.; pp. 445; 121 line cuts and halftones. $3.75. 18½s. net.

METALS AND THEIR ALLOYS: A Modern Practical Work Dealing with Metals from Their Origin to Their Useful Application, Both Individually and as Parts of Alloys; Used Where Strength, Ductility, Toughness, Lightness, Color, Hardness, Cheapness, Conductivity, or Bearing Properties Are Demanded—By Charles Vickers, Specialist in Melting, Alloying and Casting Metals; Technical Adviser to Manufacturers of Non-Ferrous Castings; Editor of *Foundry* and Metallurgical Editor of *Brass World*. Partly based on the Third Edition of "Metallic Alloys," by William T. Brannt. New York: Henry Carey Baird & Co., Inc. Cloth; 7x10 in.; pp. 767; 110 line cuts and halftones. Price $7.50.

After introductory chapters on the History, Production Methods, Properties and Use of the Elements, on Alloys in General, on [illegible] of Alloys and the Art of Alloying, [illegible] 21 chapters on various alloys and chapters on surface coloring of Alloys, Foundry Utilization of Scrap Metals, Analysis of Babbitt Metals and Foundry Data.

STEAM POWER—By C. F. Hirshfeld, M.M.E. [illegible]

[illegible] first edition was favorably reviewed in these columns Feb. 15, 1917, p. [illegible]

[illegible] Julius Springer. Boards; 7x10 in., pp. 338; 334 line cuts.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

The "Romance" of the Everglades

Sir—Referring to the article describing a railroad location survey in the Florida Everglades in your issue of March 8, p. 459, I beg to advise the author of the article that the men engaged in that survey were pampered pets.

The writer was on one of those township and section surveys in the same territory. Instead of fifteen miles of survey in five days, we averaged fifteen miles of survey in one day, and our walking distance per day averaged more than twenty miles.

We lived on the same house tractor as described but it did not prepare a path for us. We cut and made our own. Our work was at right angles to the course of the tractor, it moving directly west about two miles a day while our surveys ran North and South.

When we went out in the mornings we had nothing to carry but the necessary quarter-mile stakes, section-corner pipes and sight laths for fifteen miles of line, in addition to grub sack, machetes and survey instruments. We could not be bothered with the tractor, our home, in sight at all times. We needed the extra thrill of looking for it after the day's work was done. Only one who has been among those countless coral islands can appreciate the intricacies of this game.

We had no attendant luxuries such as houseboat and physician, but we had boils aplenty.

You see we were working for a contractor and not a railroad. C. B. Burnside.

Potosi, Wis., March 15.

College-Trained Engineers for the Railways

Sir—I am heartily in sympathy with the editorial on "College Bred Engineers," in *Engineering News-Record* of March 29, p. 567. The railroads need college trained engineers to solve the problems of the railroads of today and the future, and the only way to meet this need is to make the railroad work attractive to the engineering college graduates. The engineering students must be fed in at the bottom, if they are eventually to come out at the top as trained railroad executives. With the many lines of work which are now opening up to the choice of the engineering graduate, it is going to become increasingly difficult to attract them to railroad work, unless there is a distinct effort in this direction.

W. A. Rogers,
Bates & Rogers Construction Co.

Chicago, April 6, 1923.

Sir—The article in the *Engineering News-Record* of March 29, which calls attention to the reluctance of college men to take up railway work has been read with interest. The reason therefor seems to be implied in that sentence which states that a railroad is a poor place to work. Some of the disadvantages incident to a railway position on which such a reputation is founded are, as follows:

The inability of a railway engineer to establish a permanent residence and the difficulty in saving any of his earnings, due to the constant shifting from place to place and the justifiable fear of a sudden lay-off; the low salaries paid, for the amount and variety of work demanded; and slow promotion; the advancement of friends, relatives and satellites to positions of responsibility; the unpleasant atmosphere of the average railroad organization due to the bullying and insulting tactics of many railroad executives and their encouragement of such methods; the restricted field in that it is difficult for a man with any number of years of railway training to take up an allied branch of work.

The writer has been employed fourteen years with two railroads and the above seem to be the outstanding grievances of men with whom he has been associated.

April 3, 1923. "Railway Engineer."

Maine Policy and Cheaper Highway Bridges

[*A policy of building cheaper highway bridges, recently announced by the state of Maine, was the subject of an inquiry addressed by "Engineering News-Record" to L. N. Edwards, the state highway bridge engineer, to bring out the means by which the intended economy was to be obtained. Mr. Edwards' reply follows.*—Editor.]

Sir—It is reasonable to assume that your inquiry of Mar. 29 refers to a news item which appeared Jan. 18 in a number of papers throughout New England, it having been distributed, I am informed, by the Associated Press. The origin of the news item can readily be surmised from the following quotation: "The Governor and Executive Council are convinced that there is no necessity of building such expensive highway bridges as has been done in recent years at all places in the State. Its members feel that thousands of dollars can be saved to the State and the public be equally well served by the erection of less costly types of bridges."

It is important to note that the news items have in every instance failed to give the information which is of vital importance to all bridge engineers, viz.: What basic load and strength conditions were assumed; to what extent was the service performance of the various types and classes of structures taken into account; were fire, flood, frequent repair and other hazards given due consideration, and, finally, were computations based upon such pertinent factors as original cost, safe service life, cost of maintenance, average annual expense, etc., involved in the economic consideration of bridge structures given full and proper consideration?

We feel that little, if any, real consideration was given to such important factors, for it is significant to note that the news item invites special attention to Martin's Point bridge on the Portland-Falmouth road and in this connection the claim is made that the structure "will serve all the demands of traffic for at least 20 years." This rather extravagant claim is made notwithstanding the fact that with the exception of a metal bascule lift span having a clear span length of 40 ft. the entire structure consists of an untreated wooden pile trestle with a plank floor. However this is not the most remarkable condition to which the news item directs attention for it further states that this pile trestle bridge, which has a total length of over 1,400 lin.ft., a width of 30 ft. and an average height of 20 ft. above the mud bottom of Presumpscot River, together with the bascule lift span cost $60,000. As a matter of fact the public records of Cumberland County show an expenditure of over $165,000 and in addition to this the Portland Street Railway Co. has expended over $20,000 upon the project. Incidentally the news item states that to have built at this location the type of bridge usually built by the State Highway Commission would have cost at least $1,000,000, but totally fails to point out the pertinent fact that the commission has never had this project under consideration either directly or indirectly.

The Commission's bridge division was in no way involved in the decision reported in the public press as quoted above. We know of no useful purpose it served but fully recognize that generalized statements of this kind appeal to the uninformed and serve to make more difficult the work of those whose energies are expended in producing highways and bridges involving the primary considerations of reliable and safe service, and economy in first and maintenance costs.

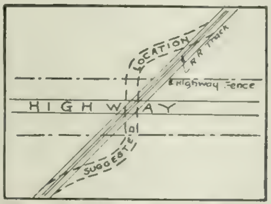
Your remark "Economy, especially in highway bridge construction, seems to be popular in the present year," refers, I assume, to the popular though intangible and altogether unreasonable idea that somewhere, somehow, someway there can be found a means by which we can design and construct bridges having adequate strength to safely support, say, a motor truck load weighing 15 tons by using the same amount of material and paying the same cost price as were involved in bridge structures built 25 years ago to safely support horse-drawn vehicle loads weighing 6 tons. The creator or creators of this popular notion have failed to recognize the elementary condition that, speaking generally, "the stoutness of every member in a structure depends upon and bears a fixed relation to the burden it must bear."

It is obvious that economies in bridge design and construction, both in first cost and in subsequent maintenance, compel a careful consideration of types of structures, the materials to be used and the construction methods to be employed. These render the building and the rebuilding of bridges more than ever before the province of the capable and efficient bridge engineer. With his aid and assistance real economies can be effected, but upon highways involving the transportation of heavy motor vehicle loads so called "inexpensive" bridges are entirely out of place.

LLEWELLYN N. EDWARDS,
Bridge Engineer, Maine State Highway Commission.
Augusta, Me., April 6, 1923.

Relocating the Railway at Crossings

Sir—In your issue of March 22, p. 543, under the heading "Plan and Construction of Highway Crossings," giving specifications reported by the committee on Signs, Fences and Crossings of the American Railway Engineering Association and approved by the association as Recommended Practice, two sketches are shown, of which Fig. 2, "Relocating a Diagonal Highway Crossing," is described under the third paragraph of the specifications.



RELOCATING A DIAGONAL R R CROSSING

In view of the fact that improved highways are being constructed today at great cost for the benefit of heavy and high-speed traffic, and that the machines which are run upon these highways are in many instances traveling at speeds as high as or greater than those of machines which travel on steel rails, and further, in view of the fact that these highways are being demanded and paid for by the public as represented by the government of the state and nation, and that the railroad is a corporation existing under and by the consent of said public, do you not consider that it would be advisable for the said committee on Signs, Fences and Crossings to reconsider the third paragraph of their specifications and also the design shown in their Fig. 2? It might be possible that they would take kindly to the suggestion of putting the necessary curves in their tracks rather than in the highway, in order to secure this right-angle crossing upon which they seem to insist—see sketch herewith.

T. M. RIPLEY.

Hornell, N. Y., March 23.

Sir—The suggested relocation of a diagonal highway crossing as suggested in a committee report of the American Railway Engineering Association, abstracted on p. 543 of *Engineering News-Record* for March 22, 1923, seems to me very unfortunate. Such a change was not so serious in the days of horse-drawn traffic, but in the days of swift motor traffic such a highway location introduces very grave dangers in the use of the highways. This is markedly so if the highway crosses below the railroad. In this case the vision of the highway ahead is obscured, so that if automobiles meet within the part of the highway shown in the figure, the driver of one car will not see an approaching car until just before it is met. The tendency also is for the driver not to stay on the righthand part of the highway and, due to obstructed vision, not to be able to get back onto the proper part of the highway before a collision with another automobile. These conditions are aggravated when the highway is on a steep grade.

Whether the crossing is at or below grade a sharp reverse curve is introduced which is very dangerous at the speed under which much motor traffic moves. Such a layout violates the first principles of highway location—that curves should be of gentle curvature, should not be sharply reversed, and should afford an unobstructed view of at least 300 ft.

Those who drive automobiles over roads with highways crossing railroads as outlined in the figure can testify to the apprehension with which such crossings are approached and to the sense of relief when they have been passed in safety. If any who are interested in this subject will visit Hanover I shall be pleased to show them, within a radius of fifty miles, five examples of highways located as shown in the sketch, which I feel confident will demonstrate conclusively to them the danger of such conditions.

CHARLES A. HOLDEN,
Hanover, N. H., Thayer School of Civil Engineering,
March 24. Dartmouth College.

Closing the Chicago River

Sir: Whether or not your editorial on "Closing the Chicago River" in *Engineering News-Record*, April 5, p. 609, was intended to provoke controversy, I am glad to note that you admit that "plenty of arguments will be found on both sides," and I am tempted to argue the matter.

In my capacity as member of several committees of several civic organizations in Chicago I have had occasion to report and to contribute to reports upon the various proposals to close the Chicago River. The following are some of the findings presented in these several committee reports:

1. The condemnation proceedings necessary to apply to the riparian rights involved before this plan could be put through, and the necessary act of Congress secured for the abandonment of the river for purposes of navigation, would both involve many years of delay before any practical improvement could be even begun. The adoption of the Hibbard plan means the abandonment of the South Water St. improvement. This delay would necessarily mean that the city would be left in its present condition for years without any possibility of vitally needed improvements.

2. The plan infringes upon the paramount public right in the navigable channel of the Chicago River. This right extends not alone to the local public, but to the public at large.

3. The plan is an infringement upon private riparian rights not alone in the section suggested for improvement, but also in the navigable channel of the Chicago River north and south of the central business district.

4. The U. S. Government has an investment of $1,800,000 in improvements to the Chicago River for purposes of navigation which would be abandoned by the adoption of such a plan.

5. The Sanitary District of Chicago has an investment of $12,106,282.41 in the improvement of the Chicago River for purposes of navigation and sanitation which would be abandoned by the adoption of such a plan.

6. The construction necessary to such a plan would be an impediment to flow of water in the Chicago River for sanitary purposes. Sedimentation occurring in the channel and obstructing the flow of water could not be removed from the section bridged over.

7. The plan would be a barrier to barge navigation from the Illinois Waterway, and it would not be possible to divert all of such traffic via the Calumet Sag Canal, which is not now navigable, without enlarging it at great cost.

8. The plan would deprive of water connections by barge with the Illinois Waterway, business and industrial concerns located on the main channel of the Chicago River, on the north branch of the Chicago River and on the south branch of the Chicago River in the section affected by the plan.

9. The expected use of the Municipal Pier, in which Chicago has an investment of $5,000,000, as a convenient transfer point of commodities between lake vessel and barge following completion of the Illinois Waterway, would be prevented.

10. The estimates of cost presented in the Hibbard pro-

posal are neither conclusive nor inclusive. The cost per mile would more likely run between five and seven million dollars than the figure of two and one-half million dollars suggested.

11. The interests of Chicago and the state are just now centered upon early completion of the Illinois Waterway, the obtaining of a 9-ft. channel for this waterway, and settlement of the old controversy over the flow of water to be taken from Lake Michigan. These latter two problems will require congressional action and any undue publicity or seeming public approval of the Hibbard proposal at this time might prejudice Chicago's chances of settling these problems, immensely more vital to its health and business prosperity.

12. At a time when the attorney generals of neighboring states are meeting in Chicago to plan court action inimical to Chicago's interests, we ought not to consider any proposal which may play into the hands of our enemies.

Further animadversion is suggested by your editorial, "the steep descending grade of shipping in the Chicago River since the eighties and nineties," does indicate the "ultimate abandonment of the River for shipping," for lake shipping, for use as a harbor for lake boatts; we must not lose sight of the fact that this is a transition period in the history of the Chicago River and its connecting waterways. It is obvious that the completion of the Illinois waterway will produce a large volume of barge traffic and that much of this traffic will be destined for industries located on and contiguous to the Chicago River and its connecting waterways. The completion of the St. Lawrence waterway will also add to the necessity for maintaining this barge channel in the Chicago River and its connecting waterways.

I believe that with certain due notice to the interests involved, it would be wise to anticipate the consummation of the transition in the type of shipping that is to use the Chicago River and its connecting waterways and to set a fairly definite date for fixing all of the present movable bridges across the river and that thereafter all bridges built should be of the fixed type. I do not believe that "the business building area has been restricted by the river to the north and west," as much as it has been by the union elevated loop railways. Business has already begun to move north and west and with fixed bridges the river would no longer be a barrier to the development of these districts outside of the loop. This whole matter should not be a subject of contention, however, but rather a subject of careful and disinterested study. To this end the Western Society of Engineers has recently contributed a most constructive suggestion; that is, the appointment of a body of competent engineers to study the question with legislative authority and appropriation.

Robert Isham Randolph,
Consulting Engineer.

Chicago, April 12.

Winds and Barometric Effects on Great Lakes Levels

Sir—The paper of Prof. John F. Hayford on "Winds and Barometric Effects on the Levels of the Great Lakes" in *Engineering News-Record,* April 12, 1923, p. 665, is a valuable contribution to our knowledge on this subject and I am impressed by the thoroughness of the study. The method is logical. Without having checked any of the computations, but taking Prof. Hayford's statements at their face value, there is one point that seems to me to have the most economic importance. If it is possible to determine the surface level of Lake Erie as accurately from a single day of observation in Buffalo as it could formerly be determined from sixteen days of observation, the operation of regulating works to control the levels of the Great Lakes will be much simplified.

The Sanitary District of Chicago, in order to settle the controversy with the federal government regarding the lowering of lake levels, has proposed to install regulating works in the Niagara and the St. Lawrence Rivers, which would raise the present levels of Lake Erie and Lake Ontario more than 1 ft. and would more than compensate for any possible lowering due to the diversion of water through the Chicago Drainage Canal. The raising of the level of Lake Erie would automatically raise that of Lakes Michigan and Huron by back-water effect. The construction of such regulating works would not be a difficult matter, but the proper operation would be. To effect a change in the level of a basin as large as any one of the Great Lakes would require considerable time. Hence the necessity for predicting the natural change so that sufficient artificial change can be made, either to augment or compensate for, as the case may be. Therefore, if the level can be determined accurately by brief observation by Hayford's method and future levels predicted more closely by a study of weather conditions, the operation of regulating works would be made much simpler. In this matter alone the study made by Prof. Hayford would prove to be of great value.

H. P. Ramey,
Assistant Chief Engineer,
Sanitary District of Chicago.

Chicago.

Why Not a Smaller Cement Sack?

Sir—I should think the ½ cu.ft. sack of cement mentioned in *Engineering News-Record,* March 29, 1923, p. 565, would be welcomed by contractors, particularly on small jobs. With the half-sack batch of concrete and often with the one-sack batch it is necessary for the laborer to divide the sack according to his judgment of what is a half sack. I have seen the following happen:

A one-bag mixer was being used. The material for one batch was delivered in two wheelbarrows. Half the aggregate and supposedly a half bag of cement were loaded on each barrow. Laborer "A" would put half a bag of cement and laborer "B" would put half *another* bag on their respective loads. On the next trip each would take what remained in his particular bag. If they had not done it this way laborer "A" would have had to handle a new sack of cement every time and "B" would have had to lift only half a sack each time. That isn't their idea of an even division of labor. It is evident that if half sacks of cement were provided a more uniform concrete would result than can be obtained by the method outlined above.

It would seem that the extra labor involved in having more packages to handle at the cars should be offset by the greater ease of handling.

L. W. Mahone.

Ames, Iowa, April 2, 1923.

Sir—The question of the returnable cloth sack and the non-returnable paper sack is one which has been discussed up and down, in and out, over and under, pro and con for many years. It is true that sacks which for twenty years cost between seven and eight cents apiece now cost over twenty cents. We sell the cement at a price which *includes* a leasing charge for the sacks, and on return of the sack we allow ten cents. Of course we do not *sell* a sack which costs twenty cents for ten cents, but our gross charge is necessarily higher than it would be if we could buy new sacks for seven or eight cents.

Ninety per cent of our shipments are made in cloth, although in quoting we always give the customer the option of taking cement in cloth or paper or in bulk, and the fact that ninety per cent of our customers prefer the cloth is sufficient proof for us that that package is preferable to and more economical than the paper package.

As to reducing the quantity per sack to 50 lb. instead of 94 lb., I am sure that the cost of eight small paper bags would be as much as or more than the cost of four large paper bags, and I am also sure that the cost of packing and loading into cars would be greater with small bags than with large.

We will give the public any size or any kind of package it wants. We believe, however, that the public would pay more for cement if it demanded it in small packages than in large. In fact, the way we prefer above all other ways to ship our product is in bulk and when our customers permit us to do so, we make a price to them of five cents per barrel less than when they require us to put it in packages. This difference represents a little more than the amount we are able to save by handling the cement in bulk.

President of a Cement Company.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Gross Revenue for the Year 1922 of $77,700,019 is reported by the Grand Trunk Ry. This leaves a deficit of $8,411,734, as compared with $14,064,442 the previous year.

Five of the Eight Units of the Chippawa development of the Provincial Hydro-Electric system are now operating, the fifth having been put in operation April 9. The total capacity of this development is now between 275,000 and 300,000 hp.

The Tennessee State Legislature has rejected a bill calling for authorization to issue $75,000,000 in bonds to complete the state highway system. Construction, as contemplated under the issue, aggregated 4,000 miles to be built over a 7½-year period.

The Denver & Rio Grande Western system contemplates the expenditure of $12,000,000 during the next fourteen months. This money will be used for the purchase of new equipment, the relaying of rails, the reconstruction of bridges and the construction of new shops.

Contracts Have Been Let and work has started on the electrification of the suburban lines on the southeast side of London. This section covers all the lines within a radius of 15 miles, and comprises 94 miles of double track and 200 miles of single track. In both speed and frequency the new service is intended to make a 30 per cent improvement over the present steam operation.

An Extensive Program of improvement work for the coming season, as prepared by the Pere Marquette R.R., includes the following items: Second main track from Delray to Plymouth, Mich., 19 miles, including grade separation at Michigan Ave., Detroit, $750,000; additions to shops at Wyoming Yard, Grand Rapids, Mich., $1,423,500; new engine terminal at Detroit, $1,000,000; new passing tracks at various points, $250,000.

Since There is Strong opposition to the proposal that Hawaiian Islands draw their highway funds from the general appropriation for Federal Aid, it is probable that no further effort to that end will be made. Because highways there must be constructed primarily to meet military needs, it is probable that a separate bill will be introduced at the forthcoming session of Congress. Subcommittees of the Committee on Military Affairs and of the Committee on Insular Affairs, accompanied by William P. Jarrett, the Hawaiian delegate, now en route to the Islands to make a study of the situation.

Dallas Votes $8,325,000 Bonds for Public Improvements

An increase in the bonded indebtedness limit of Dallas, Tex., from $14,000,000 to $25,000,000 and the issuance of $8,325,000 of new bonds, bringing the total city indebtedness up to $22,135,000 was authorized on April 3. The major part of the new bonds—$5,000,000—will be devoted to a reservoir and other improvements to the water-works. The present sewage disposal plant will be doubled in size and a pumping station built, there being an item of $500,000 for this purpose. For paving and other street improvements $1,250,000 was voted; for park improvements, $325,000; sanitary sewers, $150,000; new fire stations, $100,000; schools, $1,000,000. George D. Fairtrace is city engineer and Maj. W. J. Powell is engineer to the supervisor of public utilities.

Commerce Commission Places Value on Two Railroads

The Interstate Commerce Commission has placed a tentative value of $395,353,655 upon the Great Northern R.R. system, the largest railroad property yet to be valued by that body. This valuation does not include the securities of other roads held by the Great Northern which have an estimated net asset value of $227,076,317. The Great Northern values its own railroad property at $384,273,853.

The Commission's valuation of the Delaware & Hudson system, exclusive of certain coal land holdings and noncarrier property, is $95,834,979. On this same property the D. & H. places a value of $143,738,839.

Both railroad companies will protest this valuation as a basis of capitalization on account of their many outside holdings which have not been considered.

Distribution of River and Harbor Fund Expected by May 1

Washington Correspondence

The recommendations which have been made to the Secretary of War by the Corps of Engineers for the distribution of the $56,000,000 river and harbor appropriation will not depart materially from the division of the estimate submitted to Congress at the time the appropriation was under consideration. In some instances conditions have changed which will make readjustments necessary. It is anticipated that the Secretary of War will insist on a larger amount being expended on the Ohio River than had been suggested for that stream. This action, however, meets general approval in the Corps of Engineers, where there is a strong desire that the work on that stream be pushed as rapidly as possible. Final approval of the distribution of the river and harbor money probably will not be forthcoming before May 1.

Am. Soc. C. E. Board Meets in New Orleans

Committee Authorized to Confer With Other Societies on Public Affairs—Government Reorganization

Engineering News-Record Staff Report

The Board of Direction of the American Society of Engineers, in session in New Orleans, La., on Monday and Tuesday of this week prior to the opening yesterday of the annual spring meeting of the Society in that city, authorized the appointment of a committee of five to confer with other national societies looking toward co-operation on matters of interest in public affairs. The same committee is also given power to call upon President Harding and members of Congress in relation to the President's reorganization plan, embodied in a law passed by the latest session of Congress. The Board of Direction approved these recommendations as to government reorganization, particularly those tending to divorce civilian engineering activities of the government from engineering duties which are under military control.

LOCAL MEMBERSHIP COMMITTEES

The Board also authorized the appointment of local committees for preliminary consideration of applications for membership, final action remaining with the Board, according to the constitution.

Early in the Board's session it was laid down as a principle that the committee on Professional Conduct would consider cases of violation of the code of ethics of the Society as abstract cases from which general principles are to be formulated, unless otherwise directed by the Board.

On reconsideration the Board decided to refer proposed practice as to code violations to committee for full report.

The committee on Registration of Engineers reported progress only, and action which had been ordered to be presented at the present session, was passed over until the next meeting. By resolution of the Board, at its meeting in New York in January, the committee on Registration of Engineers was instructed to present for the consideration of the Board at its meeting in New Orleans (See *Engineering News-Record* March 1 pp. 379 and 411) a method of procedure by which the Society might actively carry out a policy looking toward the establishment in all states possessing licensing laws of a uniform law acceptable to the Society. The committee was also directed to submit a draft of such a uniform law.

Secretary Dunlap, of the Society, was ordered to confer with the secretaries of the other founder societies in an attempt to set up a nation-wide paid employment service available to members. A report on this plan is to be made at the July meeting of the Society.

(Concluded on p. [illegible])

Nationalization of British Highways Considered

Adoption of French System of Road Construction Is Being Urged By Local Authorities

London Correspondence

Adoption of the French system of road construction on a national basis throughout Great Britain is being seriously considered by many of the leading highway and urban authorities. Under the present scheme road construction is undertaken by local county councils and county borough councils with the co-operation of the Ministry of Transport. The cost is found partly by the Ministry and partly by the levy of a local rate; as a rule the Ministry finds from 25 to 50 per cent of the cost from the road tax and the balance is raised in the district of the local authority.

The complaint now is that the "dole" system maintains unemployed workers while funds are not forthcoming for the construction and improvement of highways. It is proposed that the unemployment dole should be turned over to the local authorities and used for the construction of highways.

A much discussed instance of the anomaly in existence is the case of a main road between Manchester and Liverpool. The cost of this road is estimated at around three millions, sterling. The Ministry of Transport has offered to find 50 per cent of the cost (this being considered a "first class" road) provided the Lancashire County Council and the thirteen County Borough Councils, through whose territory the road will pass, will find the other half.

The great difficulty here is that the rates of the districts would have to be increased over a period of thirty years to provide the interest and sinking fund for the one-and-a-half million, sterling. Another objection is that the government would save much of their half share by the reduction of the dole.

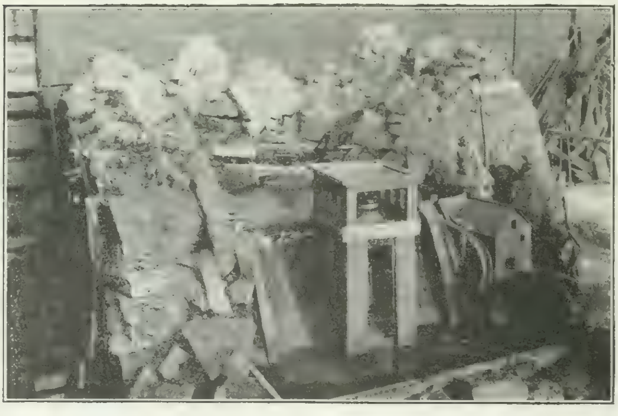
The position then is that it is almost impossible to get the local authorities to co-operate even though road construction is the most suitable type of work for all classes of unemployed. On the other hand, in the districts where the Manchester-Liverpool road has been planned, there are 120,000 able-bodied men drawing unemployment pay at the rate of three-and-a-half millions a year, plus one-and-a-half millions in what is called outdoor relief. In many cases, of course, men are offered work at wages slightly above the dole but prefer being paid at a lower rate for doing nothing.

It has also been suggested that the financing of these road schemes should be aided by a levy of 3d. a gallon on motor spirits. It is estimated that this would bring in an additional one hundred millions per year, which would go a very long way towards the reduction of local rates and make possible the construction of the many main highways of which Britain stands so urgently in need.

Quebec to Receive Bids for Des Quinze Power

In order to furnish a supply of electric power to the mining districts of Northern Ontario and the adjacent region in Quebec, the government of Quebec province will offer for sale by auction at Quebec City on April 25 a lease of the Des Quinze Rapids at the headwaters of the Des Quinze River. It is estimated that nearly 100,000 hp. could be developed. The lease will be offered at an upset price of an annual rental of $8,000 and the company obtaining the lease will be bound to develop at least 20,000 hp. in four years.

Students' Exhibit Shows Power Development



AN exhibit prepared by the students in water-power engineering of the State University of Iowa shows three types of water-power developments; low-head plant with reaction wheel (which can be seen through the glass front on penstock); the old overshot water-wheel (and grist mill) in the center (it is turning very rapidly in the picture) and the high head impulse wheel installed at the end of the steel penstock at the right. The railroad in the center is being run by power generated at the plant and passes through the city called "Gopher Prairie." Water from three sources supplies the projects which is returned to its source from the tailrace by a small centrifugal pump located underneath the exhibit. A transmission line of steel towers leading over the mountains can barely be seen.

Demand for Engineers Continues

Engineering services continue in demand with practically no unemployment in the ranks of professional engineers, according to the employment department of the American Association of Engineers. Probably a shortage will exist for both skilled and unskilled labor. It is already becoming noticeable in industrial establishments. Very few highway engineers of experience are available for employment and it will be necessary for the highway commissions to engage inexperienced men for their staffs or obtain young men who are being graduated this year from universities. The present heavy demand continues for designing engineers, in structural, mechanical and architectural lines. This holds true for practically all sections of the country except certain districts in the East. Boston reports that little outside engineering activity is in progress in the northeastern section, although most of the engineers are employed. New York reports considerable designing work now being undertaken with excellent prospect for construction work starting soon after April 1. Practically all other parts of the country report a shortage of professional engineers except a few sections west of the Mississippi River where the supply and demand about balance. The following table shows the trend of employment:

	February 1923	January 1923	February 1922
Applicants for employment	1,219	1,256	1,968
Positions received	526	537	312
Men referred	1,135	1,123	1,475
Men placed.......	115	149	172

The average salary of positions filled was $194 a month.

Standards Bureau Should Stress Scientific Research, Is View

"It is of the highest importance to the future of American industry and scientific progress that the activities of the Bureau of Standards should continue more and more devoted to scientific research of a profound and fundamental character, beyond the means of most college laboratories, where instruction to students is the chief purpose, and that these investigations shrould be of a broader scope than can be expected from research and testing laboratories in the service of special industries."

The foregoing is a portion of the findings of the Board of Visitors to the Bureau after a careful survey of the establishment's current activities. The Board of Visitors is composed of John R. Freeman, former president of the American Society of Civil Engineers; Ambrose Swasey, former president of the American Society of Mechanical Engineers; F. W. McNair, president, Michigan School of Mines; S. W. Stratton, president, Massachusetts Institute of Technology, and Wilder D. Bancroft, professor of chemistry, Cornell University.

"The determination of the physical constants of materials and the more thorough investigation of the properties of substance, apart from immediate applications seen in the industries," continues the report "seem particularly appropriate under the organic act creating this Bureau. We venture to suggest specific appropriations in the budget for such research."

War Department Grants Permission for Oakland Estuary Tube

Permission has been granted by the U. S. War Department for the construction of a tube passing under the estuary and connecting the cities of Oakland and Alameda, Calif. On receipt of this permission on April 2 the Board of Supervisors set May 8 as the date of a bond election to provide $4,496,000 for the construction of the tube.

The Oakland end of the tube will be at Sixth and Harrison Sts., and on the Alameda side at Webster and Work Sts. In the channel the tube is to be sunk deep enough to give a clear depth of 40 ft. at mean low water. The total length of the tube between portals will be 3,380 ft. and the maximum grade 4½ to 5 per cent according to final determinations. If the bonds carry, bids will be called for immediately and it is estimated that the work can be completed within two years.

Tentative plants prepared by George Posey, Alameda County engineer, provide for a tube with a 24-ft. vehicular roadway and two 3-ft. sidewalks. Pending the time that a separate tube is built for the electric railway, a double track line included within the 24-ft. roadway will be used. Preliminary studies indicate that the portion of the tube under the main channel might be made of precast concrete sections, 150 to 200 ft. long floated to place and sunk. Approaches to this section might be made in unwatered trenches.

The need for the tube is indicated by the rapid increase in traffic over the Webster St. bridge. In 1912 the maximum number of automobiles crossing this bridge in an hour was 67, in 1918 the number had increased to 444, and in 1922 it was 1,005.

The War Department has ordered that both the county bridge, which is also used by the electric railway, and the nearby Southern Pacific R.R. bridge, shall be removed by June 30 next. The penalty for non-removal by that date is set at $5,000 per month.

New York Building Congress Holds Annual Meeting

At the annual meeting of the New York Building Congress held in that city on April 17, the principal subject of discussion was the work of the apprenticeship commission conducted by the congress under the joint auspices of the employers and the trade unions of the building industry.

The commission reported that classes have been established for the carpentry and for the painting and decorating trades and that courses in the electrical trades will be opened in the immediate future. Additional building trades that now have the subject in hand for early action are the upholsterers cement-masons, bricklayers, shop-draftsmen and cabinet-makers. Other trades will be asked to adopt similar programs and it is hoped that by the time the fall school session opens, all the building trades that need definite instruction will have fallen into line.

The commission reported also that apprenticeship instruction is either planned or already in operation in many other cities, including Boston, Philadelphia, Cleveland, Detroit, Seattle, Portland, Ore., and in the State of New Jersey. It paid tribute to the co-operation that has been extended to the work by the public school authorities, the trades unions and the employers.

The meeting was addressed by Eugene C. Gibney, of the New York City Board of Education; Peter J. Brady, chairman committee on education of the New York State Federation of Labor and Wm. J. Barney, of the New York Building Trades Employers Association, all of whom emphasized the importance of the work being done by the apprenticeship commission.

The congress elected as its officers for the ensuing year, Stephen F. Voorhees, president; Andrew J. Post, Alexander Kelso and William O. Ludlow, vice-presidents; Benjamin D. Traitel, treasurer and Richard A. Wolff, secretary.

Insurance Money Due Contractors Supreme Court Decides

Contractors engaged on construction work for the government during the war on a cost-plus basis are entitled to compensation for the premiums they paid for bonds and insurance, according to a recent decision of the U. S. Supreme Court, as the result of suits brought before the Court of Claims by the Mason & Hanger Co. and the Northeastern Construction Co.

The Supreme Court several months ago decided the cases this way, but the government obtained a rehearing. Several million dollars are said to be involved in several hundred cases of this character.

Am. Soc. C. E. Board of Direction Meets in New Orleans

(Concluded from p. 723)

The Sanitary Engineering Division of the Society was authorized to raise a fund of $1,500 to be used as a prize for the best paper presented to the Division. Petitions of Syracuse and Milwaukee for local sections of the Society were granted.

Two grants were accepted by the Board from Engineering Foundation. The first of these is for $1,000 for the proposed committee on Investigation of Concrete and Reinforced Concrete Arches, and the other of $1,000 this year and $2,000 for each of the next two years for the Committee on Investigation of Steel Columns. Engineering Foundation also offered to finance these committees further.

Arrangements are being completed at the session at New Orleans for the October meeting of the Society which is to be held at Richmond, Va., with side trips to Norfolk and Washington. Detroit and Salt Lake are endeavoring to secure one of the 1924 meetings.

Both the secretary and treasurer of the Society were unanimously re-elected.

The Board of Direction had an interesting trip to New Orleans. The New York delegation picked other members along the route. The Board was entertained by engineers at Cincinnati, Nashville and Birmingham and by chambers of commerce at Mt. Pleasant, Florence and Sheffield, Ala., near Muscle Shoals, where the Wilson dam was inspected and the party entertained at luncheon by engineer officers in charge at the dam.

Contractors Liable for Delay of Penalty Clause Work

Contractors on construction work for the Government where the contracts include a penalty clause for delay are not excused from paying the penalty even though additional delay in completing the project may be caused by the Government itself, according to a recent decision rendered by the Supreme Court.

The case was a suit instituted by Roy H. Robinson, administrator of the estate of John C. Robinson, versus the United States. Robinson in 1905 had a contract to install the interior finishing of the New York Customs House. By a supplemental contract the price was increased and the time extended. The work was not completed for 121 days after the date named. The Government insisted only twelve days' delay were chargeable to it and that the contractor was liable for $420 for each of the remaining 109 days delay. It, therefore, deducted $45,780 from the amount otherwise payable. The contractor brought suit to recover that sum and contended that since the Government had caused some of the delay the provision for liquidated damages became wholly inapplicable and was unenforceable and that since the Government had failed to prove actual damages it was not entitled to any damages.

The Court of Claims found that of the 121 days, only 61 were chargeable to the contractor and that the remainder were caused by the Government after the date of the supplemental contract. That court gave a judgment of $20,160 on this point. The administrator appealed.

Detroit Votes $17,000,000 for Power, Light and Railways

At a popular election held in Detroit on April 2, $12,000,000 of bonds were authorized for a municipal power and lighting plant and $5,000,000 for street railway extensions and improvements. It is expected that about 80 per cent of the output of the power and lighting plant will be used for the municipal railway system. The power and light plant bonds received 63 per cent and the street railway extension and improvement bonds 61 per cent of the votes cast, against the legal requirement of 60 per cent. The railway extension and improvements bond had been voted upon at two previous elections and apparently had failed to carry.

Interior Department Engineers to Complete Colorado Survey

A party of ten men, including two topographic engineers, one hydraulic engineer, and one geologist, from the Department of the Interior, will make a survey this summer of the deep and narrow gorges of the Marble and Grand Canyons of the Colorado River. The party will also make detailed examinations of all the possible dam sites. The survey of this 300-mile section of the Colorado River will provide the last section in the complete river map of the 1,200 miles from Green River, Wyoming, on the Green River and from Grand Junction, Colorado, on the Colorado River, to the Mexican boundary.

Nickel-Plate to Spend $3,670,000 on Improvements

The improvement program of the New York, Chicago & St. Louis Ry. calls for a total of $3,669,646, distributed as follows, and it is stated officially that it is expected all these expenditures will be made this year:

Additional second main tracks, 39 72 miles	$1,218,580
Additional yard tracks or sidings, 11 31 miles	307,805
Improvements to shops and engine houses	242,162
Straightening and extending bridges for heavier equipment and second track	452,026
Improvements to water stations	21,120
Improvements to coaling stations	75,100
Additional coaling station	15,000
Heavier rail and other track material	389,872
Improving signals and interlocking	24,761
Additional signals and interlocking	127,191
Improving telegraph and telephone lines, 6.5 miles	13,572
Elimination of grade crossings	782,457

Delaware & Hudson Centennial

The Delaware & Hudson Co. will celebrate the centennial of the granting of its charter with a dinner at the Hotel Astor, New York City, on Monday evening, April 23. At the close of the dinner a special train will leave for Wilkes-Barre, Pa., where on Tuesday forenoon the guests will visit a modern coal breaker in operation. At noon on Tuesday the company will give a luncheon at the Hotel Casey in Scranton. After the luncheon the special train will proceed to Carbondale, where was mined the first coal brought by the company to New York City, and thence over the Honesdale branch to see the place where, some years after its organization, the company tested its first steam locomotive.

Frisco Line to Spend $3,237,000

The addition and betterment program of the St. Louis-San Francisco Ry. for 1923 amounts to $3,237,000, exclusive of equipment. This program includes the following items: (1) second track from Valley Park to Eureka, Mo., giving 34 miles of double track out of St. Louis, $987,000; (2) an entirely new mechanical layout at Lindenwood (St. Louis), $800,000; (3) a similar installation at East Thomas (Birmingham, Ala.), $750,000; (4) machinery for these two plants, $200,000; (5) new machinery for various shops and roundhouses, $400,000; (6) grade revision at Dixon, Mo., $100,000. The contract for item No. 1 has been awarded to Grant, Smith & Co., and that for No. 6 has been divided between E. P. White, Kansas City, and John R. Scott, St. Louis.

Canadian National to Provide Own Insurance

President Sir Henry Thornton, of the Canadian National Railways has decided that hereafter the system, including the Canadian Government Marine, will provide its own insurance. It is officially estimated that this will effect a saving over a period of ten years of $1,000,000 annually. The National System has been carrying insurance aggregating upward of $400,000,000 representing an annual premium of about $4,000,000 and the profits to the insurance companies have been nearly 30 per cent. Instead of insuring with the companies a cash reserve will be established to take care of all the properties of the system.

Huge Steel Arch Bridge Proposed

In a call just issued for new proposals for the Sydney Harbor bridge at Sydney, N. S. W., Australia, the 1,600-ft. cantilever on which bids were asked a year ago is retained as the main project. Alternative bids, however, are asked on an arch span of 1,650 ft. center to center of bearings. This would far exceed any existing steel arch; the largest now in existence are the 840-ft. upper arch at Niagara Falls, N. Y., and the 1,000-ft. Hell Gate arch at New York.

Bids on the Sydney Harbor bridge are to be canvassed Nov. 30, 1923.

Cooper to Develop Cotter Site on White River

Full development of the Cotter site on the White River is to be undertaken by a company being organized by Hugh L. Cooper. The interests of the Dixie Power Company in this project already have been taken over by Col. Cooper.

The project contemplates the erection of a dam 215 ft. high. An extensive pool will be created which will reach up the river as far as Foresyth, Mo. Sites also are to be developed on the North Fork and the Buffalo Fork of the White River. The total development will create 125,000 hp.

Calendar

Annual Meetings

NATIONAL CONFERENCE ON CITY PLANNING, New York; Fifteenth Conference, Baltimore, April 30-May 2.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

NATIONAL FIRE PROTECTION ASSOCIATION; Boston; Annual Meeting, Chicago, May 8-10.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION, New York; Annual Meeting, New York, May 10.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Meeting, New York, May 15.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Detroit, Mich., May 21-25.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; Annual Convention, Ithaca, N. Y., June 23-25.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J.. June 25-29 or 30.

The Rhode Island Section of the American Society of Civil Engineers will hold a joint meeting with the Municipal Section of the Providence Engineering Society, April 24. Robert Whitten, city planning consultant, will be the chief speaker.

The Dallas (Texas) Branch, American Society of Civil Engineers will hold a meeting April 22-23 at which John H. Dunlap, national secretary of the society will be present.

The Corporation of Professional Engineers of the Province of Quebec held its annual meeting last week and elected the following officers: President, E. R. Decary, Quebec, superintendent for the Province of Quebec of the Department of Public Works of Canada; vice-president, K. B. Thornton, E.E., Montreal; secretary-treasurer, Fred B. Brown, of W. J. Francis & Co., Montreal.

The Western Society of Engineers has started a movement looking toward the creation of a waterway terminal commission to be composed of engineers and be supported by an appropriation of $100,000. Resolutions memorializing the State Legislature to pass such a bill, initiated by L. K. Sherman, chairman of the sub-committee of the public affairs committee, have been passed by the board of directors and will be used in conjunction with similar resolutions from other civic organizations in presenting the matter to the legislators.

A Milwaukee Section of the American Society of Civil Engineers has been organized with J. C. Pinney, as president and A. L. Kurtz, Milwaukee Sewerage Commission, as secretary. At the second meeting April 10 a constitution was adopted to be forwarded to the board of directors for approval. Charles F. Loweth, president of the parent society, George H. Fenkell, director, and W. W. DeBerard, western editor of *Engineering News-Record*, addressed the meeting at which 30 were present.

Personal Notes

John W. Storrs, consulting engineer, Concord, N. H., has been reappointed by Governor Fred H. Brown a member of the Public Service Commission of the state. Mr. Storrs has been connected with the New Hampshire Public Service Commission since its creation in 1911, serving as its chief engineer from that year until 1918 when he was named a member of the board.

Michael J. Rutledge, associated for the past three years in hydro-electric work with Henry Holgate, consulting engineer of Montreal, has been appointed town manager of Woodstock, N. B. He is a graduate of the University of New Brunswick, and also holds a degree from the University of Manitoba. Mr. Rutledge has had a wide experience in engineering work, including municipal engineering and executive work.

John F. Stevens has returned to the United States after nearly six years spent in assisting in the operation and improvement of the Railways of Russia, Siberia, and Manchuria. From March, 1919, until that body went out of existence in October, 1922, Mr. Stevens served as president of the Interallied Technical Board at Harbin. The Secretary of State has taken the occasion of Mr. Stevens' return as a fitting opportunity to thank him publicly for his services in behalf of the people of Eastern Siberia and Manchuria, and in advancing the prestige of the United States in that part of the world.

Charles C. Carlisle, consulting engineer of Cheyenne, Wyoming, whose specialty has been water-works, sewer systems and power plants, was appointed city engineer of Cheyenne, March 28. Mr. Carlisle is a graduate of Washington State College. He began his engineering career in Wyoming in 1902, serving one year with the U. S. Department of Agriculture, and the U. S. Department of the Interior. Later he served as deputy state engineer for five years, and in 1907 designed and directed construction on the Cheyenne million dollar water system. He opened his office as consulting engineer in 1911. Among the towns he has served are Douglas, Glenrock, Mannville, Casper, Thermopolis, Riverton, Hudson, Lander, Wheatland, Laramie, Rock River, Medicine Bow, Burns, Granger and Baggs, all of Wyoming, and Potter, Nebraska. In 1912 he was appointed receiver of the North Platte Valley Irrigation Co. Since its organization Mr. Carlisle has been a member of the Wyoming Engineering Society.

G. H. Wilsey, for the past five years structural engineer of the St. Paul Union Depot Co., has been appointed principal assistant engineer, in charge of design and construction of the new passenger terminal, under the direction of **W. C. Armstrong**, chief engineer. **W. B. May** has been appointed assistant engineer in charge of construction, under the direction of the principal assistant engineer.

C. Arthur Poole, city engineer of Rochester, has appointed **John A. O'Conner** of Albany, N. Y., to take charge of subway railroad work, to succeed the late **Le Grand Brown**. Mr. O'Conner has for the past 20 years been associated with the state engineer's office in Albany.

C. D. King, of New Orleans, has been placed in charge of the maintenance of roads in the district comprising the parishes of Ouachita, Union, Caldwell, Jackson, Claiborne, Lincoln and Bienville, by the state highway commission of Louisiana. He will have headquarters at Monroe, La. These parishes have about 175 miles of roadway.

Charles F. Atkinson has been appointed division engineer for the recently created State Highway Commission at Monroe, La. He will have charge of all construction work in Louisiana, north of Alexandria.

Charles A. Pohl of New York City, chief engineer of the Niagara Gorge Ry. Co. and engineer for Anthony N. Brady water-power interests, has been appointed by the Watertown City Commission as consulting engineer on electrical equipment for the city's municipal power development at Delano Island. **William H. Cushman** is consulting engineer on hydraulic and constructional features.

C. G. Wigley, formerly chief engineer, State Department of Health of New Jersey, has been retained by the Atlantic City Sewerage Co. to investigate and report upon the necessary improvements to the sewer system and sewage treatment.

R. W. Rea, who for the past sixteen months has been making engineering investigations and reports for the Bond House of Ralph Schneeloch Co. of this city, has just opened an office as consulting civil and hydraulic engineer at 221 Lumbermens Bldg, Portland, Ore.

Major William G. Sloan, of Nutley, has been named state highway engineer of New Jersey by the new New Jersey State Highway Commission for a term of four years. Major Sloan will take up the duties of Thomas J. Wasser, former state highway engineer, who resigned after the old board had been discharged. Mr. Sloan has had a varied experience in the field of engineering. In 1900 he started as assistant engineer of the Illinois Central R.R. Co. After two years' service with the railroad he went with James Stewart & Co. and while in its employ he had charge of foundations and masonry for the plant of the British Westinghouse Electric & Manufacturing Co., at Manchester, England. During the latter part of 1903, Major Sloan was engaged as chief engineer by MacArthur Brothers Co., a nation-wide contracting concern. Within a year he became vice-president of the company and carried on large contracts in this and foreign countries. In February, 1918, he was given the rank of major of Engineers, later taking the Twenty-second Regiment of Engineers to France. This regiment took charge of light railway construction. Major Sloan is 48 years old. Edward H. Reed will continue as assistant state highway engineer.

C. J. Howard has resigned as city engineer of Corpus Christi, Texas, to become associated with E. E. Sands, consulting engineer, Houston, Texas.

L. D. Snow, recently engineer for the Mexican Gulf Oil Co. in Tampico, Mexico, has been appointed chief engineer of the South American Gulf Co. with headquarters in Venezuela. Mr. Snow is a graduate of the engineering college of the University of Texas and has had much experience as an irrigation engineer in the Rio Grande Valley. Later he was a first lieutenant of engineers, U. S. A., and after the war was on the Texas State Board of Water Engineers.

J. M. Dawson has been appointed geologist for the South American Gulf Co. in Venezuela. He was recently with the Gulf Production Co. at San Antonio, Texas. Mr. Dawson is a graduate of the University of Texas and served as a captain in the army.

William M. Robinson, Jr., recently employed as special engineer of valuation for the Georgia and the Atlanta and West Point Railroads, has entered the general practice of civil engineering, including the making of valuations, appraisals and special reports. His offices are in the Marion Building, Augusta, Ga.

J. B. Cameron, of the Ulen Contracting Corp., now doing considerable construction work in South America, has been appointed chief engineer of construction of the Atocha-Villazon R.R., a line connecting Argentine and Bolivia. Upon completion of this link railroad travel will be possible from Buenos Aires to Peru.

D. S. Fowler, formerly assistant engineer of the Illinois Highway Commission, has become associated with **E. B. Parsons**, Jefferson, Wisconsin, in the practice of civil and municipal engineering. Mr. Fowler will open an office at Watertown, Wisconsin.

Dr. Cary T. Hutchinson has become associated with Sanderson & Porter, engineers, New York City, as director of their department of railroad electrification. Dr. Hutchinson has been handling railroad electrification problems for many years, having been long identified with the firm of Sprague, Duncan & Hutchinson, later Duncan & Hutchinson, consulting engineers. Sanderson & Porter have but recently decided to extend their engineering construction and management work for public utilities to include railroad electrification. The appointment of Dr. Hutchinson is the result of this desire to broaden their engineering service.

Walter J. Dodge, assistant engineer for the California State Railroad Commission's gas and electric department for the past five years, has been appointed telephone and telegraph engineer of the commission.

John Corrigan, a building contractor of Phoenix, Ariz., has been appointed by Governor Hunt as a member of the board of regents of the University of Arizona.

J. P. Tuplin, who was for a number of years on the engineering staff of the Foundation Co. and more recently with George B. Post & Sons, both of New York, is now structural engineer for the W. S. Barstow Management Association of New York with headquarters in Reading, Pennsylvania.

U. Stephens, formerly county engineer of Runnells County, at Ballinger, Texas, becomes resident consulting engineer for the Terrell Bartlett Engineers, Calcasieu Bldg., San Antonio, Texas, at Beaumont, Texas, in connection with dock and municipal improvements.

Obituary

Col. Joseph W. Boyle, American mining engineer, well known in railroad engineering circles, died in London, April 14, according to cable advices. Col. Boyle was instrumental in organizing the first Canadian pioneer railway troops during the World War. In 1917 he was sent to Russia to aid that country in transportation reorganization. He had made his home in Woodstock, Ont.

S. Howe Bonar, city engineer of Moundsville, W. Va., died in that city recently, aged 55 years. He had been city engineer for a number of years, having previously served the county in which Moundsville is located as engineer.

George W. Kinne, formerly erecting engineer for the American Bridge Co., died recently at his home in Elmira Heights, N. Y. Mr. Kinne was a graduate of the Rensselaer Polytechnic Institute and saw service in both the Spanish-American War and in the World War.

John E. Bennett, for more than forty years one of the leading building contractors of Portland, Ore., died recently in that city, aged 75 years. He was born in Toronto, Canada, but moved to the coast in 1881 and had made his home in Portland since that time.

Walter H. Renton of the cement contracting firm of Hinchman and Renton, Denver, Colo., died recently, aged 67. Mr. Renton has been in the contracting business in Denver for thirty years. He was a native of England.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Part Played by Good Paint in Equipment Maintenance

Life of Construction Machinery May Be Lengthened by Protecting Metal from Rust

By Roy C. Sheeler

Paint and Varnish Division, E. I. du Pont de Nemours & Co., Inc., Philadelphia

During the past few years tremendous strides have been made in the development of labor-saving machinery for construction work. Nowadays, even in the construction of massive buildings and enormous development projects, there is comparatively little laborious muscular work done. Machinery has taken the place of hand labor. This has meant the emancipation of the laboring man, and has been the means of the great speeding-up that is possible in all construction work.

The care given to this machinery, most of which is high in cost, is apparently not seriously considered by many contractors. All units are attractively finished when purchased, but in some instances, at least, the paint that is applied is not of the proper character to resist for any length of time the severe conditions under which the equipment is used. While rust and corrosion of all metal surfaces is unremitting in action, the deterioration of construction machinery is particularly rapid. This is due to the unusually severe treatment accorded most of this sort of equipment. It must withstand actual abuse in many instances, due to no particular fault in its operation, but to the kind of service it must give. As a consequence, rapid depreciation of much of such equipment is inevitable.

PAINTING NEGLECTED

In comparatively few cases does any of this machinery receive a coat of paint after purchase. It continues in action until repairs are necessary, in which case certain repair parts may or may not receive paint protection. Where paint is used, it is often unsuited for the work it is called upon to do. Consequently, its life is comparatively short.

In painting steel surfaces the use to which the equipment is put should be borne in mind. Obviously, it is too much to expect any paint to bear up under constant contact with sand, gravel, cinders and other substances having high abrasive action. One might as well save his energy and the cost of paint and painting, as to paint the inside of steel dump bodies of trucks, the interior of crane buckets, or other equipment of like nature. But the *outside* of such apparatus should not be neglected, as it is generally subject to less severe treatment than the interior surfaces. Rust begins with an abrasion of the paint coat, and unless checked, it is likely to spread until the paint coat is of practically no value as a protective medium.

For repainting machinery and construction equipment, it should be borne in mind that the paint should be a rust-inhibitor and not a stimulator. Such paints as those composed of graphite, carbon, lamp-black, etc., are all right, provided they do not come in direct contact with the metal surface. But if rust spots are present and such a finishing paint is used, it will invariably *stimulate* additional corrosion at such points, rather than prevent it.

TWO CLASSES OF PAINT

There are two classes of paint that are suitable for repainting—one composed of oxides of iron or other stable pigment, ground in linseed oil, and the other a combination of known rust-inhibiting pigments mixed with a durable, elastic varnish vehicle. Either of these classes will give good service. Under normal conditions of use—that is where the surface is not subject to extremes of moisture or contact with acid or gaseous fumes—the first-named composition will give maximum protection. But where conditions of use are particularly severe, the latter mixture is preferred. It will be found to offer greater resistance to corrosion, and the rust-inhibiting qualities of such a paint makes it particularly valuable for use on bare spots as well as on previously finished surfaces.

Pointers on Paint

- *Any paint is not suitable for all purposes*
- *Rust begins with abrasion of the paint coat*
- *Paint for construction equipment should be a rust-inhibitor*
- *Preparation of clean, dry, surface is important*
- *Painting is cheaper than replacement of machinery*

The proper preparation of the surface for repainting is of utmost importance. No matter how good the paint may be, unless the surface is in right condition for painting, unsatisfactory results are sure to follow. The surface should first be clean and free from dust and dirt. All rust spots should be wire-brushed or chiseled out and carefully dusted. Do not attempt to paint over rust and expect the paint to do its duty. The rust will go on just the same—often proceeding under the paint until the surface is practically destroyed. Paint should never be applied over damp surfaces. The heat of the sun will withdraw the moisture and cause blistering and peeling of the paint.

Since construction machinery today is usually built of steel, the suitability of the paint for such surfaces is one of the most important considerations. In the main, however, if a paint is purchased for use on steel, it will give equally good service on such parts of the equipment as are made of wood. The same general directions for the preparation of the wood surface should be observed. In the case of machinery subject to high temperatures, like the boilers of steam cranes or shovels, air-compressing machinery, etc., the paint should be able to withstand such conditions. In most instances, such surfaces should be painted with a locomotive black, made for this purpose.

If contractors would bear in mind the fact that painting is cheaper than replacement, and that the money invested in paint and painting is not an expense, but an actual saving, they could do a great deal toward warding off the time when replacement of expensive equipment becomes absolutely necessary. Good paint, applied at frequent intervals will save the surface from decay and destruction. And when you "Save the Surface, You Save All."

National Association of Manufacturers to Hold Convention

The National Association of Manufacturers will hold its twenty-eighth annual convention at the Waldorf-Astoria Hotel, New York, May 14-16. The program will include discussion of such subjects as transportation, construction, production, the open shop, immigration, and taxation.

Koppel Co. Wins Court Appeal

By a decision of the U. S. Circuit Court of Appeals for the Second Circuit, rendered March 14, the Koppel Industrial Car & Equipment Co., Koppel, Pa., is sustained in its complaint against Orenstein & Koppel Aktiengesellschaft, Orenstein & Koppel Co., Ltd., L. E. Hellman and Eric Joseph. The case involves the sales activities in the United States of the latter organizations and individuals following the sale, on Sept. 12, 1918, by the Alien Property Custodian, of the American business and good will, as a going concern, of the German corporation known as Orenstein & Koppel-Arthur Koppel A. G. The sum involved in the transaction was $1,312,000 and after a reorganization the name of the Koppel Industrial Car & Equipment Co. was adopted by the purchasers of the former business.

In 1920, however, the German corporation attempted to reorganize in the United States and recapture the business sold by the Alien Property Custodian. This action brought about the suit under discussion. The Court said: "To permit of the sale of the physical property only would have deprived the purchaser in the instant case of the great value of the good will of the German corporation which had made its business and its growth during the preceding years. . . . The sale was as complete as if it were a voluntary conveyance of its interests in the United States by the German corporation. We think this conveyed to the purchaser the exclusive right to carry on the business in the United States with the right of protection of a court of equity from interference by the German corporation, for if the present interference be permitted, what was conveyed would, in time, be destroyed. Assuming a voluntary sale of its good will and business had been made by the German corporation, would it have been at liberty later to impair the good will by seeking the customers of the buyer and carrying on business using substantially the same trade name and trade symbol as they had heretofore used? We think not."

Featuring of Record Runs Elicits Further Comment

Supplementing the discussion in last week's issue (p. 688) other equipment manufacturers this week state the policies of their organizations.—EDITOR.

By H. S. STROUSE
Advertising Manager,
Pawling & Harnischfeger Co., Milwaukee

WE HAVE never found it desirable to feature record runs. It is difficult to obtain such figures with excavating machinery because every job is performed under different circumstances, and figures which would be applicable on one job would certainly not apply on another. Even where we do have records of contractors who have made unusual amounts of yardage in single shifts, we never publish them because unusual records are discredited by those familiar with excavating.

We have adopted the policy of mentioning only conservative records, for we believe it distinctly bad form to lead the uninitiated into believing in miracles. In one instance during the past year we did mention in our advertising a very unusual stunt that was performed with one of our trenching machines, but this was mentioned more from an engineering point of view than anything else. Any campaign for omitting extravagant statements from advertising of contractor's equipment, will have our hearty support, for we believe that even though exaggerated statements may be nearly true, they have a bad effect.

By JOHN H. GREGORY
Publicity Manager,
Barber-Greene Co., Aurora, Ill.

HIGHWAY construction averages have been increasing yearly. The maximum run of a few years ago is now practically the average run. Sometimes a maximum run means that the contractor has slackened off his regular work for several days in preparation for the big run. Sometimes it means that the job is carried on as usual but that positively everything on the job functions at its best for 10 hours. In either case the records do not mean anything unless accompanied by the general average for the season.

Our policy in advertising or publicity is to base our statements on general averages taken over long periods but at the same time we are not averse to telling that our machines were able to handle all the material for a record run. Unless every condition is given, general averages can be as deceiving as record runs. We believe in giving all data possible in either case.

(To Be Continued Next Week)

New Caution Plate Adopted by Motor Truck Makers

At the Motor Truck Conference held at the headquarters of the National Automobile Chamber of Commerce in New York City recently a new caution plate was adopted as standard. It is an outgrowth of a demand by motor vehicle commissioners for information on which to rate trucks and represents the result of joint action by subcommittees of the Society of Automotive Engineers, the Truck Standards Committee of the National Automobile Chamber of Commerce, and the motor vehicle commissioners of all of the New England States, New York, New Jersey, Pennsylvania, and Maryland. The new plates are $10\frac{1}{2}$ in. long, $3\frac{1}{4}$ in. wide. The information carried by the plates is indicated in the accompanying sample.

Speed ratings also were standardized by the committee and range from 15 miles per hour for a truck of gross weight of 28,000 lb. to 25 miles per hour for a 4,000-lb. gross weight, both on solid rubber tires. For pneumatic tires a maximum speed of 25 miles per hour is allowed for gross weights up to 28,000 lb.

Maximum speed 16 miles per hour. Do not exceed. This vehicle, when tested at the factory, showed a brake capacity which enabled the driver to stop it, when loaded to its stated capacity and when running at its maximum stated speed in 40 feet on a dry, hard level road. NOTE: Chassis weight includes complete chassis, front fenders step, driver's seat, tools, lamps, horn, license brackets, normal quantity of fuel, lubricant and cooling medium; but without driver, body, auxiliary power devices or equipment.

Name and
Address
of
Manufacturer
Made in U.S.A.

Chassis
Number

Caution Overloading or over speeding will void your warranty.

Maximum weights	Lbs.
Chassis (see note)	6,300
Body, load & equip.	8,000
Gross weight	14,300
Front axle (gross)	6,000
Rear axle (gross)	12,000

Body-weight allowances were adopted as follows: 1,200 lb. for a 1- $1\frac{1}{2}$-ton truck; 1,500 lb. for a 2- $2\frac{1}{2}$-ton truck; 2,000 lb. for a 3-4-ton truck; 2,500 lb. for a 5-ton truck.

Standard frame widths of either 36 or 42 in. for all sizes of commercial vehicles were indorsed.

Business Notes

JOHN F. HAVEMYER, JR., has joined the sales force of the Concrete Steel Co., with headquarters in New York City.

ROBERT F. EISSLER, for two years assistant to the vice-president of the Chicago Pneumatic Tool Co., New York, at his own request assumed his former position as district manager at Pittsburgh, effective April 1. Nelson B. Gatch succeeds Mr. Eissler as assistant to the vice-president, with headquarters at New York. William C. Straub became district manager at New York, succeeding Mr. Gatch.

HARVEY B. CHESS, JR., president and treasurer of the Consolidated Expanded Metal Cos., Braddock, Pa., died March 30.

FRED S. MARTIN, for eleven years superintendent of the large industrial motor department, Westinghouse Electric & Manufacturing Co., died recently in Pittsburgh. He was 60 years old and before joining the Westinghouse organization served with the Franklin Foundry & Machine Co., Providence, R. I., the Brown & Sharp Manufacturing Co., Providence, R. I., the Edison General Electric Co., Schenectady, and the R. D. Nuttall Co., Pittsburgh.

ADVANCE MACHINERY & SUPPLY CO., Denver, Colo., announces the closing of a contract with the Board of Water Commissioners of the city and county of Denver for three De Laval centrifugal pumping units, two electrically driven and one steam-turbine driven. The daily capacities are, respectively, 4, 8 and 10 million gal.

H. E. MARKS CORP., Pittsburgh, manufacturer of gypsum roofs, announces the appointment of the American Hard Plaster Co., Utica, N. Y., as exclusive representative in Oneida and Herkimer counties.

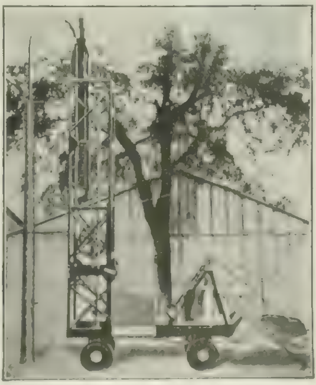
MONARCH TRACTORS. INC., Watertown, Wis., are working on a 24-hr. production schedule. Shifts have been arranged for continuous operation to meet orders on hand.

EDWARD C. WALDVOGEL, general manager, Yale & Towne Manufacturing Co., Stamford, Conn., was elected a vice-president of the corporation, at a meeting March 8 of the board of directors. His title in the future will be vice-president in charge of sales. Mr. Waldvogel has served for 18 years with the company.

Equipment and Materials

New Concrete Pole Machine

For casting concrete poles in place the Blaw-Knox Co., Pittsburgh, is placing on the market a pneumatic mixer rig planned to produce a pole following the same principles of economical design as are used in transmission towers and poles. The method employed it is claimed, allows only the proper amount of steel to be used and the proper amount of concrete to give ample protection to the steel;—the extra reinforcement ordinarily required to make the pole act as a beam while being handled is eliminated.

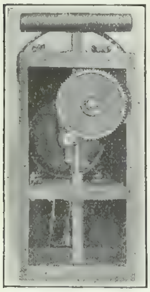


The rig is mounted either on a self propelled or a trailer truck. The mixer is served by a power loader and is operated by a gas engine geared to an air compressor. The arrangement is shown in the accompanying illustration. Concrete is discharged pneumatically from the mixer through a pipe to the top of the tower, whence it passes into a hose which loops around a movable sheave in the tower, thence up to the top head and down into the forms, terminating in a special nozzle which controls the discharge of concrete. When starting concreting this nozzle is at its lowest position, about at ground level, and the movable sheave is at its top position. As soon as discharge starts the movable sheave is power-driven downward, thus keeping the nozzle above the rising concrete. Concrete is discharged with enough force to produce is provided with an extension frame which may be raised or lowered for various heights of pole.

Forms and reinforcement can be erected either in advance of the machine or can be handled from a jib at the top of the tower. The rig can be knocked down and folded up for transport, the overall length in this condition being 25 ft. and the height 12 ft. Poles can be cast to any height up to 45 ft. Provision may be made in the forms for cross-arms, ladder rungs and any other special features.

An Improved Blasting Machine

Reserve capacity to guarantee against failure to fire any electric blasting cap in circuits up to 100 caps is provided in an improved blasting machine, developed during the war and now manufactured for commercial use by the Hercules Powder Co., Wilmington, Del. One of the principal advantages claimed for the new machine is in the generator, which is of a shunt-wound type instead of the series-wound type common in former machines. The new machine utilizes practically all of the energy of the operator during the downward stroke of the handle and the current it delivers into the cap circuit is sustained for a longer period than in the series-wound machine. The generator in the new type delivers 1½ amp. at 300 volts when connected to a circuit of 100 blasting caps in series.



Although the new machine has actually fired as many as 200 electric blasting caps, its capacity is rated at only 50 caps, for experience has shown that it is not advisable to connect more than this number in one series.

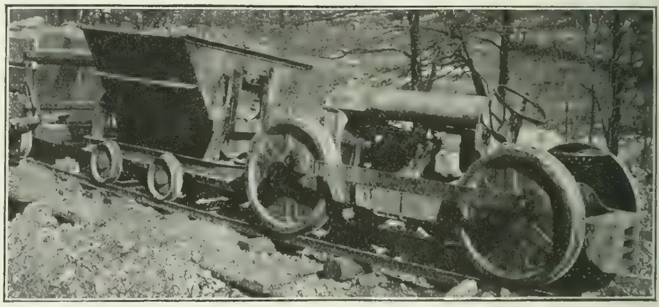
Wall-Board of Sugar Cane Wastes

Bagasse, or sugar-cane waste, is being manufactured into an insulating wall-board called Celotex by the Celotex Products Co., with headquarters at Minneapolis and plant at New Orleans. The product comes in sheets 0.4 in. thick, 4 ft. wide and from 8 to 12 ft. long. It weighs 60 lb. per 100 sq.ft. and can be sawed and applied like lumber directly as sheathing to roofs or as studding both inside and outside. The material is treated to resist the absorption of water.

Strength tests of the material conducted by Robert W. Hunt & Co. showed a favorable comparison with white pine timber. These tests included tensile, transverse and compressive strength, stiffness and nail holding properties.

Attachment Converts Farm Tractor Into Industrial Locomotive

An adaptation of the Fordson tractor to narrow-gage industrial railway haulage is made possible by an attachment manufactured by the Adamson Motor Co., Birmingham, Ala. It consists of a steel locomotive frame with cast-iron bumpers at front and rear, 9 ft. 10 in. in overall length, one-piece steel axles with Hyatt roller bearings, and flanged wheels 33 in. in diameter and with 4-in. treads built to the specifications of the American Railway Association. The wheel base is 74 in. and the gage may be from 36 to 56 in.



The attachment weighs 2½ tons and the locomotive, complete, 3½ tons. There are three speedsforward and one reverse. The brakes are of the automobile type, asbestos-lined and operated with a clutch pedal. On level track the manufacturer claims that the locomotive will haul a gross load of 65 tons in high gear, 70 tons in intermediate, and 158 tons in low gear. The tractor may be set into the locomotive attachment or changed back to its original form in about 3 hr. The Adamson company also manufactures a turntable to be installed at either end of a line of track to enable the tractor to operate on its forward speeds.

Steel Case Batteries Made in Two New Sizes

The National Carbon Co., Inc., Long Island City, N. Y. has announced two new types of Columbia "Hot Shot" batteries of the steel case construction, one of 5 cells in series arranged in two rows giving 7½ volts, and the other of 6 cells in series arranged in two rows giving 9 volts. These two new batteries have the same design and appearance as the Columbia 4-cell, 6-volt unit. With these new types of steel-case batteries it is now possible the company claims, to meet the requirements of practically every dry battery ignition system used on stationary gas engines, motor boats, tractors and construction equipment.

Publications from the Construction Industry

Hoisting Machinery—O. K. CLUTCH & MACHINERY CO., Columbia, Pa., has issued a 16-p. illustrated catalog of its single, double, and triple-drum reversible and non-reversible hoisting machines.

Tar and Asphalt Heaters—LITTLEFORD BROS., Cincinnati, have issued a 19-p. illustrated catalog of their tar and asphalt heaters, paving tools and equipment for contractors and municipalities. The capacity of the kettles range downward from 1,000 gal., for large jobs, 50 gal. for roofing and waterproofing work, and 10 gal. for a highway patrol heater. An oil-burning attachment, instead of a fire box for solid fuel, may be added to any of the company's road maintenance heaters.

Railroad Bridge Waterproofing—MINWAX CO., INC., New York, has issued an installation data folder describing the membrane waterproofing of bridge structures employed by the Chicago & Northwestern R.R. in its track elevation work.

Ventilating Fans—CLARAGE FAN CO., Kalamazoo, Mich., has published a 48-p. illustrated booklet on ventilation and the use of its multiblade fans in city schools, theatres, banks and other public and private buildings. The booklet cinsists largely of illustrations of buildings in which the company's ventilating equipment has been installed.

Colored Concrete—MASTER BUILDERS CO., Cleveland, in a new 12-p. illustrated section of its handbook, describes Colormix, an integral product for coloring, hardening and waterproofing concrete floors. The material is marketed as a paste of about the consistency of white lead, which is dissolved in the mixing water and dyes the sand and cement, thus producing a uniform color throughout the layer and not a thin veneer on top. Colored cement tile employing this new compound are made in regular sizes 6 x 6 in., 6 x 9 in., and 9 x 9 in., and larger. Colormix is supplied in six shades, tile red, linoleum brown, nile green, battleship gray, buff, and white. It is intended for decorative floors in stores, apartment houses, hospitals, schools, hotels, clubs, restaurants, and commercial and industrial buildings.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Bond Sales Gain in Number of Separate Issues

State and municipal bond sales during March totaled $62,038,909, a decrease of $15,370,088 from the February total of $77,408,997, with a still greater falling off as compared with $94,900,878 in January, according to the *Commercial and Financial Chronicle.*

There has been no falling off in the number of separate issues during the last month. The number of municipalities issuing permanent bonds and the number of separate issues during March were 371 and 510, respectively, compared with 471 and 588 for March, 1922.

Of the fifty-three representative issues listed in the accompanying table, seven sold at par, forty-three above and only three below par; the yields ranging from 4.15 to 6.64 per cent.

Rates varied from 4 to 6 per cent; the single 4 per cent issue being in South Carolina and the 6s in Florida, Indiana, California, Porto Rico, North Carolina and Ohio. The only issue drawing 4¼ per cent was sold in New York state, while the 5½s were disposed of in Texas, Ohio, Louisiana, Washington and Utah. Securities drawing 4½ and 5 per cent formed the bulk of the fifty-three disposals and were fairly well distributed throughout the country. The two 4¾s, however, were sold in Ohio and Kentucky.

New Jersey to Issue $8,000,000 Road Bonds This Year

The first step to carry out the provisions of New Jersey's $40,000,000 road bond issue was taken recently by the State Highway Commission when bonds to the extent of $8,000,000 were authorized for issuance. Under the terms of the act, the commission may use no more than $8,000,000 a year for five years. The plan, as outlined by the commission, provides that $4,000,000 be issued about June 20, bearing date as of July 1; $3,000,000 of this amount would be used for actual road construction and the other $1,000,000

REPRESENTATIVE PUBLIC BOND SALES DURING APRIL, 1923

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Indiana.................	....	$1,000,000	4½	97	....	March, 1923	.. .	Northern Trust Co. of Chicago, and others
County								
Athens, O..............	Road improvement	53,000	5	100.508	4.73	Sept. 1, 1923	1924–33	Spitzer, Rorick & Co., Toledo
Brewster, Tex..........	Road	300,000	5½	100.91	. .	Mar. 29, 1923	......	Hall & Hall of Temple, Tex.
Clackamas, Ore.........	Road	246,070	5	100.41	4.72	Mar. 1, 1923	1937–41	Stacy & Braun and John E. Price & Co
Clay Co. Road Dist., Tex....	Road	8,650	5½	100.		....	......	H. C. Burt & Co., Houston
Douglas, Neb...........	Road	400,000	5	108.416	4.27	Oct. 1, 1919	1942–43	P. W. Chapman & Co., Inc., New York
Dubois, Ind............	Highway improvement	59,000	4½	100.	...	Apr. 10, 1923	1924	Dubois Co. State Bank
DuPage, Ill............	Road	600,000	4½	100.41	4.45	May 1, 1923	1924–43	Northern Trust Co., Chicago
Highland, O............	Road	56,000	5	100.468	4.90	Mar. 1, 1923	1924–31	N. S. Hill & Co., Cincinnati
Highlands, Fla.........	Road	525,000	6	101.87	5.82	....	1924–53	Spitzer, Rorick & Co., Toledo
Holmes, O..............	Road	16,650	5½	100.779	5.33	Apr. 1, 1923	1928	Commercial and Savings Bank, Millersburg
Huron, O...............	Road	8,500	5	100.06	4.99	Apr. 1, 1923	1924–32	Tucker and Robison, Toledo
Middlesex, N. J........	Road improvement	239,000	4½	101.433	4.33	Mar. 29, 1923	1925–45	Vanderhoef & Robinson, New York
	General improvement	45,000	4½	100.124	4.47			
	Bridge	42,000	4½	101.392	4.35			
Montgomery, O..........	Bridge	9,000	5½	101.868	5.07	Apr. 1, 1923	1924–32	N. S. Hill & Co., Cincinnati
Pitt, N. C.............	Bridge	100,000	5	102.10	....	Apr. 1, 1923	1928	Title Guarantee & Trust Co., Cincinnati
Pulaski, Ind...........	Ditch	6,440	6	100.	....	Mar. 15, 1923	1924–33	Breed, Elliott & Harrison, Indianapolis
Redwood, Minn..........	Drainage	195,000	4½	100.11	4.49	Apr. 1, 1923	1929–43	Minnesota Loan and Trust Co. Minneapolis
Rush, Ind..............	Road	33,982	5	101.622	4.69	Apr. 1, 1923	1924–33	Rushville Nat. Bank, Rushville
San Joaquin, Calif.....	Reclamation	105,000	6	93.	6.64	Mar. 1, 1923	1939–43	Hunter-Dulin Co., San Francisco
Sevier, Utah...........	Road	120,000	5	102.50	....	....	1934–43	Ashton Jenkins, Salt Lake City
Smith, Tex.............	Road improvement	90,000	5	102.013	....	....	....	Sidney Spitzer & Co., Toledo
Surry, N. C............	Road	150,000	5	102.64	....	....	....	Sidney Spitzer & Co., Toledo
Vanderburgh, Ind.......	Road	22,200	4½	100.	....	....	1924–33	Oliver Edmond of Evansville
Washington, O..........	Road	77,000	5½	101.47	5.19	Mar. 1, 1923	1924–33	W. L. Slayton & Co., Toledo
Township								
Huntington Beach School Dist., Orange Co., Calif.	School	250,000	5	102.31	....	....	....	Security Trust & Savings Bank of Los Angeles.*
Municipality								
Ashland, Ky............	Sewer	80,000 120,000	5 4¾	101.832	4.43	Apr. 2, 1923	1932–37 1942–52	Keane, Higbie & Co., New York
Bexley, O..............	Street improvement	162,540	5½	101.27	....	Apr. 1, 1923	1924–32	Ryan, Bowman & Co., Toledo
Charleston, S. C.......	Sewer	500,000	4	91.94	4.62	Mar. 1, 1923	1963	Peoples National Bank, Charleston
East Cleveland, O......	Street improvement	175,000	5	101.62	4.74	Apr. 1, 1923	1924–36	Guardian Savings and Trust Co., Cleveland
East Providence, R. I..	Highway	105,000	4½	100.364	4.43	May 1, 1923	1924–33	R. I. Hospital Trust Co., Providence
Franklin, Tenn.........	Water-works extension	25,000	5	101.32	4.76	Apr. 1, 1923	1928–32	Williamson Co. Banking & Trust Co., Franklin
Garfield, N. J.........	Water	131,000	5	100	...	Jan. 1, 1923	1924–29	R. M. Grant & Co., Inc., New York
Glastonbury, Conn......	School	175,000	4½	103.265	4.23	Jan. 1, 1923	1924–58	R. M. Grant & Co., Inc., New York
Hagerstown, Md.........	Sewerage system	450,000	4½	103.316	4.34	Apr. 1, 1923	1964–86	Stein Bros. & Boyce and others
	Disposal plant							
Lajas, Porto Rico......	City improvement	116,000	6	109.	5.11	Jan. 1, 1923	1928–51	Provident Savings Bank, Cincinnati
Leavenworth, Kan.......	Street improvement	110,000	5	100.125	....	Dec. 1, 1922	1924–33	Brown-Crummer Co., Wichita
Madison, Wis...........	Sewerage	200,000	4½	100.86	....	Mar. 23, 1923		A. G. Becker & Co., Chicago
Madisonville, La.......	Public improvement	25,000	5½	100	...	Mar. 1, 1923	1924–43	Covington Bank & Trust Co.
Maiden, N. C...........	Street improvement	25,000	6	103.50	5.43	Jan. 1, 1923	1925–37	Geo. McCorkle and Dr. Sterling Ruffin, Washington, N. C.
Marshville, N. C.......	Water	75,000	6	104.56	5.56	Apr. 1, 1923	1926–63	Prudden & Co., Toledo
	Sewer							
Massillon, O...........	Paving	39,482	5	100.869	4.83	Apr. 1, 1923	1924–32	Guardian Savings and Trust Co., Cleveland.
Mayfield, N. Y.........	Pumping system	50,000	5	100.15	4.98	Jan. 4, 1923	1927–51	Sherwood & Merrifield, New York
Muskegon, Mich.........	Storm sewer	35,000	4½	101.042		Mar. 26, 1923	1940–45	Bolger, Mosser and Willaman, Chicago
Newark, N. J...........	Public improvement	685,000	4½	102.261	4.30	Apr. 2, 1923	1924–52	West Side Trust Co., Newark
	Sewer	[illegible]	4½	102.224	4.29	Apr. 2, 1923	[illegible]–63	
	School	985,000	4½	101.134	4.32	Apr. 2, 1923	1924–43	
	Fire apparatus	50,000	4½	100.222	4.42	Apr. 2, 1923	1924–29	
Norwalk, O.............	Street improvement	[illegible]	5	100		[illegible] 1, 1923	1924–31	H. B. Bennett, Toledo
Painesville, O.........	Paving	221,000	5	100.38	4.91	Apr. 1, 1922	1924–32	[illegible] & Co. of New York and others
Rockford, O............	Waterworks	8,500	6	101.59	5.62	Jan. 1, 1923	1924–32	[illegible]
Sandusky, O............	Street improvement	[illegible]	5	100.828	4.84	Mar. 1, 1923	[illegible]	[illegible]
Saratoga Springs, N. Y..	Park	[illegible]	4¼	101.19	4.15	Mar. 1, 1923	1942–44	[illegible], New York
	Waterworks	[illegible]					1931–41	
	Public improvement	14,000					1931–37	
	Bridge	[illegible]					1931–42	
Seattle, Wash..........	Light and power system	2,520,000	5½	103.30	5.15	May 1, 1923	1929–43	[illegible], New York
[illegible], Calif.....	Park	[illegible]	6	101.36	...	Mar. 1, 1923	[illegible]	[illegible]
Springville, Utah......	Water	[illegible]	5½	100.10			1943–53	[illegible]
Toledo, O..............	Bridge repair	[illegible]	4½	100.64	4.44	[illegible] 15, 1923	[illegible]	[illegible] & Co. of Cleveland and others
	Public building	418,000	4½			Mar. 1, 1923	1924–44	
	Sewer	700,000	4½			Jan. 16, 1923	[illegible]	

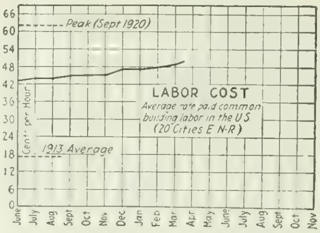
would be reserved for bridge work. The commission would issue a similar amount of bonds next December. The law places a maximum of 30 years for the bonds on road and 15 years for bridge bonds. The money derived from the bonds need not actually be expended during the calendar year for which it is certified.

Common Labor Wage Rate Higher

The wage rate for common labor in the construction industry has returned to the level prevailing in 1920 and the first quarter of 1921, in the New York district. Union building laborers now receive 75c. per hr. for an eight-hour day, as against 60c. in the spring of 1921.

The average rate paid common building labor in the United States, compiled from reports received from twenty important centers, is now about 50c. per hr., or 16 per cent above the rate prevailing in June, 1922.

Present costs as applied to unskilled common labor are now approximately 194 per cent above the 1913 average and 19 per cent below the peak of 1920.



LABOR WAGE RATE CURVE, 1922-23

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of April 5; the next, on May 3.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3 44	$4.20	$4.50	$3.30	+$3.55	+$4 20	+$3.85	$4.10	$3.75
Structural rivets, 100 lb.	4.00	4.85	5.25	3.75	+4.25	5.15	4.75	4.50	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.34	4.10	3.15	3.22½	+3.45	3.85	3.40	4.10	3.50
Steel pipe, black, 2½ to 6 in. lap, discount	51%	52%	45%	59½%	55-5%	38%	38.2@50.2%	45%	32.76
Cast-iron pipe, 6 in. and over, ton	58.50	+58.00	57.00	+58.20	60.50	67.00	60.00	+60.00	60.00
Concreting Material:									
Cement without bags, bbl.	+2.80	3.25	2.25	2.20	2.39	2.85	2.71	2.90	2 68
Gravel, ¾ in., cu.yd.	2.25	1.90	2.25	2.25	1.75	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.00	1.24	+1.90	2.25	1.00	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.50	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	65.00	40.00	53.00	60.00	45.75	42.75	39.00	+31.00	95.00
Lime, finishing, hydrated, ton	16.80@17.10	23.00	22.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1 40	2.50	1.50	1.25	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	13.00	+13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.0893	.115	....	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1314	.0893	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	+1.16	+1.28	+1.35	1.25	+1.34	+1.41	1.34	.86	1.16
Common Labor:									
Common labor, union, hour	.75	.35	....	......	....	.50@.55	.56¼	....	......
Common labor, non-union, hour	....	.30	.30@.50	.72½	.35@.50	.35@.50	.50	.30@.70	.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 81½c.; building laborers, 75c.; minimum for pick and shovel men, 50c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine casing. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.86) Bag charge is 80c per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Reinforcing bars firm at $2.50 per 100 lb., Pittsburgh, with quotations of $2.75, frequently made for prompt deliveries. Plates and shapes remain stronger and higher than bars; minimum price, $2.45, maximum $2 75@$2.85, owing to premiums demanded for spot shipments, due to pressure at the mills. Ship and tank plate consumers and steel fabricators taking bulk of tonnage. Steel structurals up 25c. in Denver, 15c. in San Francisco and 10c. in Minneapolis; bars advanced 12½c. in Denver and 10c. per 100 lb. in Minneapolis, following mill rise.

The Birmingham mill base on 6-in. Class B cast-iron pipe-advanced $2, to the present price of $49 per ton, effective Apr. 9. Atlanta warehouses quote rise of $3, Seattle, $2 and Chicago, $1 per ton, following mill advance.

Cement quoted at $2.80 per bbl., without bags, in New York, against $2.70@$2.80; sand now $1.90 per cu.yd. up from $1.87½ and common brick $13.10 per M., compared with $11.60, delivered to users in Dallas, Texas, one week ago.

Lumber prices show very little change, with the upward trend of the market apparently temporarily checked. Douglas fir timbers (base) $31 in Seattle, against $30 per M. ft. b.m., last week; this represents the only change in lumber prices in nine cities reporting weekly to *Engineering News-Record*.

Seed scarcity causing gradual rise in linseed oil quotations. Raw oil up 2c. in Denver, 3c. in New York, Dallas and Atlanta and 5c. per gal. in Minneapolis.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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A New Start on Society Co-operation

BY ITS vote at the New Orleans meeting, the board of directors of the American Society of Civil Engineers indicated that it did not consider the recent referendum against the Federated American Engineering Societies as a mandate for isolation. The new committee to confer "with other national societies" looking toward engineering co-operation has no instructions other than those it may have absorbed by listening to the discussions of the board, so its future action in large measure depends upon its personnel and the degree of receptiveness with which its approaches to the other societies are met. The committee can hardly fail, however, to make every effort to initiate some scheme of co-operation which will satisfy the many civil engineers who think such co-operation imperative; nor can the directors of the other societies well refuse first to seek out the as yet unexpressed will of their members and then to discuss with the civil engineers the means whereby the mean of the combined wishes of all the engineers of the country can be approached.

Providing for Discussion

FROM a social point of view, last week's New Orleans meeting of the American Society was a distinct success. The good people of New Orleans were the best of hosts, the trees were green and the skies blue and the Mississippi obliged with a near flood which showed all the potentialities of high water with none of its dangers. No one who went but who would go again, given the leisure and the money. But as a technical meeting it fell a good way short of what these sectional meetings may some time become. Possibly the main function of these meetings is to introduce the members frequently to various parts of the country and, what is more important, introduce the scattered membership to the society as a working actuality. The New Orleans meeting did both these things most successfully. But after all the society is a technical body and the opportunity for technical discussion afforded by the presence of many distributed members should not be lost, as it was lost from lack of time or preparation at New Orleans. No one can spend a few days in the lower valley without realizing how controversial a subject has become the question of river control but no one would have learned it at the meetings. They consisted of calm presentation of some facts and a few arguments, none of which were given with any reference to those who held opposing views. It was hard to escape the conviction that the proceedings were altogether too dignified. A good open floor fight might have enlightened all the hearers, brought forth useful information and revealed states of mind. The written discussions may do all of these things for a much larger audience but if it is not worth while or feasible fully to enlighten the attendant at a meeting, is it worth while only partly to enlighten him? Either the technical side of the sectional meetings should be left out altogether or some preparation and allocation of time should be made for free discussion. When the technical divisions get to functioning there will doubtless come the kind of planning and the concentration of interest which is necessary for a successful floor discussion, and then the quarterly meetings will become what they already promise—the most forward step in the society's recent history.

The Right Method of Attack

ALARMED by the increasing number of automobile accidents at grade crossings, thoughtful people are casting about for some means of preventing such accidents. Snap judgment would dictate entire elimination of the grade crossings as an answer to the question, but entire elimination would bankrupt the railroads and throw too great a burden on the taxpayer. The alternative then is to improve the crossings and provide them with adequate protection. The problem of providing such protection must be tackled by both the railway and the highway authorities and must be tackled quickly. To do it quickly and with the least expense will require co-operation, not conflict, among the parties concerned. New Jersey has grasped this idea. This issue reports a conference of railroad officials, state and county highway authorities and the state regulatory board, at which conference the problem was outlined, an ultimate goal set, and a definite step taken toward reaching that goal.

Sound Sense as to Publicity

LIKE a breath of fresh air in a close room comes the report of the publicity committee of the Iowa Engineering Society, abstracted elsewhere in this issue. We offer our compliments to the framers of this report. It is a gratifying reminder that all engineers have not been stampeded from their traditional good judgment and their respect for sound reason and the realities. The reliance of so many engineers upon publicity as a "magic automatic elevator"—to quote the committee—and their readiness to accept the press agent as the "elevator man" has been pathetic. And even more pathetic and inexplicable has been the readiness of some who should know better to invoke in behalf of their profession the ethics and the practices we have come to expect in connection with the promotion activities of the stage, the screen and the legislative lobby. So great a capacity for self-deception and self-justification is not what we have been taught to expect from the engineer. Mr. Schlick's committee does well also to point out that, while the societies may guide or supplement individual effort, they cannot take its place in building up public respect for the profession. When the public has a satisfactory experience with one engineer as a fellow citizen it is inclined to think well of engineers in general; when it sees one engineer achieve leadership in his community it is inclined to look upon the engineer in the abstract as having the stuff of which leaders are made. The committee is on sound ground also when it expresses its belief that some of the qualities of leadership, now potential in engineers as a class, must be developed and strengthened before they will be ready to play their full part in public affairs. That development can come mainly through development of the individual, and that in turn can come best through his individual participation in public affairs as a citizen possessing peculiar abilities to be of service to his fellows.

Private Bridge Enterprise

WITH THE conclusion of arrangements for financing and starting actual construction on the Anthony's Nose-Bear Mountain bridge over the Hudson River, as announced during the past week, private enterprise again enters the field in which it played an important part generations ago. Toll-bridge construction is likely to become a prominent factor in the highway field during the next decade or more. The needs of the day call for it, and with wise regulation it should be in all respects sound and favorable to the development of the community. More than once during the past two or three years *Engineering News-Record* has advocated construction of main bridges over large water barriers by private enterprise as the only available method of providing much needed links of communication across barriers that now isolate large and flourishing regions from each other. The case of these major crossings differs fundamentally from that of the ordinary highway bridge across a small stream. Small bridges are built wherever any highway encounters a stream, while at major streams the one or two most desirable crossings out of a hundred possible ones must be selected, as it is financially impracticable to build all. Distributing the cost of minor bridges over the entire tax roll is equitable and avoids the impossible burden upon traffic of toll collections at bridges; but the cost of large crossings is apt to burden the tax roll with an inordinately large item which is of advantage to a limited number of users, while on the other hand toll collection at such points is not burdensome to traffic. Private enterprise, in other words, tends to assure the construction of that crossing which is most desired by the traffic and places the cost upon the traffic that demands its construction. It has still another advantage: Since the mounting burden of public expenditures renders quite impossible for the present any general policy of constructing large highway bridges by public moneys, we must either do without these badly needed crossings or build them with private money on the toll basis. For these reasons we believe that the efficient development of our highway traffic system will be furthered by extension of the tendency indicated by the Anthony's Nose project.

Two O'Shaughnessy Dams

THE six million dollar concrete dam, 341 ft. high, which has just been completed on the Hetch Hetchy project, has been named O'Shaughnessy Dam in honor of M. M. O'Shaughnessy, city engineer of San Francisco, who has been more closely identified with the project as a whole and with this structure in particular than has any other individual. The Board of Supervisors of San Francisco officially named the structure on the suggestion of the local chapter of the American Association of Engineers, despite Mr. O'Shaughnessy's comment that it is not good policy to erect monuments to a man who is still living because before he dies he may do something to change public sentiment. It is appropriate that Mr. O'Shaughnessy should be honored for the great part he has played in consummating the Hetch Hetchy project. The obstacles and opposition that had to be overcome presented more difficulties and worries than all the construction work thus far accomplished by Mr. O'Shaughnessy, who has borne the brunt of all Hetch Hetchy battles for ten years past. Deserving of honor for this work as is M. M. O'Shaughnessy, it is a pity that the engineers and city authorities of San Francisco responsible for the action mentioned above, were unaware, as it is only fair to assume they were, of the fact that two years ago the city authorities of Columbus, Ohio, honored the memory of Jerry O'Shaughnessy by designating as the O'Shaughnessy Dam the new water-works dam for that city—as a correspondent states elsewhere in this issue. Thus, unless San Francisco finds some other way of honoring M. M. O'Shaughnessy, confusion will result from the use of identical names for two water-works dams. Moreover, the notable structure which M. M. O'Shaughnessy has so ably promoted and built has been recorded for a dozen years or so, both in engineering and more general literature, as the Hetch Hetchy Dam, a fact that will make for much confusion in connection with so notable an engineering structure.

The D. & H. Celebration

CENTENNIAL celebrations of privately conducted enterprises are decidedly rare in this country. The celebration of its centenary, therefore, by the Delaware & Hudson Co. this week is an event that prompts reflection not only upon transportation progress and its influence on national development, but on the maturing character on our industrial organization. To the first of these topics, transportation, the speakers at the gala dinner in New York naturally gave chief attention. The main theme that ran through the addresses deserves repetition—indeed, cannot be too often repeated: that efficient transportation, pushed aggressively ahead of industrial and agricultural development, is just as necessary for the maintenance of our prosperity and our national welfare today as it was for the welding together of our nation and the encouragement of its growth in the last century. The health of our railroads, in particular, must be a matter of national concern, of national education. The man in the street must be made to understand it; otherwise we may expect only the destructive action at Washington and in state legislatures. The obligation of engineers, contractors, manufacturers to think soundly on railway legislation and regulation, to furnish what leadership they can, is apparent. * * * The maturing character—or at least maturing age—of our industrial development is apt to be forgotten. True, our industry, by and large, is still youthful. But there are some lusty old fellows among us, when individual organizations begin to celebrate their centenaries. It indicates that we have, even though it be unconscious, some business traditions. The meteoric character of the new often blots out the substantiality of the old. Young industries rise and often fall, and their fall is due to the neglect of the lessons which our maturer industries could have taught them. We need to acquire a higher regard for the principles which these industries have worked out. Greater business stability would result.

Concrete Road Maintenance

METHODS and costs of concrete road maintenance are presented somewhat completely in two articles in this issue. Although practice in only one state is explained this state was the pioneer in building in large mileages the type of paved road that is now ascendant in most states. For over a decade pilgrimages have been made to the concrete roads of Wayne County. It is not as an isolated example, therefore, that one must consider Michigan practice, but as an embodiment of the latest experience and the best technique in keeping up concrete paved highways. This understanding is necessary to full appreciation of the articles being considered.

Demanding first notice are the figures of cost—particularly those given for Wayne County. It is rare that well segregated costs of upkeep and a careful census of traffic are co-ordinated as they are in these records to furnish values in terms of service. The roads considered have representative variety—some of them are modern and some old and of a structure now regarded inferior; some of them carry a moderate traffic and some an exceedingly heavy traffic. About as low and also about as high maintenance costs as concrete pavements in ordinary highway service may ever be expected to show are represented by the figures given. In view of these facts the assertion in the article that concrete road upkeep does not exceed the rates—2 to 4 per cent—of upkeep on well maintained buildings, is worth keeping in mind.

While the demonstration is clear that the cost of maintaining concrete roads is not extravagant in comparison with the cost of keeping up working structures of other sorts it is quite as clear that the concrete road is annually a mounting expense. It is plain too that unless we consider service, annual costs have no great constructive significance. The traffic census is a necessary accessory of maintenance cost determinations. Also to contribute most it must give more than vehicle mileages; it must give ton mileages. These are not new ideas but they are given emphasis anew by the maintenance cost records of 1922 in Wayne County.

With the aggregation of large mileages of concrete roads in limited areas, as in Wayne County (Detroit), Milwaukee County (Milwaukee), Cook County (Chicago) and other centers of population, there is portended a change in maintenance methods. The small gang with its individual little outfit for filling cracks and making patches will be replaced by central mixing plants both for concrete and bituminous materials supplying larger gangs outfitted with tank trucks or, in case of concrete patching, with trucks equipped for wet batch haulage. Both articles published in this issue give interesting examples of this departure in practice.

A question which naturally arises is: How is the central mixing plant to be co-ordinated with maintenance by patrol? Extension of special gang maintenance to these at present occasional conditions of mileage concentration is one possibility. Another is to have a common central supply plant for a group of contiguous patrol sections. There are too many factors to be considered to attempt any decision here, but a decision will be called for as situations develop where groups of roads offer opportunities for economy by central plant service.

In the family of highway activities maintenance has been the little sister in the cut-down skirts. After appropriations for construction, maintenance has been fitted out with what remained. This condition prevails in practically every state which has not a generation of improved roads. It is now beginning to be remedied and it follows that some of the best thinking of highway engineers is being done in maintenance.

How Can We Stop Duplication of Orders?

THE BUILDING industry is suffering from duplication of orders. To insure the receipt of materials, contractors and dealers, fearing a shortage, are ordering double and treble the quantities they will actually require. The result may be, before long, serious "apparent" shortage of materials, with consequent additional price increases. Thus there will be further discouragement to building to the detriment of the public and of the construction industry.

But it is not only the consumer of building materials that suffers. The manufacturer also is a victim. If he takes the full face of orders as *bona fide*, he is now believing that he is well sold up for the season. Nevertheless, when the expected time of heavy shipments arrives he will probably receive heavy cancellations with the result that his piled up stocks, carried usually with the assistance of bank loans, will be left on his hands.

Both consumer and producer, therefore, suffer from present practice. What is the remedy?

The seat of the trouble lies in the form of order for the purchase of many building materials and in the accompanying trade practice. This form of order is called a "contract," though in its use it is a travesty on that respected form of legal document. A contract implies mutual advantage or concession. In the alleged "contract" for buying building materials the manufacturer guarantees not to raise the price. That should be sufficient concession from him; that is the advantage which he surrenders to the purchaser. But on top of that he guarantees to give the purchaser the lower price in case the market declines and then—concession of concessions—in actual practice permits the purchaser to cancel without any penalty whatever.

In return for these concessions, what does the purchaser agree to do? Absolutely nothing. He is protected in price against both rise and decline. Under trade practice he may cancel if he wishes. The advantages are his; the risks are the producer's. There is no mutuality. The "contract" in fact, is not a contract; it is an option, giving all advantage to the buyer and imposing, as the trade construes it, no obligation.

Mutuality would certainly demand that the intending purchaser, in return for price protection, should guarantee to take the material in accordance with the terms of the order or incur a financial penalty for cancellation.

In other words, a non-cancellable form of contract, or one carrying financial penalty for cancellation, would be a contract in the true sense—in that it would impose reciprocal obligations. It would hold forth definite advantage to the buyer; it would insure the producer against cancellation.

At this very time, everyone in the construction industry is fearful that rising costs will start a serious retarding movement in construction. It is an opportune time for the industry as a whole to eliminate features that encourage inflation. A good start would be made by adopting a fair materials purchase contract—a contract that would be in reality a contract, in which both parties would have obligations and advantages.

Concrete Road Maintenance Methods and Tools

Crack Filling Processes—Materials for Filling Joints—Patching Tools and Procedure—Central Mixing Plants—Resurfacing and Widening Methods—Costs

By G. C. Dillman
Deputy Commissioner, Michigan State Highway Department,
Lansing, Mich.

State road maintenance through county organizations is the practice in Michigan. Some of the counties, a notable example being Wayne County in which is the city of Detroit, have large mileages of concrete road and liberal appropriations for their maintenance and practices have been highly perfected. The author of this article as deputy commissioner in charge of state maintenance has direct knowledge of these practices and has summarized their outstanding features. His consideration includes not only the normal tasks of filling cracks and joints and patching breaks, but also resurfacing, widening and marking. It is perhaps the best presentation recently published of strictly modern methods and equipment for concrete road maintenance.—Editor.

Cracks in a concrete pavement do not necessarily indicate failure. However, all joints and cracks should be filled. Should they be neglected for a considerable length of time there will follow spalling of the concrete next to the opening. Continued neglect will result in water entering through the crack to the subgrade and a depression across the pavement follows. Concrete pavements, therefore, must be patrolled. The repair men should go over concrete roads at least every three to six months when the traffic is comparatively light and every month if the pavement has been built for some years and is carrying a traffic of 5,000 or more vehicles per day.

Repairing Cracks—In making repairs, cracks and construction joints should first be swept out with wire or stiff fiber brooms. If the pavement is old, there may be loose tar or asphalt filler that is of no further value. This should all be hooked out and the crack then swept before refilling. Instead of an ordinary pouring can a conical shaped can is recommended; it has these advantages: (1) Absolute control over material; (2) Wind cannot disturb; (3) Amount of material used is reduced and (4) The workmanship is better.

The conical shaped pouring can should have a capacity of about 2½ gal., and be provided with a wire shut-off, the wire extending up through the closed top. A wooden handle should be attached to the top and to the bottom should be securely fastened a cast-iron tip or shoe. The can must have an opening in the side near the top through which it may be filled. In operation it is filled with the heated tar or asphalt and then moved along the crack or joint at such a rate that, with the flow of material regulated by means of the shut-off, the crevice is completely filled and no more. Dry sand, preferably sharp and coarse, is then cast on the hot material so traffic will not pick it up. Should the concrete next to a crack or joint be chipped to the extent that there is an appreciable depression, the filler should be allowed to spread out to fill the low place and then be covered with granite chips ranging from ¼ to ½ in.

Slight depressions caused by the action of traffic or defective spots in the pavement containing lumps of clay, unsound or soft aggregate or perhaps sticks, are repaired by a thorough cleaning, the application of bituminous material and a covering of granite chips or their equivalent, care being taken to use no more material than is required to bring the patch flush with the surrounding surface. When defective places of any considerable size or depth less than the thickness of the pavement slab are to be repaired, the edges should be cut down until they are vertical. After thoroughly cleaning the hole it should be painted with tar or asphalt after which it is filled with clean hard stone of suitable size—the stone keyed in by tamping if the hole is of some depth—and grouted with tar or asphalt virtually making a penetration patch. The surface of the patch should be covered with clean pea gravel or stone chips. The bituminous material used for this purpose should be the same as that used in the construction of bituminous or penetration macadam. A cold mix of small stone and suitable bituminous material may also be used successfully.

Joint Fillers—The joint filler should be a bituminous material that does not get too soft during the summer or too hard and brittle during the winter. Most tar fillers now in the market and intended for year-around use have this fault and after watching results in many sections of Michigan, it has been decided to do away with the purchase of any joint fillers by trade name. Road officials should specify the material to be used and through proper laboratory control see that it is secured.

Tar joint fillers used in Michigan have a softening point (cube in water method) ranging from 90 to 100 deg. F. for the softer fillers and 105 to 110 deg. F. for the heavier ones. A filler meeting the lower limit for softening point will not last for any length of time because it will work down through a crack or joint and if not may pick up in warm weather. A filler meeting the higher limit will become too brittle during the winter months and may chip to the extent that the crack will not remain water proof as long as it should.

To meet the needs for a tar filler that is satisfactory the following specification is recommended for use throughout the year for such a climate as is had in Michigan:

The refined tar shall be homogeneous and free from water and shall meet the following requirements:

1. Specific gravity 25 deg. C.—25 deg. C. 1.20 to 1.28.
2. Softening point 35 deg. C. to 41 deg. C. (95 deg. F. to 105 deg. F.)
3. Total distillate by weight.
   To 170 deg. C. not over 1.0 per cent.
   To 270 deg. C. not over 12.0 per cent.
   To 300 deg. C. not over 20.0 per cent.
4. Softening point of residue from (3) not over 75 deg. C.
5. Total bitumen 80 per cent to 95 per cent.

Asphaltic joint filler has not had very general use although it is quite generally recognized that blown asphalt is desirable for this purpose. The blowing process imparts certain desirable characteristics that cannot be secured in any other way, chief among them being the change to a more or less rubbery product. The blowing process is in quite general use by manufacturers of asphalt products and it should work no hardship if blown asphalt is specified. On account of the characteristics of this material, it will not become unduly soft during the summer months and does not become brittle except possibly for a slight depth at the surface during the winter.

An asphaltic joint filler such as referred to is on par with a tar filler. It should meet the following specifications which are the Bureau of Public Roads' specifications P. A. F.-1 with exception that blown asphalt is specified:

The oil asphalt shall be *partially blown*, homogeneous, free from water, and shall meet the following requirements:

1. Specific gravity 25 deg. C—25 deg. C. not less than 0.980.
2. Flash point not less than 200 deg. C.
3. Softening point not less than 80 deg. C.
4. Ductility at 25 deg. C. not less than 2.
5. Penetration at 25 deg. C. 100 g., 5 sec., 30 to 50.
   Penetration at 0 deg. C. 200 g., 1 min., not less than 20.
6. Loss at 163 deg. C. 5 hours not more than 1.0 per cent.
   Penetration of residue at 25 deg. C. 100 g., 5 sec., not less than 20.
7. Total bitumen (soluble in carbon disulphide) not less than 99.5 per cent.
   (a) Organic matter insoluble not more than 0.2 per cent.

Uneven Joints—Uneven joints are caused by faulty construction. Either the expansion joint was not vertical, allowing one concrete slab to push above the adjoining slab when the concrete expanded or the surface was not properly finished at the joint and should be cut down. In case one slab has heaved above the other and will not settle back into its proper place in a short time, the concrete on the high side should be cut out from 8 to 12 in. back from the joint and for the full width of the pavement. The face of each slab should then be made vertical and the opening refilled with concrete.

Breaking up Concrete—Until quite recently the removal of broken sections of concrete when making repairs or cutting through a concrete pavement in order to do certain underground work was considered difficult and unduly expensive and was undertaken only as a last resort. With recent development in the use of compressed air operated machines for making pavement cuts, this type of work has become simplified; time and labor saved with a resulting saving in money, and much better control over the work secured than by hand methods.

The "paving breaker" is a one-man outfit. It is nonrotating in action and operates on the same principle as the hammer drill. Shanked steels with moil or chisel bits are used to break up the concrete. The concrete to be taken out is first outlined with chalk, then the moil point is driven into the concrete several times at an angle until a hole is made. It is then enlarged to conform to the chalk outline and the edges of the opening are made vertical by means of the chisel bit. If a portion of the subgrade is to be removed and is of clay or shale, it can be very easily loosened by driving the moil into it a few times in a lifting position.

Two paving breakers may be operated by compressed air furnished by a portable gasoline driven compressor. For general use the complete outfit should be mounted on a truck or trailer so it can be quickly transported from place to place.

Hammers have also been built on the rear of motor trucks. The hammers should weight from 800 to 1,000 lb. and in the center of the hitting face should be fixed a tool-steel point. This device is very effective and efficient for cutting out a strip of concrete along the edge of an existing pavement but is not as practical as a paving breaker which gives absolute control of the location of the break in the slab.

Repairing Holes—After removing the broken concrete the sides of the pavement still in place should be squared up leaving vertical edges as regular as possible. Then dig out the soft subgrade to solid ground or perhaps to an old road bed. This will generally be of sufficient depth for the old broken concrete to be placed in the bottom and provide for about 8 in. of new pavement above the old concrete. Any accumulation of water should first be removed. Only one layer of the broken concrete should be placed in the bottom and the pieces not too close together because the concrete to be placed should surround the broken pieces, otherwise a more or less porous base may be obtained when the new concrete is poured. The slab intact should be undermined about 4 in. to provide a supporting shelf or footing.

It is well when practicable to cut bleeders through the shoulders of the road and fill with stone, coarse gravel or small pieces of broken concrete in order to give proper drainage to the subgrade under the patch. This is especially important when the subgrade is a very retentive soil.

The mix used in making these patches should be 1 part cement, ½ sand and 3 gravel or crushed stone. The concrete should be dense and well spaded. Care must be taken to strike off and finish the surface of the patch so that it will conform with the general contour of the pavement surface surrounding it. The new concrete should be covered with earth and kept well damped for a few days after being placed. Unless an accelerator is added to the mix, the patch should be closed to traffic for two weeks and after it is thoroughly cured and under traffic for some time, the edges should be treated with bituminous filler to prevent chipping.

Central Mixing Plants—When there is a considerable mileage of concrete surface requiring extensive patching, a central mixing plant should be installed for the following reasons: (1) The mixing operations are removed from the road grade, thus reducing confusion to traffic; (2) stock piles of materials and loaded trucks are not taking up part of the roadway; and (3) the method is more economical.

When considering the location of a central mixing plant, the cost of delivering raw materials to the plant must be balanced against the cost of delivering the concrete to the road to be repaired. During the past summer approximately 5,000 sq.yd. of concrete pavement was repaired on the Dixie Highway in Monroe County, Michigan. The way this work was carried out, because of the volume of work done and because it was one of the first successful central mixing plant operations in repairing concrete surfaces on country roads, deserves description.

The mixing plant consisted of a two-bag mixer placed on the ground level. Adjacent to the mixer was erected a portable steel building for storing cement. The building had a capacity of two cars. The operation of the mixer required one mixer man, one cement man and two to four wheelbarrow men depending on the haul. The concrete was transported from the mixer in Ford trucks with high speed gears and the trucks carried slightly less than ¾ cu.yd. of mixed material and traveled on the extreme hauls at about 30 miles per hour. The minimum amount of patching was done at the north end of the road, which was the extreme haul of about ten miles, and the material was delivered from the mixer to the place to be patched in about 24 minutes. There was no evidence of initial setting or segregation of material and in all respects the transportation of the concrete was successful.

In 1923 a more elaborate central plant will be installed by erecting a bin and using a clam to fill it. A proportioning box will be built and the mixer skip will be filled directly from this box. This will eliminate two and possibly three men at the plant, make the work easier and speed up the patching operation considerably. Incidentally the reason for such extensive patching on the road named was that the road was constructed during the latter days of the World War when traffic demanded a paved surface which had to be constructed under unfavorable conditions.

Accelerated Setting of Concrete—During the summer of 1922, calcium chloride was quite extensively used when making concrete repairs. From 2½ to 3 lb. of calcium chloride to the sack of cement was incorporated in the mix. By doing this a section of pavement that has been patched may be safely opened to traffic in a week and in some cases the patches have taken traffic in four days without any apparent harm being done. The use of such an accelerator is of great value in maintenance work of this nature because of the added convenience to traffic and the short time it is necessary to maintain barricades and lights and detours.

Resurfacing and Widening—Some of the first concrete roads built are not adequate in width for present traffic and occasionally the surface appears to have worn down considerably. Investigation has proved, however, that the wear is only slight even though the road carries a great volume of traffic. The depreciation is due largely to cracking, spalling at the joints and uneven wearing, and any one or a combination of them may necessitate rather extensive work.

A few sections of old concrete roads have been resurfaced with a layer of concrete not less than 3 in. and running to 4 or 5 in. in thickness, the layer being properly reinforced. Although this type of reconstruction has been fairly successful, it cannot be recommended on account of the high cost. A better method would be to widen the existing pavement, if in reasonably good condition, by putting in a strip of concrete at least 2 ft. wide on each side with a curb 6 in. wide and deep enough to take a hot mix bituminous top. This is a problem in reconstruction and will not be discussed.

It is entirely practicable to widen concrete pavements by placing a strip of concrete on one or both sides of an existing slab. Ordinarily there is sufficient shoulder width to widen from 3 to 5 ft. on a side. Care must be taken that the new subgrade is sufficiently solid to support the comparatively narrow strip of pavement. It is best to lower the new subgrade 2 in. below the bottom of the pavement in place and to excavate 4 to 6 in. underneath the old concrete to give it additional strength at the edges.

If the pavement to be widened was rounded off at the edge when built as was sometimes the case, it is necessary to break or cut off this rounded portion to allow for a proper junction with the new concrete. This may be done quite readily with 16-lb. hammers, the laborers working to a chalked line 6 to 8 in. from the edge of the old pavement. Several miles of narrow pavement in Michigan have been widened to 18 and 20 ft. during the past three years and were it not for the longitudinal joints between the old and new sections, the widening would scarcely be noticed.

Surface Treatment—Occasionally a concrete pavement becomes somewhat rough due to excessive cracking or uneven wear of the surface caused by aggregates that are inferior and wear unevenly. Such pavements are sometimes maintained temporarily by surface treatment with a proper grade of refined tar. There is difficulty, however, in securing sufficient adhesion between the bituminous surface and the concrete. Then its initial cost together with the necessity for continuous maintenance throws this particular type of work out of consideration as a general thing. In no case should an attempt be made to put a thin bituminous surface on a new concrete road because it is quite certain to result in a failure.

Before treating an old surface, all cracks, joints and depressions must be repaired as previously outlined. It is important that the surface be thoroughly dry and properly cleaned before application of the tar. Refined tar to be used for this purpose should be applied hot at the rate of about ½ gal. per square yard, the quality of material being similar to that used for hot treatments on water-bound macadam surfaces. Immediately upon application, cover it uniformly with clean, dry stone chips or pea gravel spread fan-wise with shovels. Care must be exercised that only enough top dressing is added to take up any excess tar and be incorporated into the surface. If warm weather follows soon after the work is done, the surface may bleed somewhat in places. If so, additional chips or pea gravel should be immediately added otherwise traffic will probably pick up the free tar which will result in a partial failure of the treatment. Such a treatment as this will automatically seal over all cracks and joints, yet the seal coat, which should not exceed ¼ to ⅜ in. in thickness, has very little if any, cushioning value. The only valid reason for such a treatment is to smooth up somewhat a concrete surface that has become rough as already stated.

Shoulder Maintenance—It is very common to find ruts in the road shoulders next to the pavement. Unless these ruts are properly taken care of they may become dangerous to traffic and allow water to work underneath the pavement. These ruts form most readily in soil which quickly saturates and hence softens, permitting water to cut deep, especially on steep grades where drivers of horse drawn vehicles use the earth shoulder as a brake by permitting two wheels of their wagon to run off the pavement.

This particular defect should be given the closest attention and if the road is heavily traveled, it is well to construct a strip of macadam or place a few inches of gravel next to the pavement. Many accidents are due to the wheels of a fast moving vehicle being suddenly turned onto a soft shoulder, possibly low and rutted, hence it is of prime importance that the shoulders next to the concrete surface be maintained at the proper height and made substantial enough to support traffic that may be diverted onto them.

Pavement Marking—During the past two years, the practice of marking rural as well as city and village pavements, has become common. Lines from 4 to 6 in.

in width should be painted down the center of pavements to provide lanes, thus serving to divide and direct traffic. This should be done at least around curves, preceding bridges and narrow places in the road on approaches to hills or at any place where there is danger of overlapping traffic.

Costs—Consideration of maintenance costs should take into account the traffic a road is carrying, that is, the vehicle-mile or ton-mile unit of cost should be determined. Such determinations, however, can be made only after a rather complete traffic census has been carried out.

During the past three years in Michigan traffic surveys have been made and in a short time it is hoped to determine, reasonably close, the cost per vehicle-mile to maintain all types of roads on our trunk line system.

A considerable mileage of what might be termed "pioneer" concrete road construction was carried out in Michigan and on account of unforeseen traffic conditions we now have, the maintenance of these first built pavements is comparatively high.

A study of our 1921 maintenance costs on trunk line concrete pavements (eliminating a few miles built during latter days of the World War and a few miles of early construction that should really have been rebuilt rather than maintained in existing condition) reveals the fact that the average maintenance cost per mile for the pavement slab was $365 and $255 per mile for work on the grade including small bridge and culvert repairs and replacements, making a total of $620 per mile. Charges for supervision, markers and signs and snow removal are not included in the above costs.

As the mileage of this type of pavement increases, it is believed that the average slab maintenance cost will decrease, due to better and heavier construction. In a general way it may be said that for a 16- to 20-ft. concrete road well built, it will cost in the neighborhood of $50 per mile annually for filling cracks and joints and a total annual slab maintenance of from $100 to $400 per mile, depending on the amount of traffic.

Zoning and Pavements Paramount in Choice of Convention Topics

In order that an attractive program might be prepared for the Convention of the League of California Municipalities to be held at Coronado next September, ballots containing a tentative list of subjects for discussion were sent to city officials throughout the state requesting them to mark their first, second and third choices. When replies had been received from 90 cities the ballots were tallied, the first choice vote being counted as one, the second choice as two thirds of a vote and the third choice as one third of a vote. The resultant tabulation as published by the League is as follows:

27	Zoning—classifying districts, changing
17⅔	Pavements—grading, materials, cleaning, repairing
16⅔	Business Licenses—desirability of, limitation
16	Sewer Systems—materials, cleaning, disposal method
15	Building Codes—fire limits, removing dilapidated buildings
11⅔	Garbage—segregation, collection, disposal
11⅓	Public Spirit—how to arouse, civic organization
10⅓	Street Lighting—most efficient methods, standards
[illegible]	Traffic Problems—street cars, buses, automobiles
7⅓	Budget System—provisions of
7	Parks and Playgrounds—apparatus, fencing, swimming pools
4⅔	Pension Systems—equitable tables, rights of pensioner
4⅓	Fire Protection—alarm systems, apparatus
4⅓	Public Officials and the Press—commendation, condemnation
3	Street Ornamentation—parking spaces, trees, street [illegible]
2⅔	Social Service—health centers, relief to needy, etc.
2⅓	Purchasing Agents—powers and duties
2⅓	Liability Insurance—state or municipal
1⅔	Billboard Regulation—prohibition, regulation
1⅓	Municipal Markets—limitations and management

Maintenance Methods and Costs on Wayne County Roads

Heated Tanks on Trailers Carry Tar Filler for Day's Operations—Hardeners Mixed With Concrete for Patching

By Leroy C. Smith
Engineer Manager, County Road Commissioners, Wayne County, Michigan

Extracts from a paper read at the annual Michigan Conference on Highway Engineering, Feb. 14, 1923, at the University of Michigan.

IT IS usual to figure maintenance and depreciation on a building at the rate of 2 to 4 per cent annually. I have no knowledge of any concrete pavement costing a greater amount for maintenance. Roads built ten years ago, with a maximum thickness of 6-in., before better practice had been established, required the greatest expenditure. Maintenance costs are also directly in proportion to the intensity of traffic and the weights of the loads. These facts are clearly indicated by the accompanying tabulation of maintenance costs for 1922 of concrete pavements in Wayne County, Michigan.

MAINTENANCE COSTS FOR 1922 OF CEMENT-CONCRETE PAVEMENTS FOR VARIOUS ROADS IN WAYNE COUNTY, MICHIGAN*

Name of Road	Length, Miles	Average Age	Cost of Tarring	Cost of Concrete Patching	Cost per Mile	Average Traffic Per Day	Cost per Vehicle-Mile
Huron River Drive	25 5	8	$759	$1,016	$69	414	$0 00084
Warren Avenue	22.0	3	2,261	1,413	167	1,398	0 00060
Seven-mile Road	31.1	7	3,586	9,523	422	1,482	0 00140
Mack Avenue	7.5	6	284	673	127	2,040	0 00031
River Road	12.5	11	3,860	2,707	525	3,930	0 00067
Michigan Avenue	20 7	11	5,779	4,760	509	4,812	0 00052
Gratiot Avenue	4.3	7	1,136	849	462	5,200	0 00044

* Notes: These figures are based on a 14-hour traffic count per day. Calculations are based upon a 200-day year. Cost per mile does not include maintenance of shoulders, ditches, guard rails and culverts.

As will be noted, thoroughfares upon which there should be 60-ft. pavements, lowered to city grades, with underdrainage, are still being maintained as 16 and 18 ft. concrete roads, none of them more than 6 in. thick. These roads are now carrying traffic of from 5,000 to 10,000 vehicles per day.

Maintenance of concrete pavement involves the tarring or asphalting of cracks and joints, and concrete patching where a considerable area of the pavement is broken down.

Repairing cracks and joints—Three or four times a year it is necessary to apply small quantities of tar or asphalt to the cracks, joints and small abrasions in the surface of the pavement. Central yards are established in convenient locations to supply materials for maintaining 100 to 150 miles of concrete road. These yards are situated adjacent to railroad sidings, so that tar may be purchased in tank-car lots. From the tank-cars it is pumped, or blown by air, into elevated storage tanks of 15,000 gal. capacity. These tanks are provided with steam coils for heating the tar, and are insulated so as to hold the heat. Five-ton motor trailers are provided which will hold from eight to ten barrels. The trailers have kerosene heaters to keep the tar at the proper temperature during the entire day.

The work is so organized that a night watchman heats the tar, fills the trailers and prepares the equipment for use on the following day. In the morning, a tarring gang is able to start out from this central yard with a truckload of dry sand and granite chips and a 10-bbl. trailer of hot tar, ready to go to work. It has been found that the equipment outlined is of about the right capacity to supply a tarring crew of six men for a day.

Cone-shaped distributors are more economical of material than the old fashioned pouring pot with a fan-shaped nozzle. They are also far more easy to operate in windy weather.

The advantages and economies of the above methods of tar distribution are apparent. The cost of the barrels, amounting to 4 to 5c. a gallon, is immediately eliminated. The cost of handling and filling is eliminated for the producer of the bituminous material which is reflected in the price paid for the product. Considerable saving is made in the cost of the distribution of the tar on the road; unloading from trucks, dumping to the side of the road, opening the barrels, filling small tar kettles and heating the material by inefficient methods are eliminated.

Concrete Patching—Where the pavement becomes shattered or is broken down in an area of at least 1 sq.yd. it has to be repaired by some other method than the application of bituminous material and aggregate.

Such holes must be torn out and it is the best practice to waste the broken concrete, not using any of it in making the patch. It is desirable to enlarge the hole to a point where but few cracks radiate from, or circle about it. The excavation should be made at least 1 in. below the old concrete, and the ragged edge should be as nearly vertical as possible, if anything, undercut, so that the patch will give support to the surrounding concrete. No bituminous treatment should be given to the edges of the old concrete.

The best outfit for digging out the old pavement is a large portable air compressor, mounted on a five-ton trailer and driven by a 30-hp. gasoline engine. The capacity of the compressor should be sufficient to furnish 125 cu.ft. of air per minute; this will necessitate a two-cylinder 8 x 8 in. compressor. This equipment is easily transported over any area accessible to motor truck haul. It will furnish air for two large concrete breakers, which have been found very effective in digging out and loosening the old concrete. In fact, three men so equipped will accomplish more per day in removing old concrete than will a gang of twelve men using the old method of sledge, pick, crowbar and jack.

A small 7-S building mixer will mix as much concrete in a day as the air compressor will prepare holes for. Trucks delivering the aggregate and cement to convenient piles along the road and wheel-barrows feeding the mixer and delivering mixed material to the holes are the most common and the most efficient method for the concrete patching job.

Where traffic is heavy, a small central mixing plant is desirable. With this arrangement, a 14-S mixer should be used and should be fed with a batch hopper or bin which can proportion and feed the mix by gravity. The bin should be fed by a small revolving crane picking the material up from piles where it has been previously dumped from motor trucks. The mixed concrete from a central mixing plant can be distributed to the holes in the pavement either by small Ford trucks carrying one batch or by motor buggies. The set-up for the central mixing plant should be made at frequent intervals, say one mile, along the line of the road to be repaired. The great advantage of a central plant is that it does not clutter up the highway with material, cement and equipment, as is the case when the mixing is done with a portable mixer.

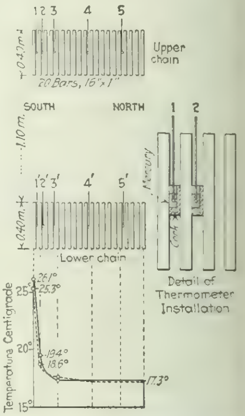
To facilitate traffic it is desirable to tear out and repair only one side of the road at a time, leaving the other side and shoulder free for passing vehicles. Where the hole in the pavement is at the edge, forms consisting of 2 x 8 in. planks firmly staked, or steel road forms, should be used. The patches should be struck off with a strike-board and should be belted—in fact all the first-class methods used in the construction of a new road in the way of workmanship should be employed in making patches. One of the most important things is to build the patch so there will be no unevenness at the junction of old concrete with new.

The use of hardeners such as calcium chloride, Cal and hydrated lime, is recommended in all concrete used for patching. Experience indicates that about 5 per cent by weight is the right proportion. It is admitted that the resulting concrete may not ultimately be so strong, with the use of hardener as without it, but it takes a permanent set so that it is safe to open the patch to travel within a week, instead of holding it closed the usual length of time. This is of so much greater importance than any other consideration that it makes the use of hardeners imperative.

Temperature Variation in Eyebar Chains Found Slight

RESULTS of measurements of temperature differences in the eyebar chains of the Elisabeth suspension bridge over the Danube River at Budapest, Hungary, were recently communicated by Stephan Gallik, chief of the bridge department of the Ministry of Commerce of Hungary, to Ralph Modjeski. They indicate that the effect of heating on the side facing the sun is so slight as to be negligible in stress calculations.

The main carrying members of the bridge are two superimposed chains, each composed of twenty eyebars 16 x 1 in., cut from wide plates. In the tests, which were made a number of years ago, ten thermometers were inserted between the bars of the upper and lower chains, in the positions in the sketch herewith, two in each chain being placed in the spaces nearest the south side of the chain and the other three distributed in the remaining width. At the location of the thermometers the paint was scraped from the sides of the bars, and recessed cork plugs were placed in these spaces so as to form small pockets against the sides of the eyebars. These pockets were filled with mercury and the thermometer bulbs set in this mercury bath. A detail sketch illustrates the arrangement.



TEMPERATURE MEASUREMENTS IN EYEBAR CHAINS

Location of thermometers shown at left. At right is a detail sketch of the arrangement of mercury pockets to receive the thermometers. Two curves at the left represent the average results of readings during two weeks.

Such groups of thermometers were placed at several points along the length of the upper and the lower chain, and readings were taken throughout a period of two weeks. Typical results are plotted in the diagram below the sketch of the thermometer location. The temperatures of the upper chain are indicated by a full line and those of the lower chain by a dotted line.

No marked differences of temperature were found except in the bars nearest the sunny side. The outer bar was from 4 to 9 deg. C. and the adjacent bar 1 to 2 deg. warmer than the mean of all the bars, while from this point inward the temperature was sensibly uniform across the remainder of the width of the chain. Differences in temperature between the upper and the lower chain were very slight, not exceeding 1 to 1½ deg. C. Calculations showed that if the entire upper chain were 10 deg. higher in temperature than the lower chain the stresses would be increased only 9 per cent at the worst point. As the actual difference was less than 2 deg., it was concluded that unequal temperature distribution does not influence the design of the chains.

Increase in Industrial Employees

In 32 out of 43 basic industries there was an increase in the number of men employed in February as compared with January, according to the *Monthly Labor Review*.

O'Shaughnessy Dam Completed and Reservoir Storage Begun

Closure Made at Low Water "in the Dry"—Precast Railing Placed in Short Sections Is to Be Used Again When Dam Is Raised

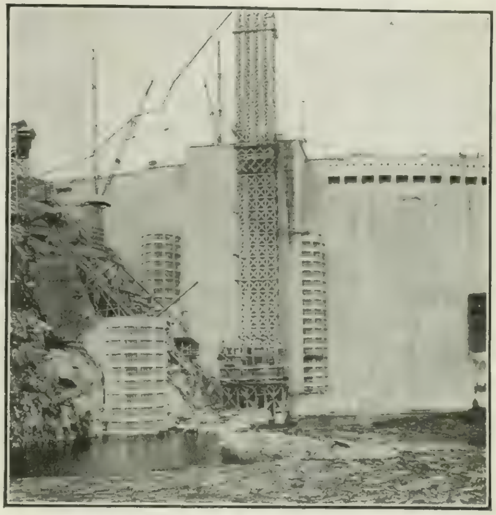
O'SHAUGHNESSY Dam, the name recently given to the main dam on the Hetch Hetchy project (hitherto known as the Hetch Hetchy Dam), which is San Francisco's future source of water supply, has been completed except for a few minor details and was accepted by the city as of March 28. Closure of the temporary flood passageway through the dam was made March 12 and the stream flow was then discharged through valves in the bypass tunnel until the last of the construction equipment could be removed from the valley. Storage is now accumulating in the reservoir.

Under the terms of the Hetch Hetchy grant the 250,000 acres in the Modesto and Turlock Irrigation Districts are entitled to a specified flow taken to represent approximately the natural flow of the stream and this natural flow must be allowed to pass the dam whenever the irrigation districts can use it to advantage. The bulk of the storage is to be taken from flood waters. Records show that in May and June floods often bring enough water in two weeks to fill the 206,000 acre-ft. capacity of the reservoir.

The dam has been built by the Utah Construction Co. to whom the contract was awarded in August, 1919. There have been five 90-day extensions of the original contract and until the exact status of bonus and penalty conditions has been determined, the exact amount of payment under the contract cannot be stated. It will, however, approximate a total of $6,000,000 exclusive of the valves and gates which were furnished under a separate contract.

The accompanying illustrations show the yardages placed in the dam in the successive months of the construction period. The dam is arched on a 700-ft. radius and the first construction stage just completed brings the structure to a total height from foundation to crest of 341 ft. The dam is 298 ft. thick at the bottom and 600 ft. long on the crest. A description of the construction plant and program appeared in *Engineering News-Record*, Sept. 21, 1922, p. 464.

The recently closed temporary passageway through the dam had its upper end tapered from a 12 x 13-ft. section at the upstream face to a 12 x 12-ft. section, 32 ft. from that face. The natural stream flow had been passing through this passageway since being diverted from the bypass tunnel to permit placing therein the three 36-in. valves and the concrete plug in which they are embedded. When closure of the dam was to be made the valves in the bypass tunnel were opened and the flow was made to pass trough them by means of small diversion dams thus making it possible to work "in the dry" in plugging the temporary passageway through the dam. Only the 32-ft. tapered section was plugged, the remainder of the passageway through the dam was left open and will serve as an outlet from the various drains and inspection galleries through the structure.

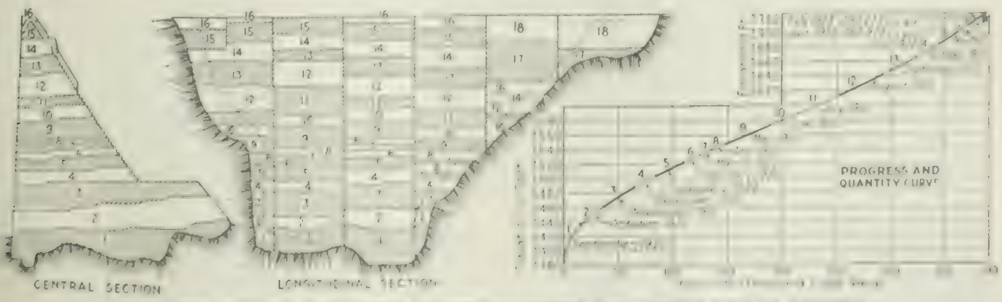


UPSTREAM FACE WITH STORAGE ACCUMULATING

Bypass tunnel intake racks at left, above them is the intake for the other three 36-in. valves. Racks in the center mark the intake for six 60-in. valves. Gunite is being applied. The railing is partially in place. Tower and concrete plant being removed. Floating debris is cordwood from clearing contracts.

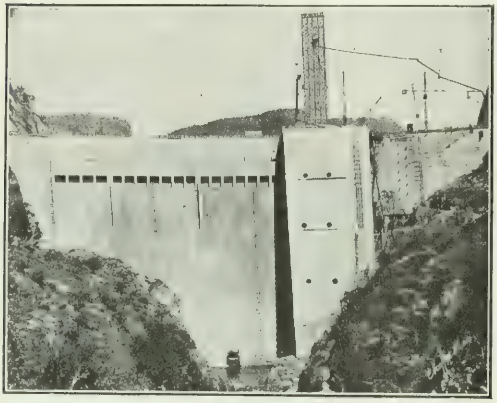
All the control equipment, consisting of six 36-in. valves for regulating the flow into the aqueduct and six of 60-in. diameter for controlling the flow of water released for the use of the irrigation districts, are in place ready for service. All these are the Larner-Johnson balanced valves.

When the dam is later raised the additional 85 ft. contemplated in the original plans, the bank of eighteen 10-ft. siphon spillways on the crest will be filled with concrete. The railing was placed in precast sections



PROGRESS RECORD BY MONTHS OF O'SHAUGHNESSY DAM, HETCH HETCHY PROJECT between posts 16 ft. apart. The posts are grouted into reinforcing bars projecting from the crest of the dam, but at least the panels are to be removed and used again on the crest at higher level when the dam is raised.

The work has been done under the direction of M. M. O'Shaughnessy, city engineer of San Francisco. At the dam C. R. Rankin has been resident engineer for the city and A. E. Paddock has been resident engineer for the contractor.



DOWNSTREAM FACE OF O'SHAUGHNESSY DAM

At the base appears the outlet of the temporary passageway that is now the main drain. Outlets of the six 60-in. valves are seen in the thicker section which indicates thickness of the structure when the additional 85 ft. is added to the height. Outlets of three 36-in. valves are close to the rock at the right.

Microbiology and the Theory of Activated Sludge

An Editorial Discussion Reprinted from "The Surveyor," London, England, for March 9.

MICROBIOLOGY and the theory of activated sludge were dealt with recently by Dr. A. M. Bushwell and Mr. H. L. Long in a paper published in *Engineering News-Record.* The paper is especially interesting, as it shows the order in which the protozoa make their appearance during the maturing of the activated sludge. There are, however, one or two statements made which are based on papers of other authors that are open to criticism. While it is true that Dr. Fowler considers the process to be partly due to a clotting action, he cannot be said to state that the process is a mechanical one, for in the same paper he definitely states that in his view the process is entirely due to bacterial activity. With regard to Ardern and Lockett's work, although they state that nitrification does take place provided that aeration is carried on for a long enough period, it appears that clarified or clear effluents are produced without the phenomenon of nitrification taking place. The final oxidation to nitrates is possibly desirable as a safeguard.

It is perhaps true that the organism M 7 is the only one that has been specifically mentioned in connection with the activated-sludge process, but it should be remembered that this organism was not isolated from the sludge or sewage, but from a canal. It does not appear that this organism has ever been found in activated sludge; the way in which this organism acted was held to explain to some extent the action of activated sludge. Ellis, in "Iron Bacteria," questions the work, and doubts whether this organism, which was described by Mumford in the *Journal* of the Royal Sanitary institute, is an iron organism, and whether it has the power of oxidizing iron compounds or of secreting an enzyme. It must be remembered that the organisms which occur in sewage have been largely investigated and isolated, and such organisms will occur in activated sludge. B. proteus vulgaris, B. pyocyaneus, B. Florescens liq. and others have been isolated from a sewage plant dealing with activated sludge. These were all found to break down nitrogenous organic compounds.

The authors of the paper say that a miscroscopial examination of the sludge does not reveal the presence of adsorbed matter, and that the particles "are composed entirely of active growing microscopic organisms." It is, however, a fact that in the examination of many samples of activated sludge it has always been found to consist of debris surrounded by bacteria and protozoa. One would hardly expect such an examination to reveal the presence of adsorbed colloidal matter. The action probably is somewhat as follows: The sludge, on being agitated with the sewage in the tank, adsorbs on the surface particles of colloidal matter, in this way clarifying the sewage. The organisms, particularly the bacteria, feed on adsorbed matter, there reducing it. The protozoa feed on the bacteria and also on the organic matter present, and thus the process of purification by activated sludge is brought about by physical and biological means.

[The foregoing comments were submitted to Dr. Buswell, who has supplied the following remarks—EDITOR.]

The authors of the article referred to in the editorial from the *Surveyor* reprinted above wish to call attention to the following two points:

1. The sewage organisms, B. proteus vulgaris, B. pyocyaneus, B. Florescens liq. mentioned as having been isolated from a sewage plant dealing with activated sludge, are all liquefying organisms and if present would tend to undo the work accomplished by the sludge in changing dissolved and colloidal organic matter to an insoluble state. Our object has been to emphasize the importance of organisms which synthesize rather than peptize, since they will be sludge formers.

2. We do not wish to be understood as claiming that there is no physical or mechanical phase to the reaction. We do believe, however, that the biological phase offers the more fruitful field for research at the present time. We have compared the activated sludge process to the disposal of garbage by feeding it to hogs, realizing that the mechanical collection of the garbage is an important part of the process but meaning to point out that it would not be successful unless the herd of hogs were cared for by a trained attendant preferably under the supervision of a veterinarian. Considerable is known concerning the care of hogs but very little is known concerning the organisms essential to the activated sludge process, the sludge formers.

Sacramento Garbage Being Fed to Hogs

The garbage incinerator at Sacramento, Calif., was closed last October and a start made on disposal by feeding to hogs on land rented by the city. The city collects the garbage and delivers it to the hog farm, with average haul of two miles. The contractor supplies the hogs, which must weigh not less than 80 lb. each when delivered to the farm, and carries on all the work and does all the business required. When the contractor sells the hogs he pays the city the sale price for one-third of the net gain of the hogs in weight. The contractor started with 300 hogs on Oct. 9 and expects to increase the number to at least 1,200. The material not consumed by the hogs is to be scraped up, dumped into large holes and covered with earth. According to estimates made by H. C. Bottorff, city controller of Sacramento, the city will make a net profit of $1,200 a year on the contract by this plan and in addition will save the $13,500 a year which it has cost to operate the garbage incinerator. The population of Sacramento by the census of 1920 was 65,908.

City Controls Sub-surface Use of Public Streets

New York Borough Builds Since 1915 400 Miles of Under-surface Structures to Standard Plans —Complete Records Kept

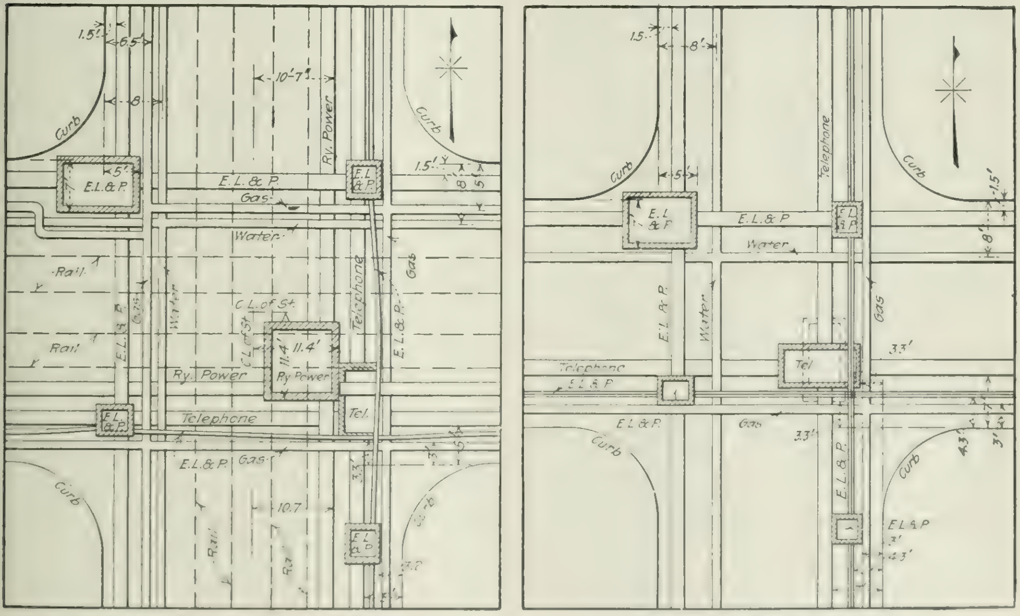
By Charles U. Powell
Chief Engineer, Topographical Bureau, Borough of Queens, New York City

PROFITING by the experience obtained in the other more intensely built-up boroughs of the city of New York, the Borough of Queens in 1915 undertook to control the sub-surface use of its highways. Careful studies were undertaken, and a lane chosen for each class of sub-surface structure, so that regardless of the sequence of construction, a given structure is always located in the same relative position in the highway. The locations of all the lanes were determined with a view to the greatest economy of construction and a minimum mutilation of street pavement, as well as to economy of space.

In the beginning, the adoption of a standard plan was resisted by some of the public service corporations; while these responsible acknowledged the advantage of the general scheme, the standard plan did not in every case work out with the greatest economy to each structure. Wherever a structure can be more economically installed by a departure from the standard treatment, requests are made for special consideration. Consideration is always accorded, but unless a great saving can be effected, the standard plan is insisted upon.

There are, however, several instances of departure from the plan for good reason. For example, in the case of a street bordering upon a public park, where the standard gas pipe lane was on the side of the park, the gas company was permitted to depart from the standard plan and place its pipe on the inhabited side of the street. By this the need of house connections crossing the street, and the resultant damage to pavement was avoided. Likewise, in a few instances where it became necessary to join new work with existing structures built prior to the standard plan, departure was permitted to avoid a needless kink in the pipe or duct lines, but this variation is always limited to a single city block. Trolley tracks in a street also in some cases influence the location of the sewer and other substructures. The result is that of the 442 miles of sub-surface structures built in the streets of Queens Borough since the adoption of the standard plan in 1915, more than 400 miles have been built in accordance with the standard plan.

The accompanying drawing indicates the standard location of pipes, ducts, boxes, and manholes for the various structures in a roadway 40 ft. or less in width, and likewise the treatment in roadways of width greater than 40 ft. It will be noted that no sewer location is shown upon the plans. The usual location of the sewer is in the center of the street, but sometimes it is on both sides of the center in wide streets where there is more than one line, and also where large trunks occur along a street with trolley tracks. The hand holes, drip boxes, and water gate locations are not standardized, it being permissible to place these where convenient outside the areas reserved for manholes and pull boxes standardly fixed upon the plans.



Roadway Width Greater than 40 Ft. Roadway Width Less than 40 Ft.

STANDARD LOCATION FOR SUBSURFACE STRUCTURES IN QUEENS BOROUGH STREETS

To enforce the standard plan it was necessary to control the various corporations placing structures in the street. The method of control exercised, in the absence of definite laws giving the Borough President jurisdiction over the placement of substructures, has been to require the approval of the Substructure Bureau before permits to open highways for construction are granted. A public service corporation desiring to place a pipe or duct line has since the adoption of the Greater New York Charter been required to obtain from the office of the President of the Borough a permit to open the street. The Highway Bureau, which issues these permits, has since the adoption of the standard, required the approval of the sub-surface bureau before issuing permits. Thus, in a somewhat back-handed way, the various companies are made to conform to the plan. In the course of the first year cordial co-operation was obtained, for it was learned by experience that the plan in the long run worked for the interests of all. From the very start the various bureaus of the borough and the water department of the city agreed to the standard plan, and helped to realize it.

The Bureau of Substructure is a division of the Topographical Bureau of the Borough, which, under the jurisdiction of the President of the Borough, Maurice E. Connolly, is administered by the engineer in charge of the Topographical Bureau, through the assistant in charge of Substructure Division, Thomas P. Cunningham. Thus the Topographical Bureau designs and controls the development of the streets of the borough, both horizontally and vertically (location and grade) and it also controls the sub-surface use of the streets.

Progress in the Classification of Engineering Positions

Committee of the A.A.E. on the Classification of Positions in Engineering Makes Encouraging Progress

By A. B. McDaniel
Member, Civilian Advisory Board, General Staff, War Department, Washington, D. C.

IN THE decade preceding the World War, great material development and prosperity had bred a general feeling of smug satisfaction in this country. We contented ourselves with the happy thought that the schools were educating the young, the great "melting pot" was assimilating the immigrants of many nationalities and welding them into one homogeneous body, and the industries were developing a contented and efficient army of workers. This illusion was rudely shattered by the selective draft with its revelations of physical subnormality of nearly one-half of the men drafted, of illiteracy to the extent of practically one-fourth of the men examined, and of deficiency in trade skill among one-third of the men tested.

This startling condition of unpreparedness necessitated the setting up, by the War Department, of an emergency training program, which included the instruction of 130,000 men in 147 schools in 67 different lines of technical work, the establishment of the Students Army Training Corps in the colleges and universities, and the development of a new system of educational training, comprising the following steps: (a) The accurate definition of every job to be done; (b) the determination of each man's special abilities; (c) the allocation of men to the jobs in accordance with their predetermined abilities; and (d) the development of the ability to master the assigned job as rapidly as possible.

With the aid of hundreds of the leading educators, psychologists, engineers, and technical experts of the country, the government developed a system of educational training based on the principle of "learning by doing." This motivated form of instruction was productive of excellent results in the intensive training of men in the various occupations and trades required by the non-combative arms of the military establishment.

Early in the development of the army training, it was found that the first step in the preparation of courses of instruction was the detailed determination of what the men must be trained to do. This discovery resulted in the preparation of brief statements of descriptive qualifications or minimum specifications for the various positions for which men were being trained.

Carnegie Foundation Report—Several years ago the engineering report, made by Dr. C. R. Mann for the Carnegie Foundation for the Advancement of Teaching, in co-operation with the four founder engineering societies, recommended that a study be made to ascertain just what topics should be taught to increase the efficiency of our educational plants and to improve the character of their product. Special emphasis was laid in this report upon the importance of determining the topics common to all branches of engineering.

This report aroused much discussion among educators and engineers as to the length of courses of instruction and the nature and amount of subject matter that should be included in our technical curricula. A great variety of suggestions have been made as to the number and combinations of general and technical subjects that should be used. But after several years of fruitless discussion, no general agreement has been reached and little progress has been made towards this important study.

In any educational program, it is of prime importance that the objective for training be clearly defined. Unless we know where we are going, but little progress can be made. Thus it is obvious from our recent army experience that the basic work is the clear specification of the results to be accomplished. This plan is so very obvious and simple that one wonders that educators have not put it into practice long ago. But, it must be remembered that the necessary analysis must be made among the practitioners in the office and field, and cannot be done by overworked teachers in the classroom and laboratory.

Such an analysis was initiated by industry about a year ago in three of the larger manufacturing centers of the East. An analysis of several positions in different plants in the same city indicated that it was possible to determine the basic requirements and prepare minimum specifications which could be used by these concerns in the selection, assignment, and promotion of employees. Although the general policies, methods of organization and local conditions introduced special requirements for the same positions in different plants, it was found that the basic requirements of any position were the same in all the plants. This discovery, which substantiated the results of similar work carried on in the army during the past five years, makes it possible and logical to prepare statements of necessary qualifications which comprise minimum requirements. In one large industrial center, the classification work has proceeded with such success, that the industries have secured the co-operation of the local chambers of commerce, the public school system, and local educational institutions with a view to the preparation of a suitable training program which will be based upon the results of the classification study now being made.

Work of A. A. E. Committee—Several months ago the American Association of Engineers appointed a committee of engineers and educators to make a study of the engineering field with a view to the classification of its various positions. The committee has started its work in the highway engineering field and has secured the co-operation of the U. S. Bureau of Public Roads, and several state and municipal highway commissions and bureaus scattered throughout the country. The committee is securing data from about a thousand highway engineers in the various positions from chainman and rodman to district or division engineer. These data are accompanied by typical problems, which illustrate the basic requirements of the various positions. For example, the problems furnished by any position, such as resident engineer, indicate the nature and amount of mathematics, language, pure and applied science, economics, law, accounting, etc., as well as the executive, supervisory, manipulative, and technical abilities required.

The minimum specifications for the different positions are being prepared after a compilation and a thorough study of the data, received in the occupational study sheets. These specifications clearly and briefly state the minimum or basic requirements as to the things a man must be able to do, the things that he must know, and the personal abilities and qualities which he must possess in order to fulfill the demands of the position. The local conditions of climate, topography, transportation, organization policies and systems, etc., will often introduce special features in many positions. Past experience has indicated, however, that for any position, the basic requirements are practically the same in different organizations and in different parts of the country.

The experience of the army in the selective draft, of industry in its personnel service relations, and of a large number of employment bureaus, licensing boards, civil service commissions and similar agencies, clearly indicates the wide field of use of minimum specifications for the proper selection, assignment, promotion and transfer of workers in all fields of labor. As time goes on, experience emphasizes the need of these fundamental instruments for the proper allocation of personnel, so that it may be possible to fit "round pegs into the round holes" with a minimum expenditure of time and energy.

Engineering educators and practising engineers are generally in accord that our technical courses should train students in the fundamental elements of the profession. Also, there seems to be a general agreement as to the importance of providing a suitable background of training in subjects of a general or cultural nature. Undoubtedly the work of the Committee on the Classification of Engineering Positions will be of definite assistance to educators in pointing out the fundamental elements of technical training. The practitioners in the engineering field intimate that more time and attention should be given in engineering curricula to humanistic subjects. It is evident that the technical schools should give careful consideration to the possibility of providing some instruction in economic principles, business relations and industrial organization. The large number of engineers who are enrolled in correspondence schools giving instruction in economics, business administration and similar subjects shows that the engineers above the mere technical grades, require a thorough grasp of social, economic and business principles.

The work of the committee, even in this preliminary stage, points out the importance of a thorough study of the present status of engineering education. Are the engineering schools of the country turning out only narrow-gage technicians? Should not the engineering curricula provide for a broad fundamental training in pure and applied science with a suitable background of the humanistic studies? Are the technical schools fulfilling their entire function if some provision is not made for the direction and guidance of the young men and women who leave their cloistered halls to enter the arena of life? In order to answer these questions properly, is it not necessary to have fundamental data, which can only be secured from careful job analyses and minimum specifications made by the practitioners in the profession, who know the actual requirements of the work?

The report of the Committee on the Classification of Engineering Positions will be available some time in May.

Seepage Losses From Mackay Reservoir

By Lynn Crandall
Watermaster, Big Lost River, Mackay, Idaho

IN CONNECTION with the administration of the waters of Big Lost River, Idaho, for the past few years, records have been collected showing the seepage losses through, under and around the Mackay dam. Conditions at the site of this dam, together with the results of experiments on models and a proposed design for a dam at the site, are given in detail in the *Transactions* of the American Society of Civil Engineers, Vol. LXXXI, December, 1917, page 1.

The dam as built and now in use consists of a gravel fill about 70 ft. high at the point of maximum height. It has a top width of 174 ft., an upstream slope of 3 to 1 with a facing several feet thick of fairly fine material, a downstream slope of about 1½ to 1 riprapped with heavy rock. The storage capacity at a gage height of 64 ft. is 41,000 acre-feet. Usually the gates at the dam are closed tight during the winter months and the discharge at the measuring station two miles below the dam at such times is shown in the following tabulation:

TABLE I—DISCHARGE IN SECOND-FEET AT GAGING STATION BELOW MACKAY DAM WITH GATES AT DAM CLOSED

Gage Height, Ft.	1918-1919	1919-1920	1920-1921	1921-1922	1922-1923
10			43	50	
15			47	52	
20	68		59	63	
25	76		69	75	
30	87	85	85	84	
35	94	94	100	95	97
40	111		122	103	102
45	121		135	112	106
50	137			135	113
55					123

Records for all stages each season are not complete as the gates were partly open at times, and no records at all are available for gage heights over 55 ft. as stages in excess of this amount have only been attained during the flood period when the gates are partly open to pass water needed for irrigation. About 25 per cent of the discharge shown appears in the river channel immediately below the downstream toe of the dam; the balance flows into the river at various points between the dam and the gaging station. No time interval was used in preparing this table, the discharge in each case being the discharge on the particular day when the reservoir reached the indicated gage height.

Gravity Freight Yard at Canton, Ohio; W. & L. E. Ry.

Single Switching Incline Without Hump Classifies Traffic in Both Directions—Scale on Incline—Engine Terminal With Turntable—Repair Tracks

THE revision and enlargement of the Gambrinus freight yard and engine terminal of the Wheeling & Lake Erie Ry. at Canton, Ohio, is a good example of improvements needed or being made at division points on many railways in order to facilitate the handling of increased traffic. In this case the work includes relocation of main line, construction of additional yard tracks, introduction of gravity switching and the construction of a new engine terminal. Topographical conditions permit of gravity movements without the construction of a "hump" to give the necessary grades.

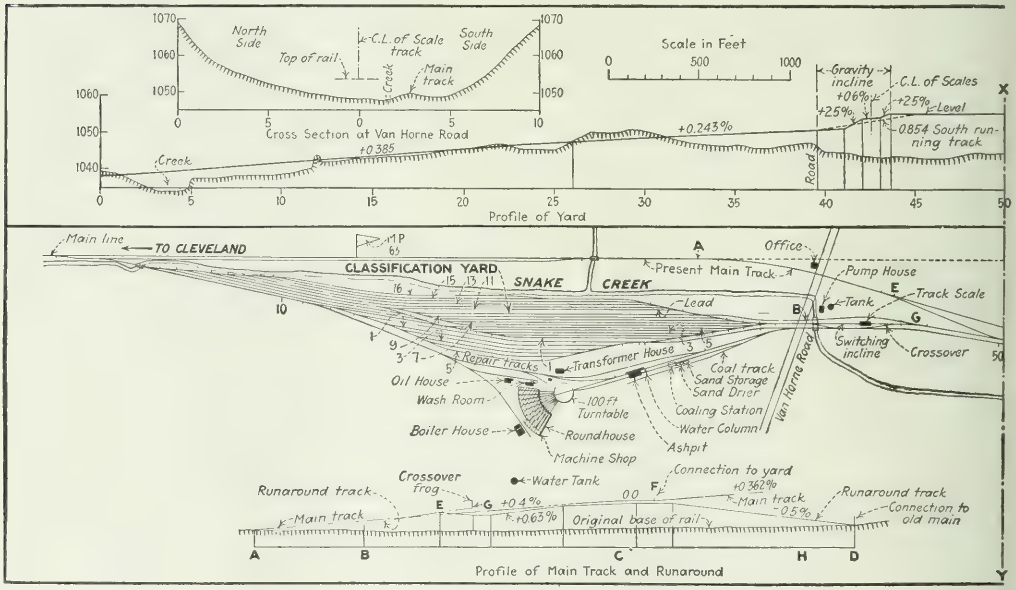


FIG. 1—LAYOUT OF FREIGHT YARD AND ENGINE TERMINAL OF

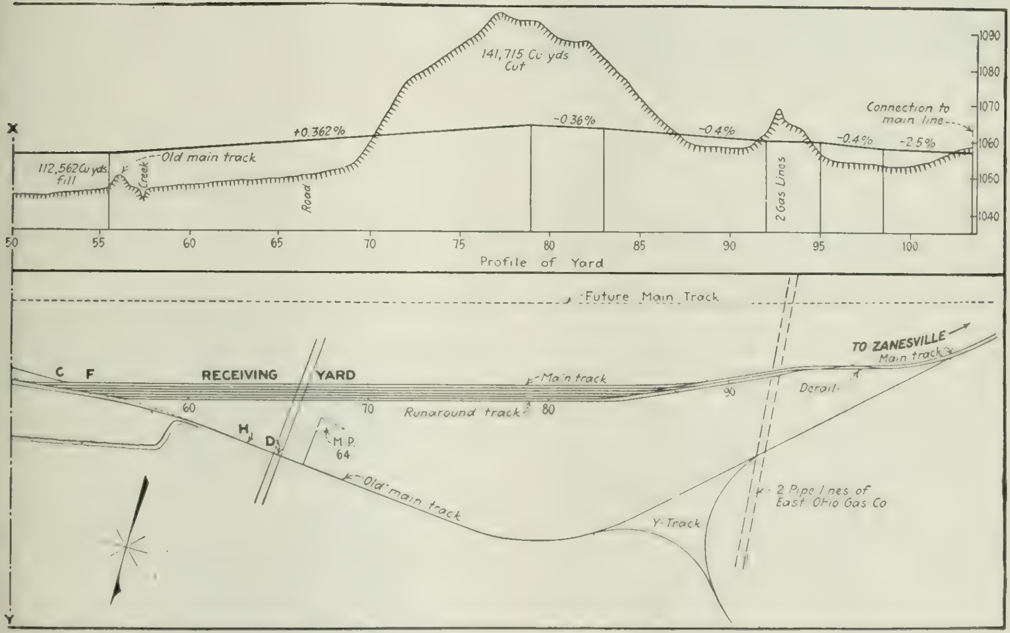
The Gambrinus yard at Canton was established originally in 1917-1918, and is a division yard on the main line from Zanesville to Cleveland, Ohio. Although the railway runs practically north and south it lies in an east and west direction through Canton, as indicated by the plan, Fig. 1. On the divisions served by this yard the ruling grades are 0.5 per cent. Fig. 2 is a view looking east, with the coaling station and engine terminal at the left and the classification yard at the right.

Traffic Conditions—As in most cases of this kind the design of the improvement was governed largely by traffic and operating conditions. At the Gambrinus yard there are ordinarily about six trains daily in each direction. Coal represents 60 per cent of the northbound traffic, while the southbound movement consists mainly of miscellaneous freight. Practically all inbound trains are broken up, the cars being classified for various destinations and for local distribution. A few solid trains are run through, with only a change of engines and filling out with additional cars on account of change in tonnage rating. Standard tonnage trains are rated at 3,060 tons (loaded cars) northbound and 2,400 tons (loaded and empty cars) southbound, the number of cars being fifty in each case. The average number of cars switched daily is 225 northbound and 200 southbound. About 30 "bad-order" cars and 75 "hold" cars are switched out daily.

Yard Layout—In the original location the main track from Zanesville ran north of the receiving yard in a long curve and then crossed the head of this yard, continuing along the south side of the classification yard. In the recent revision, one of the new tracks on the south side of the receiving yard is utilized as the main track, thus avoiding the crossing of yard tracks. When additional receiving tracks are required a new and direct main track will be built on the location indicated by a dotted line in Fig. 1. The old curved main track, with its wye for turning engines, will be retained, but instead of crossing the yard tracks it will lead into the engine terminal.

Since the heavier movement is east and northbound, the layout is planned with a special view to the handling of traffic in this direction. In the general plan there are two yards in tandem connected by the gravity switching track or incline and by other auxiliary tracks. Northbound trains enter a receiving yard having seven tracks for 62 to 84 cars. The north track is a thoroughfare or running track and at present the south track is utilized as the main track, but future widening of the yard will be on this latter side. Beyond the gravity track is the classification yard, with fifteen body tracks for 165 to 210 cars each and two leads or running tracks. Southbound trains from Cleveland also enter the same receiving yard, since there is a gravity switching track in one direction only and the classification yard serves for traffic in both directions.

Yard tracks are laid mainly with 90-lb. rails and gravel ballast. Body tracks are spaced 14 ft. c. to c., and ladders or running tracks are 20 ft. c. to c. from body tracks. Frogs are mainly No. 8. All switches are operated by hand. A caboose track is arranged parallel with the gravity incline track, and parallel with this also is a runaround track for bypass movements of cars or trains through the yard. The main line is single track, but at each yard entrance a freight lead track about 4,000 ft. long is provided, so that trains destined for the yard can be kept clear of the main track. For night work the yard is lighted by flood lights mounted on the coaling station, the roundhouse and a highway bridge which spans the gravity track.



WHEELING & LAKE ERIE RY., AT CANTON, OHIO, AND PROFILE OF YARD

A considerable amount of grading was required for the additions to the yard layout. This included a deep cut of 141,700 cu.yd. and a fill of 112,560 cu.yd. for the receiving yard and its connection with the classification yard, but the latter yard required only light filling. The main track from Zanesville approaches the yard on an ascending grade of 0.7 per cent and yard tracks rise from the main track connection on a grade of approximately 0.4 per cent which continues into the receiving yard. Beyond this the grade falls at 0.36 per cent to the end of the ladder, whence there is a level stretch to the gravity incline. From the foot of this incline a descending grade of 0.243 and 0.385 per cent extends to the main track connection and continues on the main line.

Gravity Switching—An unusual feature is that although the switching for classification of cars is by gravity movement there is no actual hump, the yard being so graded that all movements for classification are on descending grades. Thus the usual ascending grade to the summit of a hump is absent in this case, as will be seen by the profile in Fig. 1. From the head of the gravity incline there is an accelerating grade of 2.5 per cent for 25 ft., followed by 50 ft. of 0.6 per cent, on which the 150-ton track scale is located. Thence a second accelerating grade of 2.5 per cent extends 50 ft. to the head of the classification ladder. In the classification yard the grade is 0.243 and 0.385 per cent.

It is not the practice to uncouple every car at the head of the accelerating grade, cuts of cars for the same destination being switched at one movement and weighed automatically in passing over the scale. The speed averages 8 m.p.h. on the first grade, 6 m.p.h. over the scale and 10 m.p.h. to the head of the classification ladder.

Yard Operation—In the receiving yard at the west end, the road engines are cut off and proceed past the hump by a runaround track on a grade of 0.834 per cent to the engine terminal. When the train has been marked or carded a yard engine pushes it to the head of the accelerating grade for classification. The caboose is placed on a second runaround track, south of the hump, ready to be switched to an outbound train. Outbound trains for both north and south movements are made up on certain tracks of the classification yard which are assigned as departure tracks. These tracks are equipped with compressed air piping for testing the train brakes before the road engines are attached.

For a switching service of about 425 cars daily (including both directions) five yard engines are required for the 24-hour day. About thirty bad-order cars daily are switched out and moved to the repair tracks. About seventy-five "hold" cars are also switched out daily and moved to assigned tracks in the classification yard to be held awaiting orders for further movement.

As an example of the way in which yard tracks are assigned, the following list is given:

Repair Tracks: (1) Cars for train No. 190 (which is a fast freight), (2) coach repairs, (3 and 4) bad-order cars, (5) repair track at present occupied by wrecking train. Classification Tracks: (1) and (2) "Hold" cars and cars for B. & O. R.R. and for local industries and team tracks in the Allen St. district; (3) merchandise cars for the Canton freight house and for local industries in what is known as the middle district; (4) cars for South Canton; (5) cars for United Furnace Co. and United Alloy Co.; (6) branch local and swing cars; (7) and (8) empty box cars in reserve, for prospective loading; (9) cars for Pennsylvania R.R.; (10) cars for Berger Co. and north end industries; (11) a lead or thoroughfare track; (12) northbound local cars; (13) cars for Akron, Cleveland & Youngstown Ry; (14) cars for Kent; (15) and (16) cars for Cleveland.

FIG. 2—CANTON YARD AND ENGINE TERMINAL

Engine Terminal—About twenty road engines have to be cleaned and served daily at this point in addition to the five yard engines. For this service a compact engine terminal is provided, having approaches from each end of the yard, as shown in Fig. 1. The east or main approach has two tracks leading to the turntable and a third stub track for coal and ash cars. Both of these engine tracks are served by a coaling station, a water column and a double ashpit.

The 100-ft. turntable is of the continuous girder type, supported at the center and at each end, thus eliminating the necessity of spotting the engine in position as on the balancing type of turntable. There is said to be also less shock in moving the engine on and off the turntable. A 300-hp. motor is geared to the carrying wheels at one end and the turntable can be moved through a complete revolution in 90 seconds. The ten-stall roundhouse is 115 ft. deep, except that for a space of four stalls it is 135 ft. in order to provide a machine shop.

This building has walls of brick and steel sash, with a timber roof having beams supported on interior columns. Other facilities include a service building for the yard crews and trainmen, a wash room, foreman's office, transformer house, power house and a boiler house for heating the other buildings. A second water column serves the two approach tracks from the east end of the yard. Water of good quality and not requiring treatment is pumped from wells to two elevated steel tanks of 100,000 gal. capacity each.

Two engine tracks are served by the coaling station, Fig. 3, one track passing under the bin and the other at one side. On the opposite side is the coal car track with track hopper. This coaling station is of timber construction and has its 200-ton bin divided into two compartments in order to handle different grades of coal for hand-fired and stoker-fired engines. The spouts discharge vertically and are so hung as to have considerable lateral play in order to prevent damage if struck by an engine while being spotted in position or started. Coal cars on the stub track dump their contents into a hopper from which the coal is fed by automatic charging scoops or loaders into the two 1-ton buckets, each bucket being operated by a balanced electric hoist. Timing devices insure that the loaders and buckets work in harmony. Since the hoist is operated by a worm gear the bucket cannot run away or overhaul. From 500 to 600 tons of coal are handled daily. The sand drier has a 10-ton bin and can dry ten tons per day. Compressed air forces the sand through pipes for delivery to the engines. This coaling and sand plant was built by the T. W. Snow Construction Co., Chicago.

A double-track water-filled ashpit which is provided for cleaning the engine fires is of reinforced concrete and has its side slopes lined with paving brick laid on a 1½-in. mortar bed and held in position by shelf angles, as shown in Fig. 4. Each track has one rail laid on the wall of the pit and the other carried by a pair of I-beams supported on posts spaced 5 ft. c. to c. These posts are of 18-in. cast-iron pipe filled with concrete and seated in concrete pedestals. A 4-in. water pipe enters one end of the pit and at the other end is an overflow elbow on an 8-in. outlet. This elbow arrangement is considered less liable to obstruction by refuse than an opening in the end wall. The two engine tracks on the ashpit are spaced 18 ft. c. to c. and at one side is an ash track spaced 16 ft. from the engine track for

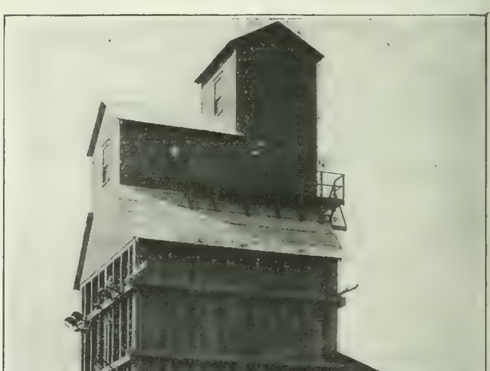
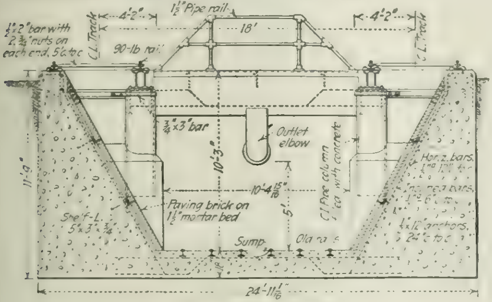
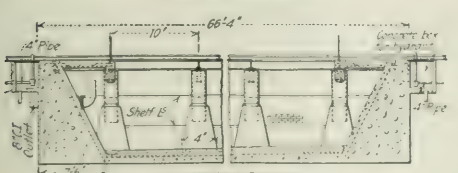


FIG. 3—COALING STATION SERVES TWO ENGINE TRACKS

the use of a locomotive crane which removes the ashes with a grab bucket at convenient intervals. It was planned originally to handle the bucket from a gantry crane spanning the three tracks, but the present arrangement is simpler and less expensive.



Enlarged Cross-Section



Longitudinal Section

FIG. 4—WATER-FILLED ASHPIT

The design and construction of the Gambrinus yard and engine terminal were carried out under the direction of W. L. Rohbock, chief engineer of the railway.

Removing Seepage and Alkali from Irrigated Lands

Excess Water in Soil Gives Engineers Technical and Social Problems in Protecting and Developing Reclaimed Areas

By D. W. Murphy
Consulting Engineer, Los Angeles, Calif.

A PECULIARLY difficult problem which arises in the maintenance of lands reclaimed by irrigation in the arid districts of the West is the liability of these lands being damaged by the accumulation of an excess of water in the subsoil and the consequent gathering on the surface of earthy salts, commonly called "alkali," to such a degree as to prevent profitable crop production. This difficulty is accentuated by the fact that it is not purely of an engineering character, but is so interwoven with social or economic considerations that the engineer must have something more than technical ability in order to deal with it. He must be able to secure the confidence of the people and without alarming them unduly to convince them of the necessity of providing for conditions which may not be apparent for months or years.

It is safe to say that 15 to 20 per cent of the lands reclaimed by irrigation have been ruined or are endangered by seepage or alkali. Assuming that a total of 20,000,000 acres of land have been irrigated within the United States, then from 3,000,000 to 4,000,000 acres have been affected and possibly a million acres have been rendered useless. If the cost of irrigation and other improvements is taken at $100 per acre, then the net loss is about $100,000,000. Much of this loss could have been prevented, if engineering skill and forethought had been employed.

Sufficient studies and investigations have been made and sufficient works constructed to show the feasibility of protecting reclaimed lands from a waterlogged and alkaline condition. The U. S. Reclamation Service is understood to have expended already upwards of $10,000,000 in providing drainage works, and continued investment must be made as conditions develop.

Extensive studies of this problem in the Imperial Valley in southern California, have resulted in a drainage program involving the expenditure of $2,500,000. Excellent results have been obtained already in some parts of the valley, but in some other portions of the valley where exceedingly tight soils exist considerable time will be required to restore the lands to their former condition and value. In the Palo Verde Valley, between Needles and Yuma, on the Colorado River, it has been demonstrated that drainage will be effective, and construction work is soon to be commenced.

Drainage is as necessary to the ordinary irrigated area as is a sewerage system to a community when an abundant water supply has been brought to the houses. Many localities are becoming alarmed at the rise of ground water. This rise is due largely to the fact that the irrigation water supply is so great that there has been little enforced economy in its use. On many of the irrigation enterprises there has not been a continuous observation of the ground-water conditions or a systematic study of the subsoil relations. As an example of these conditions, vineyards worth $1,000 an acre in the San Joaquin Valley, California, gradually went out of bearing. The vines were pulled up and alfalfa was planted, but in a few years the alfalfa also ran out and barley was tried. Later, the land was given over to salt grass. This great loss could have been avoided by proper diagnosis and treatment before the conditions appeared on the surface.

Taking care of irrigated lands, especially in large areas provided with an abundant water supply, involves the following considerations: (1) The determination of ground water and alkali conditions of the soil; (2) the working out of measures which will control the ground water and protect soils from becoming unfit for cultivation. Detailed studies along these lines are frequently of little interest to the engineer trained primarily in planning and building works for irrigation. The curative measures involve the planning and construction of drainage works and the maintenance of these works in such condition that they will perform their functions. Even with adequate drainage works, questions involving irrigation and the methods of handling soils in order to keep them in proper physical condition must be given attention.

Beyond the laying out and construction of drainage works, constant vigilance is necessary to see that the works are properly performing their function and that new conditions or complications detrimental to the soils do not arise or are remedied. These problems may be classed as "engineering questions," but many of them do not come within the scope of ordinary engineering practice. They can be solved when engineers and others who have to do with irrigation are taught to realize that all irrigation enterprises are threatened by the dangers of excess water and alkali.

Submarine Rock Drilling Records and Unit Costs

Open "Lake and Inside" Harbor Drilling Alternated as Weather Determined—Range System Prevented Duplicate Work

By Emile Low
Buffalo, N. Y.

Drill boat operations in Buffalo harbor and in the lake outside the harbor entrance make possible a useful analysis of submarine drilling records and costs. The rock drilled consisted of hard limestone, which underlies the vicinity of Buffalo, and the adjacent north Canadian shore of Lake Erie. The holes ranged from 4.2 ft to 8.6 ft. deep. It was necessary to drill to a minimum of 26 ft. below mean lake level, in order to make sure that no material was left above the depth of 23 ft. This necessitated drilling 3 ft. below grade. The spacing of the holes was 4 ft. between the rows and also 4 ft. between holes. Generally 30 holes were drilled at one setting of the drill boat, each hole being shot as soon as finished.

TABLE I—OUTPUT TOTALS OF DRILL BOAT

Section	Hours Worked	Hours Delayed	Total Hours	No. of Holes Drilled	Average Depth	Total Lineal Feet Drilled	Area Drilled Square Feet	Cubic Yards Drilled to Grade	Cubic Yards per Hole	Dynamite Used Pounds
1	1,366	59	1,425	5,567	5.6	30,640	85,582	8,093	1.5	16,155
2	1,358	121	1,479	6,470	5.7	36,889	103,162	10,335	1.8	20,143
3	1,153	49	1,202	3,790	7.9	30,086	68,448	12,243	3.2	23,355
Total	3,877	229	4,106	15,827	6.2	97,615	257,192	30,671	1.9	59,653

The boat was steel and had a length over all of 137.5 ft., a beam of 32 ft., and a depth of 6.5 ft. It was anchored in position for drilling by four spuds, one at each corner. It carried five steam drills, each mounted on a structural steel frame, the drills being raised and lowered by cables operated by small hoisting engines, instead of by a hydraulic cylinder. With this exception the other equipment, spud and other hoisting machinery, boilers, etc., did not vary much from the usual drill boat outfit. Loading the holes and firing the charges were done in the customary manner.

Tables I and II give the performance and time records. The explosive used was Atlas 60 per cent nitroglycerine in 2 x 8 in. cartridges. The boat was operated day and night, in two 11-hour shifts, the crews changing at 6 o'clock a.m. and at 6 o'clock p.m. Each crew and their wages were as follows:

1 Foreman $6.00 per day	$6.00
5 Drillers—$3.31½ per shift of 11 hours	16.57
1 Blaster—$3.59 per shift of 11 hours	3.59
6 Deckhands—$2.71 per shift of 11 hours	16.26
1 Fireman—$3.04 per shift of 11 hours	3.04
1 Blacksmith—$3.59 per shift of 11 hours	3.59
2 Blacksmith helpers—$2.49 per shift of 11 hours	4.98
Overtime, estimated	.97
Per shift	$55.00
Per hour	5.00

The men lived ashore and boarded themselves, being carried to and from their work by the construction company's tugs.

In addition to the wages there were other fixed expenses per shift, which are tabulated below:

Coal—4 tons @ $3.00	$12.00
Oil and waste	2.00
Small repairs and incidentals	8.00
Total	$22.00

TABLE II—UNIT PERFORMANCES OF DRILL BOAT

Section	Days Worked	Holes Drilled per Day	Feet Drilled per Day	Holes Drilled per Hour	Feet Drilled per Hour	Feet Drilled per Drill Hour	Area Drilled per hour	Cubic Yards Drilled per Hour	Dynamite, Lbs. Per Cu Yd.	Dynamite, Lbs. Per Foot of Hole	Dynamite, Lbs. Per Hole
1	65	85	471	3.9	21.5	4.3	60.1	5.7	2.0	0.61	2.9
2	67	96	551	4.4	25.0	5.0	69.8	7.0	1.9	0.54	3.1
3	55	69	547	3.1	25.0	5.0	56.9	10.0	1.9	0.77	6.2
Total	187	85	522	3.8	23.8	4.8	62.6	7.5	1.9	0.61	3.8

The total expense of operation was then $77, or $7 per hour.

Table III shows approximately the cost of operating the drill boat during the time of its employment. The capital cost was as follows:

Cost of drill boat	$50,000	
Interest, 6% for 1 year		$3,000
Depreciation, 10% for 1 year		5,000
Total		$8,000

The boat was actually engaged in work 7½ months, but to allow for fitting out and laying up, 8 months time has been allowed. It will be noted that the time lost was only a little over 5 per cent of the total possible working time.

The largest item of expense is labor, 36 per cent; fuel, oil, waste and repairs are 14 per cent; while towing, explosives and interest and depreciation are each 13 per cent. The items of superintendence, yard and office expenses make up the remaining 11 per cent. To the above cost must be added that of dredging which will average 20c. per cubic yard for drilled and blasted rock, scow measure, which is equivalent to 40c. place measure.

TABLE III—DRILL BOAT OPERATING COSTS

			Per Hole	Per lin.ft	Per cu.yd.
Labor, 200 days, @	$110.00 =	$22,000	$1.39	$0.23	$0.72
Fuel, oil, waste, repairs, etc., 200 days @	44.00 =	8,800	.56	.09	.29
Tug, towing, 200 days @	40.00 =	8,000	.50	.08	.26
Explosives, 60,000 lb. @	.12 =	7,200	.45	.07	.23
Exploders, 20,000 @	.04	800	.05	.01	.03
Superintendence, etc.		2,000	.13	.02	.06
Yard expenses		3,000	.19	.03	.10
Office expenses		2,000	.13	.02	.06
Interest and depreciation		8,000	.50	.08	.26
Totals		$61,800	$3.90	$0.63	$2.01

Where submarine bedrock excavation is carried on in exposed situations, and operations are intermittent, the cost can easily reach double that figured above.

The contractor was the Empire Engineering Corporation, New York, N. Y.

Accidents to Water Department Employees

Out of a payroll of nearly $2,000,000 at the Detroit Water Department for the year ending June 1, 1922, there were 248 accidents to employees of which 205 were non-compensable. Of the forty-three compensable cases the department paid $2,459 compensation and $1,374 hospital charges. Fees for medical attention and services for the 248 cases were $2,515. Fourteen first-aid cases were cared for by foremen and time keepers. Of ninety-one automobile accidents with department cars thirteen cases were held to be the drivers' fault and nine unavoidable. In forty-five accidents outside parties were held responsible but no damage was done the department cars. In twenty-four accidents outside parties were billed for $341.34.

Publicity Only Will Not Raise Engineers' Status

Potentialities of Engineer for Public Leadership as a Citizen Must Be Developed—Operations in Iowa

Abstract of report of publicity committee to the Iowa Engineering Society, by W. J. Schlick, Chairman.

MOST discussions of publicity for engineers are based on three related principles: (1) Engineers do not have the standing, and do not receive the recognition to which they are entitled. (2) This condition is due to a lack of appreciation, resulting from a lack of understanding on the part of the general public. (3) Publicity will correct this error on the part of the public. Publicity is considered as a sort of magic automatic elevator; the engineer gets on by writing something of his work, or by declaring his belief in the above principles, and presto! he becomes recognized as "the" man of value in his community. The committee on publicity of the Iowa Engineering Society has taken a slightly different view. It believes that publicity—news stories and feature articles telling of the engineer's work and setting forth its value and importance to the community—is desirable. But it believes that more will be required before the profession reaches the place engineers wish it to have.

It is hard to believe that the world is in a conspiracy to hold the profession back, or that the engineer does not have the place in public life to which his work and service entitle him. In the long run most of us get just what we deserve, whether we are engineers, lawyers, doctors, merchants or bootleggers. If this be true it remains for us to find the trouble and the remedy in ourselves.

We frequently enjoy having one of our number, or better yet a prominent man from another state, tell us how much better public affairs would be conducted if only engineers were in charge of those affairs. Such discussions always imply that the engineers have all the necessary requirements but that some intangible something prevents them from attaining those positions. Has your work or mine, that of the average member of this society, ever been such as would lead anyone to guess that we had those qualities? Your committee believes that, potentially, the engineer has the qualifications necessary to a successful handling of public affairs, but that some of the very necessary of those qualifications are, at this time, only potential. These qualifications exist but they have not been developed nor used. Too many of us are "kidding" ourselves into believing that a desire to hold positions requiring those qualities is equivalent to a certain knowledge that we do possess them. Until engineers choose to develop and use those qualities, this talk of the value of the engineer in charge of public affairs is going to continue to be largely talk.

The question of whether the engineer wishes to step out of the strictly technical field into this broader field seems to be answered, so far as this organization is concerned, by the frequent discussions of these subjects, and your committee felt free to consider it because it is unfair to expect a little publicity work to furnish all the power to operate the elevator to fame and recognition.

What is the outstanding difference, so far as this consideration is concerned, between the doctor, merchant or attorney who gets behind some project of public improvement, and the average engineer? Simply this. The doctor or attorney considers the improvement from a general standpoint as a citizen, while the engineer considers it from the standpoints of materials, stresses and economics. The successful promoter considers the problem in terms and from a viewpoint which the general public can understand; the engineer's terms and viewpoint are so almost wholly "Greek" to the public that they hardly know whether he has considered it at all. So long as the engineer confines his efforts wholly to his technical work as an engineer, the public cannot know much about him.

The engineer cannot educate the public to his viewpoint, at the start at least, so if he wishes to put the elevator into operation he must adopt the viewpoint of a citizen and work as a citizen of his community. If he renders this sort of service along with his technical service, the public can and will recognize his value and importance. Publicity is necessary, but it is only one part. When the engineer thinks and talks as engineer-citizen he will recognize more "news stories" in his work, and will do more work that is of itself news. If he continues this development he will soon reach a stage where he will "receive" publicity—he won't have to "get" it.

All of us hear statements that "the society or the profession ought to do so and so." What idea is back of such a statement? Too often it is an idea that the society or the profession is an abstract something, the speaker having no direct connection with the doing of those things though he may come in for a part of the benefit. When each engineer will speak and think of his society and his profession as "we" instead of "they," and realize that he is speaking and thinking of a group of individuals and not an abstract "it" or "they," advancement of the profession through society efforts will be certain. Upon these principles the committee has based its work. It has concluded that legitimate publicity for the engineer's work is necessary and that before the engineer can change his status greatly he must think and act as a citizen as well as an engineer.

As we see it, it is up to the engineering profession. If the members are willing to pay the price in work they can attain any status or place they choose, but we cannot get something for nothing from the profession any more than we can from the Iowa Engineering Society or the corner grocery.

After a consideration of the needs and possibilities the committee decided on a short intensive program. (1) Letters to each member of the society asked him to prepare, and offer to his local paper, a description of the interesting features of his season's work; this letter to be followed in two weeks by a follow-up letter to jog his memory if he had laid the first aside and forgotten it. (2) Some engineers in each county were requested to take the responsibility of seeing that a tax-analysis diagram for his county be prepared and copies placed in the treasurer's office and the bank at tax-paying time. Each man was left free to organize the plan of procedure as he saw fit, except that we suggested that the work be done through and credited to local clubs where such clubs were formed.

It was realized that some members would not be in a position to prepare and publish articles because of their connection with organizations having a designated publicity officer, or because of their employment as subordinates, but we felt that all should know what we were trying to do. A number of letters were received explaining why the writers could not do as we suggested. Some replies indicated confusion in the minds of the writers as to the difference between news stories and the longer descriptive feature articles. There was some tendency to criticize the papers for refusing to print write-ups of the latter class as regular news items. Irrespective of what we may think of the relative importance of what is printed and what is submitted, we must realize that if we are going to play the newspaper man's game we must play it his way, at first at least, because he hasn't asked us to come over into his yard to play.

In only one case did the submitted articles show any tendency to attempt to use the write-up as a means of personal advertising. Many of the articles were really good boosts for the engineer in question but he was mentioned only in the manner necessary to describe the work.

Twenty engineers sent in clippings or reported that articles had been published or accepted for publication, an average of one out of each twenty-five members.

Our batting average in the tax-analysis work has been more gratifying. Replies have been received from the men in 38 counties, all but three expressing approval of the plan and promising to prepare and place the diagrams.

Lower Mississippi River Problems Discussed at New Orleans

Papers Describe the Methods of Flood and Navigation Control and Discuss Necessity for Change in Accepted Methods

FOLLOWING the recently inaugurated policy of concentrating the technical features of the quarterly meetings on some one phase of engineering, the spring meeting of the American Society of Civil Engineers at New Orleans, April 18-20, was devoted to "The River and Harbor Problems of the Lower Mississippi." Two technical sessions were held at which eleven papers were presented. Unfortunately the time allotted was too short to permit full discussion so that the proceedings consisted mainly in the presentation in abstract of papers available in preprint form.

The papers fell roughly into two classes; those descriptive of the navigation control and operation on the lower river and those concerned with the matter of flood control. The former, being plain statements of fact, admitted of but little difference of opinion; the latter, on the contrary, were of a highly controversial nature and promised considerable discussion, which as it turned out, will have to be held over for the "Proceedings" of the society.

History of River—Maj. Gen. L. H. Beach, Chief of Engineers, U. S. A., opened the descriptive papers by an exposition of the "Work of the Corps of Engineers on the Lower Mississippi." He said that the Mississippi was not to be compared with the European rivers on which most of the science of river hydraulics is based. It is much larger, has prolonged rainfalls in its drainage where those in Europe are fed slowly from melting snow, is silt bearing to a high degree and of great variability in volume. All of these facts make the rules laid down abroad of limited value here. General Beach recited the history of the control of the river, the slow elevation and prolongation of the levees, the two pass developments at the mouth and the steady improvement of the banks and levees against caving. He said that the river needs continued study and more money. When the flood crises come all the engineers can do is to watch the critical places and fight the floods by the accepted methods. He referred to the work at the Passes as the most difficult task in engineering in the world today, the one place where sufficient money is of little importance. General Beach did not refer specifically to any method of flood control or to the proposed spillway at New Orleans.

Sydney F. Lewis, of the Louisiana State Engineer's office, said in discussion that it was imperative for control of the lower river that there be a complete levee system, and that the bank protection be carried forward. There is more danger from caving than from overtopping.

Success of Levees—A. L. Dabney, consulting engineer of Memphis, Tenn., presented in abstract a paper entitled "Success of the Levees During the Flood of 1922." In general he said the system was proved successful last year for in the 1,000 miles between Cairo and New Orleans, with 1,400 miles of levees only partly up to commission standard, there was only one break and that in a levee 24 ft. below standard. There were two breaks below New Orleans, also in non-standard sections. He admitted that there would have been more breaks had it not been for determined fights at numerous points but such fights are a part of the system of levee control. He cited the following tabulation of levee breaks in recent floods:

Year	No. of Crevasses	Area Flooded
1882	700	100 per cent
1912	15	30
1913	7	10
1916	1	5
1922	1	1

As a result he concluded that any engineering project which functions 99 per cent, as did the levee system in 1922, is a success, particularly when progress has been made as indicated in the table. Mr. Dabney further presented his prediction as to prospective flood heights based on the best present knowledge, as follows: Cairo, 57; Memphis, 47; Helena, 57; Baton Rouge, 48.5; New Orleans, 24. He believed levee heights 4 ft. above these gages would insure safety against greatest possible flood.

Spillways—John Klorer, city engineer of New Orleans, in a paper entitled "The Flood Problem of the Lower Mississippi River," gave the view of those who are not entirely satisfied with the "levees only" theory of control and who feel that spillways below New Orleans would tend to relieve that city from danger in extreme floods. He referred to the report of the "Safe River Committee of One Hundred" described in *Engineering News-Record*, Jan. 4, 1923, p. 21, and its recommendation for a spillway near the site of the Poydras crevasse, ten miles below New Orleans on the east bank of the river. Of the "levees only" theory and the safety of the proposed spillway, he said:

> The policy of closing off basins or parts of basins in the upper districts regardless of providing facilities in the lower river for safely passing the extra amount of water thus sent to it seems to have met with little opposition until recently. The attitude of complacency heretofore existing in this part of the state to such procedure may be attributed to accepting unquestionably certain doctrines preached by the Mississippi River Commission most prominent among which was the following: "An alluvial stream flowing in a bed of its own formation will ultimately scour out a channel to accommodate its flow." The high authority pronouncing this dictum was responsible for the hope that was aroused in the minds of the people of the valley that an application of the confinement theory would in due time enlarge the section of the river and eventually take care of the floods at lesser heights. Twenty-five years application of this theory on the lower river under the most favorable circumstances have showed no indication of the fulfillment of this doctrine. The very opposite conclusion is inescapable to anyone who will compare recent discharge measurements with those of former years. The people of the lower valley hailed with delight the announcement in 1914 of an ultimate levee grade based on an ultimate high water, believing that the upward revision of levee grades had at last come to an end. But they have since viewed with distrust the gradual degradation of the term "ultimate grade" into the term "approximate ultimate grade" and now the more recent term "present provisional levee grade."
>
> The advocates of the Lake Borgne Spillway did not contemplate that it would be possible to maintain the bed of the spillway channel without erosion. It was recognized that erosion would follow and as an attempt at directing the location of the erosion it was believed that in building the side levees, these should not be built from excavations taken near the berm, but should be built by hydraulic

dredge, digging a pit along the axis of the proposed channel to induce as much as possible the scour to take place midway between the side levees. Manifestly it would be desirable to permit the discharge from the spillway to dig a channel for itself and depress its bed or entrench itself for the entire five miles from the lake to the weir. By bringing gulf level from Lake Borgne to the flexible concrete mattress apron provided at the rear of the weir, the problem of maintenance could be localized and better handled.

As to the danger of the structure washing out on account of the character of the foundation and insufficient dimensions, this is a question open to discussion after examination of a suggested plan that was prepared for the consideration of the government authorities. It was recognized from the start that the plan as submitted and as finally decided on might involve considerable modifications. For instance no study was given to the hydraulic jump feature as a means of dissipating some of the energy of flow. The shape of the rear surface of the weir should be dependent on the outcome of observed results on experimental models constructed to scale. The question as to the proper width of the flexible concrete mattress beyond the rock cribs while shown as being 200 ft. wide was also recognized as being a detail open to further discussion. A combination of the rigid type of structure typical of American practice, and of the flexible type of structure, as practiced in Egypt and India, was chosen, since both types seem to have desirable features.

With reference to the boldness of the undertaking to relieve the Mississippi River of 250,000 sec.-ft. over a weir 6,600 ft. long, constructed on a clay foundation, the job does not rate in magnitude with similar structures successfully executed by English engineers in India, notably the Dehri Weir (on the Sone River) which is 12,500 ft. long, and constructed on a sand foundation, and with a discharge capacity of 830,000 second-feet.

The flood of 1922 will be memorable in this end of the valley for many years, not by reason of the record-breaking elevations attained by the river that year, for these will be exceeded before many more years, but by reason of the sweeping aside of many of the traditions, theories, and folklore ideas concerning the flood control of the Mississippi River.

No longer will the people of the lower Mississippi valley believe the doctrine that you can put more water into the river and not raise the flood elevation appreciably. No longer will they believe that if you take water out of the river, it will not lower the flood height appreciably. Fine spun theories about the peculiar behavior of sedimentary streams under the conditions mentioned will no longer convince them to the contrary. The fallacy of these teachings was completely proven in 1922; closing Cypress Creek gap disproved the one, and Poydras crevasse disproved the other. As a result, there has been a slow sloughing away of the confidence previously felt in the "levees only" theory and an insistent demand for some additional form of flood control—a form of flood control that spells lower flood heights, not higher flood heights—a form of flood control that provides not only for flood protection—but for flood relief as well, and the proposed spillway into Lake Borgne will partly afford the desired relief.

Col. C. McD. Townsend (retired), Corps of Engineers, U. S. A., and formerly president of the Mississippi River Commission, had prepared a written discussion of the flood-control problem and the proposed spillway, which he presented only in brief abstract. He said that the demand for a spillway was only a repetition of post-flood activity for the past 75 years. In 1852, according to Humphrey and Abbott, the same arguments as today were given only to be refuted. Colonel Townsend said that spillways are impracticable mainly because of the difficulty of disposing of the water through them and not because of any impediment to navigation due to shoaling of downstream channel. If a spillway was to be built below New Orleans there are, he said, better sites than that through to Lake Borgne. Further, Colonel Townsend believed that he had absolute proof that the river was deepening its channel and, as a result, the levee system would not have to be indefinitely raised. He admitted that it was obvious that spillways, outlets or crevasses would all cover flood heights: That is not now the debatable question. The problem is the practicability of building and holding spillways and their economic necessity, considering the status of the levee system existing.

A final paper involving the question of flood control, though only indirectly, was the plea for a government experimental hydraulic laboratory by past-president John R. Freeman. Mr. Freeman's paper was in print, an elaborate discussion of the present state of knowledge of river hydraulics, a description of the few experimental laboratories of the kind sought, and the suggested design for the one prepared in Senator Ransdell's bill of the last Congress. In brief, Mr. Freeman's argument is that while there is no certainty that the Mississippi flood problem will be solved in the miniature channel which can be set up in a laboratory, there is a chance worth taking that investigations possible in such a laboratory will contribute much to our knowledge and practical applications may result. In conclusion Mr. Freeman took exception to the dictum of Mississippi River engineers that the river must not be straightened but must be led around the many bends it has established. He said this is a theory based mainly on navigation requirements and while he did not insist on the straightening theory as the solution of flood troubles, he did contend that there might possibly be more in it than its opponents admit and that it was worthy of more serious consideration than they are willing to give it.

Lieut. Col. E. J. Dent, Corps of Engineers, U. S. A., the district officer at New Orleans, took exception to Mr. Freeman's theory that the behavior of so tremendous a river as the Mississippi could be predicted from a miniature stream.

Papers on the port and navigation problem consisted of a general description of the port of New Orleans by John F. Coleman, consulting engineer to the Board of Port Commissioners at New Orleans, and of the whole question of lower river ports by S. M. Young, chief engineer of the same body. Both engineers pointed out the difficulties of construction on the alluvial silt and of freight handling design for a varying stage of twenty or more feet. The final papers were in advocacy of increased river transportation.

Additions to Wood Block Specifications

Two new sections were added to the specifications for wood block street paving and flooring which for some time have been before the American Wood Preservers Association. The specifications were adopted as standard. Bituminous mastic cushion consisting of 10 per cent of bitumen, either coal tar or asphaltic oil, and 90 per cent of clean, dry, screened sand may be used instead of a cement-mortar cushion. To permit the mastic to cure it is to be spread a day in advance of laying the blocks. A maintenance clause calls for inspection each summer and a surface treatment of light tar ([illegible] to [illegible] gal.) and sand when the pavement shows signs of shrinkage or open joints.

From Job and Office

Hints That Cut Cost and Time *For the Contractor and the Engineer*

Five-Story Chicago Warehouse Moved in Two Directions

HAULING a 4,000-ton building by cables instead of pushing with jacks was the method adopted in moving the five-story warehouse owned by B. A. Eckart and occupied by the Continental Paper Bag Co. on North Ada St., Chicago, when its original site was acquired for the extension of Ogden Ave. It was necessary to move the building 110 ft. south and then 220 ft. west to its new location, where foundations had been built in readiness. Cable haulage was adopted because of the greater speed possible over jacking, which latter is very generally used in moving buildings of this type. Hauling in this case averaged a distance of 64 ft. per day, with a range of 45 to 90 ft. The work in progress is shown in Fig. 1.

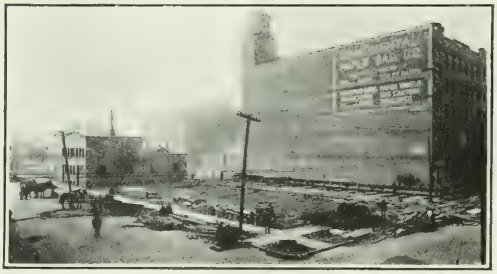


FIG. 1—MOVING A LARGE WAREHOUSE IN CHICAGO

The building has been moved south and is ready for changing the supports to move west to the rear of the two-story structure at the left.

This building, erected in 1908, is 70 x 125 ft. in plan, with brick walls and heavy timber framing, the columns carrying beams on which are laid laminated wood floors and a wood roof. The bays are mainly 15½ x 16 ft., but with side bays 15½ x 18 ft. The floors are 2 x 6-in. sticks placed solid and on edge, with maple flooring nailed over them. As this flooring rests on brick pilasters and is not anchored into the walls, as where joists are used, the precaution was taken to tie the longer walls together at the fourth and fifth floor levels by means of four heavy tie rods with nuts bearing on pieces of steel channels placed horizontally against the outside of the walls. In the first story, four inclined shores were placed at each column and wedged up against the cap, as shown in Fig. 3, in order to distribute the load over the blocking built up under the first floor. Doorways and elevator openings were shored up with posts and jacks. Except for this shoring and the tie rods no reinforcement was made to the building in preparation for the move. There was no manufacturing machinery in the building. One of the long walls was a party wall. The loads per square foot were estimated at 3,740 lb. under the brick tower carrying the water tank, 3,715 lb. under the party wall, 3,400 lb. under the other walls and 2,420 lb. for the column footings.

Adjacent buildings had been torn down and as these were small unimportant structures there were no basements to be crossed after the warehouse had moved clear of its own basement. The line of travel crossed an alley but no streets. After the ground had been leveled it was practically floored with timbers 12 x 12-in. laid longitudinally in the direction of movement. Across these were laid timbers 6 x 6 in. supporting sixteen pairs of 60-lb. rails, the rails of each pair being 12 in. apart and carrying the 3-in. steel rollers on which the building moved. The arrangement of timbers, rails, saddles and rollers is shown in Fig. 2. Blocking between the upper timbers was placed under the rails, which were leveled up by wood shims as directed by an instrument man with level. At first the rails were not connected, but afterwards it was found desirable to use ordinary splice bars and bolts. Without the splicing the leaving end of one rail would droop under the load, so that the entering end of the next rail formed an obstruction to the rollers. With the spliced joints the rails deflected uniformly.

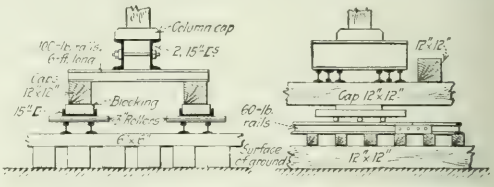


FIG. 2—ROLLING SUPPORTS FOR BUILDING

Raising the building about 3 ft. from its foundations was the first step and this was done with about 1,200 ordinary house-moving screw jacks. Most of these were of cast iron, rated at 5 tons load each, but there were also cast-steel jacks rated at 15 tons. Timber blocking was then built up in the basement to support the cap timbers and rails.

Traveling Supports—Under each of the end walls transverse to the line of movement were placed two lines of 12-in. I-beams across which were laid needles or short pieces of similar beams on which were timbers and wedges driven tight against the bottom of the wall. Across the building and parallel with the line of movement were I-beams extending the full width, and between their webs were wedged heavy

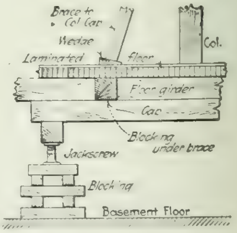


FIG. 3—FIRST-FLOOR BLOCKING AND COLUMN BRACING

timbers so as to form a rectangular framing. In addition to the continuous lines of I-beams there were four massive timbers 20x20 in. extending across the full width of the building so that there was no separate strain on the walls during travel.

Each basement column cap rested on a pair of 15-in. channels spaced about 16 in. apart and held together by long bolts. As the building was raised the basement columns dropped out. The channels in turn rested on two pairs of short rails laid across the cap timbers. Beneath the cap timbers were the lines of 60-lb. rails, with rollers and saddles fitted between the rails and cap timbers, as shown in Fig. 2.

These saddles were placed opposite each column and each wall pilaster. Each saddle consisted of a 15-in. channel 3 ft. 6 in. long with its flanges upward and the web carrying blocking wedged against the cap timbers. This channel rested on three 3-in. steel rollers laid across the pairs of 60-lb. rails already mentioned. Each saddle was estimated to carry about 17 tons, or nearly six tons per roller.

Haulage System—At ten points in the 125-ft. length there were attachments for the hauling system. At each of these points a pulley was shackled to a cable extending to the far side of the building and wrapped around a timber laid across the ends of the 12-in. I-beams. In this way the hauling strain was taken in compression instead of tension on the framing which supported the building. Three capstans were anchored about 275 ft. from the building, each having a ⅝-in. cable and operated by a team hitched to a sweep. The cable layout is shown in Fig. 4. The main cable was continuous between the two end capstans, being passed through the blocks already mentioned and a line of blocks anchored to deadmen in front of the building. In order to equalize the strain, however, a pulley was placed in the middle bight or loop and was attached to another block in the bight of a short cable from the middle capstan.

The three teams were started and stopped simultaneously by whistle signals to the drivers. When the central traveling pulley came up to the capstan, work had to be stopped while it was moved back to take up the cable slack.

Moving 110 ft. south occupied two days. Then the entire framing system had to be changed to put the continuous lines of beams in the direction of the new movement westward. This next move of 220 ft. was accomplished in three days.

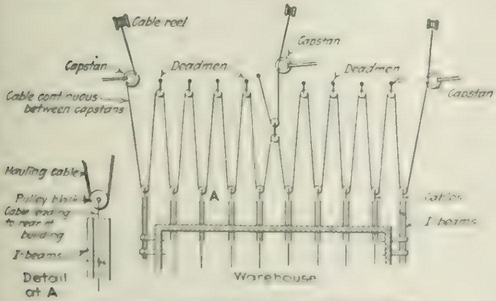


FIG. 4—LAYOUT OF HAULAGE CABLES

The final operation was underpinning the structure on its new foundations. By means of jacks it was lowered to the desired elevation, and brickwork was then built up tightly between the beams to fill the space between the foundation walls and the building walls. After the mortar had set, the timbers and needles were removed and the openings were bricked up. Concrete caps were built up on the concrete piers under the interior columns, 2 in. below cast-iron base plates, and this space was grouted through holes in the plates.

This moving work was carried out by the L. P. Friestedt Co., Chicago, under the personal direction of Frank P. Noe, president. The architects for the building were Zimmerman, Saxe & Zimmerman, Chicago.

Homemade Road Shoulder Shaper

By E. B. Blough
Superintendent of Construction
Illinois Division of Highways, Dwight, Ill.

After having tried for several years to accomplish fine shoulder grading on improved highways with a road grader, the writer became convinced that due to the fact the grader's wheels had to travel on the graded shoulder extremely fine work was impossible. The machine herewith illustrated was devised.

IMPROVISED FINISHER IN OPERATION

Details of the sort of machine wanted were worked out first and taken to a local foundry and machine shop for an estimate. The estimate given of $200 was considered too excessive for an experiment so the chief mechanic and helper on the work made the finisher. They put in about three days making and assembling and trying out the machine. The total labor cost on it was about $35, and the material, besides the bolts, consisted of angles, I-beams and channels which were taken from the scrap pile collected from old bridges replaced. Reserve blades for a subgrader were used for the shoulder finisher blades. A few fish plates, bars, pins, hinges and old cable resurrected from the junk pile also were used.

The machine was tried out and worked even better than it was expected because it was found that in freshly graded dirt it quite easily cut 6 in. and disposed of it either on the ditch slope or in the ditch itself. As there was no lever for the adjustment of the blade, holes one inch apart were put in the bars the blade frame is attached to. Thus a finer adjustment was possible by removing two bolts on each side. The width of the shoulder cut can be regulated by sliding the I-beams to which the blade frame is attached out or in as is needed, or by changing the line to which the truck is driven.

The finisher was attached to a trailer and pulled by a three-ton truck. A stick was fastened crosswise of the radiator and extended towards the center of the pavement far enough so that a chain could be hung from it to drag on the center crack in the pavement when the truck was in the right position to give the desired width of shoulder. With this arrangement a good truck driver was able to drive in almost perfect line, therefore getting a practically perfect shoulder.

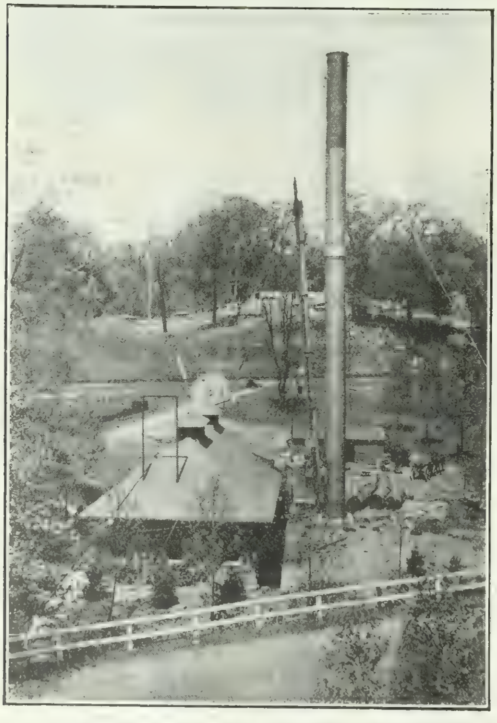
It was found that if the shoulder was graded to within three or four inches of finished grade and left a few inches wide, a second trip with the finisher gave an almost perfect shoulder and slope, leaving but little hand work and that only at culverts, bridges and side roads. It was also found that in a few places the original grade was so heavy that a considerable amount of dirt was left in the ditches after the finisher went over. In most cases this could be smoothed off with a drag without disturbing the general line of the shoulder or the grade of the ditch.

Steel Stack Used as Mast for Derrick in Replacing Other Stacks

By George F. Paul

Chicago, Illinois

IN DISMANTLING and erecting three smokestacks at the Nassau branch of the Brooklyn Union Gas Co., considerable ingenuity was shown in using one of the stacks as a mast in forming a derrick by means of which the other stacks were handled. The stacks were 48 in. in diameter and 95 ft. high. They were of $\frac{1}{4}$-in. steel and weighed 13,680 lb. each. The roof over the stacks was slate resting on light angle iron strips and would just about stand the weight of a man, so it was impossible to work from this roof.



STEEL STACK USED AS DERRICK MAST

The workmen first removed some slate from over the building wall at the edge of the roof and then rigged up a 72-ft. pole weighing about two tons on this wall. Then they rigged up an 82-ft. pole alongside of the building, and dismantled and re-erected the end stack. Next they had this stack secured with an extra heavy back guy, then rigged the 72-ft. pole on this stack by lashing a steel wire around the stack and one around the base of the pole and securing a swivel in both lashings. The second stack was picked up and swung around to the 82-ft. pole and lowered to the ground. When the second stack had been re-erected the 72-ft. pole was then rigged on the center stack. The 82-ft. pole was standing in an alley which it was necessary to maintain unobstructed as coal was being taken through this passage-way at all times for the making of gas. This work was completed in 17½ days by the National Trucking & Rigging Co., Brooklyn, N. Y.

From Job and Office

Hints that Cut Cost and Time

Four Problems in Surveying

By L. F. Hammond

State Highway Department, Clintonville, Pa.

TO CHECK the offsets or lay-off a templet, strike-off, or subgrade tester on a circular curve at any point for any crown rise or pavement width use the following formula:

$$y = C\left[\frac{x}{d}\left(\frac{x}{d} - 2\right) + 1\right].$$

y = depth below crown at point "x", x = distance from outside edge of pavement, d = ½ width of pavement, C = crown rise.

To make a joint at right angles to a 16-ft. road, measure from a chalk mark on the inside edge of form 12 ft. along same, then diagonally 20 ft. to a point of intersection on the other form, which is directly opposite the first mark. For an 18-ft. road use distances of 24 ft. and 30 ft., respectively.

Where a railroad preliminary line has been superimposed on a map with given elevations the following method will give grades on curves for compensation.

Multiply the length of each curve by the degree of curve times the compensation factor; to the sum of the products add the difference in elevation between the first and last station and divide by the horizontal distance. This will give the grade in per cent for the tangents. Then for each curve deduct the degree of curve multiplied by the compensation and the result is the grade on the curve.

Example:

Length of section of a 5-mile line, Sta. 0 to Sta. 64 is 6,400 ft., difference in elevation 64 ft.; 10 tangents, total

From Job and Office

For Contractor and Engineer

2,750 ft.; four 12-deg. curves totalling 1,410 ft., four 8-deg. curves, total 930 ft.; and one 3-deg. curve of 740 ft.

$14.10 \times 12 \times .035 = 5.922$ $(.035 = \text{compensation factor})$.
$9.30 \times 8 \times .035 = 2.604$
$5.70 \times 6\tfrac{1}{2} \times .035 = 1.297$
$7.40 \times 3 \times .035 = .777$

10.600
64.

64)74.600

Tangent 1.1656%

Compensated grade for
12 deg. $1.1656 - (12 \times .035) = .7456$
8 " $1.1656 - .28 = .8856$
6½ " $1.1656 - .2275 = .9381$
3 " $1.1656 - .105 = 1.0606$

In tying in two surveys and desiring to reduce them to one set of co-ordinates, the differences "m" (long.) and "n" (lat.) and angle "a" of the azimuths are known. The corrected co-ordinate of any point "p" can be determined:

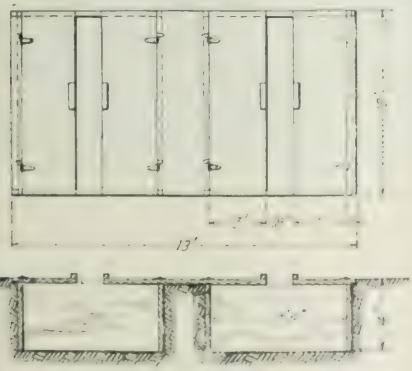
$x = (x' + y' \tan a) \cos a \pm m = x' \cos a + y' \sin a \pm m$
$y = (y' - x' \tan a) \cos a \pm n = y' \cos a - x' \sin a \pm n$

If "a" is under 10 ft., $x = x' + y' \tan a \pm m$; and $y = y' - x' \tan a \pm n$.

x and y are corrected co-ordinates, x' and y' co-ordinates to be changed.

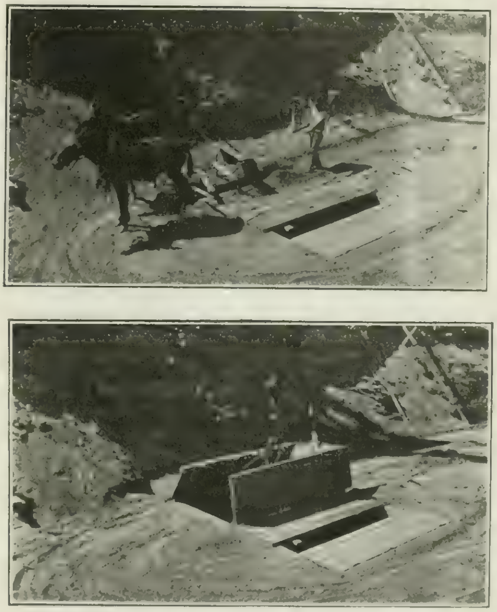
Fresnos Deliver Direct to Skips in Traps Under Hinged Covers

IN FINISHING the last of the excavation and trimming the slopes of the intake canal on the Pit River project in California, after the steam shovel has been taken out, it was necessary to lift a considerable yardage of earth from the bottom of the cut which is about 50 ft. deep. The quickest and cheapest means of getting this material to the top of the cut was by means of a skip operated with stiff-leg derrick on the edge of the cut. A suitable derrick was already on the job, having been used in the canal operation. The material could best be collected and delivered to within reach of the derrick boom by means of Fresno scrapers. It was therefore decided to devise some means of loading skips direct from the Fresnos.



PLAN AND ELEVATION OF TRAPS BUILT IN THE BOTTOM OF THE EXCAVATION

To accomplish this a pair of pits or traps were dug, lined with plank and covered by hinged plank doors, as shown in the accompanying illustration. With an empty skip in one of these traps and the covers closed, earth was dumped from the scrapers through the space between the covers into the skip beneath, this dumping process being continued until the skip was loaded. A laborer stationed there for the purpose would then shovel into the skip any material left on the cover and attach the skip chains to the hook lowered from the derrick.



DEVICE FOR LOADING SKIPS DIRECT FROM FRESNOS IN FINISHING DEEP OPEN CUT

Above, Fresno dumping into skip in trap through space between covers.
Below, Skip being lifted out of trap by derrick, raising the covers automatically as it rises.

In the process of lifting the loaded skip the doors would automatically be opened and would remain open ready for the return of the empty skip. In this way the final cleaning up of the cut was done quickly without the use of many men or much equipment. By using two skips and filling them alternately the teams could be kept busy continuously while alternate skips were being handled by the derrick.

The work was under the direction of O. W. Peterson, construction engineer for the Pacific Gas & Electric Co., from whom the foregoing information was obtained.

From Job and Office

Hints that Cut Cost and Time

Computation of Areas Mechanically

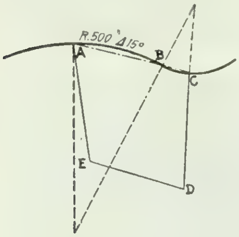
By Reeve Conover
Del Monte Properties Co., Pacific Grove, Calif.

THE following system is in use in this office for working traverses and areas in the curved subdivision of a tract of about 5,000 acres belonging to this company.

Traverses—Write courses and angular functions, and set the north and east co-ordinates of point "A" in cols. 5 and 6 as shown in tabulation.

(1) Cos.	(2) Stations & Bearings	(3) Sin	(4) Distance	(5) North Co-ordinates	(6) East Co-ordinates
....	"A"			985 42	617 55
. ..	N 10° 00′ E		165 14		
.98481	.	.17365			
..	"B"			1,148 05	646 23
..	N 65° 00′ E		543 14		
.42262		.90631		.... .	
..	"C"			1,377.59	1,138 48
.	S 80° 00′ E		114 25		
.17365		98481		.... .	
...	"D"			1,357.75	1,250.99

Set the north co-ordinate of "A" in the lower dial of the calculating machine with the decimal point seven places to the left (985.4200000), then set .98481 (cos. of 10°) on right hand side of keyboard. Turn operating crank ahead, as for multiplication, until 165.14 appears on upper dial. The lower dial then shows 1148.05 which is the north co-ordinate of point "B"; clear keyboard and upper dial only and proceed in a like manner to obtain the north co-ordinate of "C"; in figuring the third course the operating crank should be turned backward, as for division, as this course runs south and the operation is subtractive. Continue until all north co-ordinates are computed, then figure the east co-ordinates in the same manner, turning ahead for east and backward for west.



AREA CONTAINING CURVED BOUNDARY

This assumes that the origin of co-ordinates lies south and west of all parts of the area under consideration. This method eliminates the necessity of knowing the "latitudes" or "departures" as the co-ordinates are taken directly from the machine, which multiplies and adds (or subtracts) simultaneously.

Areas—To figure the area of the foregoing, having completed the closure, write the co-ordinates as follows:

	(a)	(b) North Co-ordinates	(c) North Differences	(d) East Co-ordinates	(e) East Differences
1	"A"	985 42	.	617.55	
2	"B"	1,148.05	—392.17	646.23	+520.93
3	"C"	1,377.59	—209.70	1,138.48	+604.76
4	"D"	1,357.75	+613 76	1,250.99	—422.27
5	"E"	763.83	+372.33	716.21	—633.44
6	"A"	985.42	—384.22	617.55	—69.98
7	"B"	1,148 05	.	646.23	...

The values in Column (c) are differences between alternate north co-ordinate values, thus 1377.59 — 985.42 = 392.17; and Column (e) gives differences between alternate east co-ordinate values. The algebraic sum of each of Columns (c) and (e) is zero. Multiply Columns (c) and (d) together and check by multiplying Columns (b) and (e), leaving the resultant of the operations in the lower dial. Individual products do not need to be considered as the final result is their algebraic sum; in the above case, 305,028 sq.ft. This is twice the area of the figure and the acreage is obtained by dividing by 87,120.

Figures With Curved Boundaries—

In computing the area of the figure shown in the figure herewith write the co-ordinates of points *A* to *E* inclusive and compute, as shown above, the area *ABCDE*. Add to this the area of the segment lying along *AB* and subtract that of segment along *BC*.

The area of a segment $= R^2(\Delta - \sin \Delta)$, the angular value in the first term being in radians which is the value given in the tables usually called "arcs for radius 1". Thus the area of segment along *AB* is

$$250000 \frac{.26180 - .25882}{2} = 372.5 \text{ sq.ft.}$$

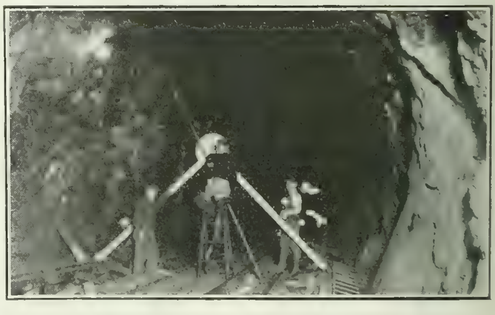
In this office we have computed and blueprinted a table giving the values of $\Delta - \sin \Delta$ for each minute of arc and to five decimal places. We also have a circular slide rule graduated for these values and for *R*, which gives double segment areas at one setting to a degree of precision sufficient in most cases.

Inexpensive and Effective Tunnel-Gun

By Aaron Evans
Rockport, Wash.

AN EFFECTIVE tunnel-gun made on the job at little expense is being used in the construction of Seattle's 11,000-ft. pressure tunnel. Construction was as follows:

Jumbo tracks were laid to line and grade near the intersection of the side walls and the tunnel invert. These tracks are a constant distance from the tunnel center line. A cross-section device was built to fit across these rails. The protractor was set in the center of the tunnel. It automatically becomes perpendicular and at right-angles to the axis if the feet are set properly on the jumbo tracks. A plumb line is then hung from the center of the graduated disk down past the 180-deg. mark. Once set a wing nut holds it in place.



INEXPENSIVE TUNNEL-GUN BUILT ON JOB

No time is lost in setting up this arrangement. The recorder limits the speed. The chainman of the engineering party doing the tunnel work built it under the supervision of W. D. Patterson, transitman.

From Job and Office

For Contractor and Engineer

Distant Reading or Recording Extensometers

SUCCESSFUL distant-reading and recording extensometers have been developed by the Bureau of Standards, using the principle that the resistance of a carbon contact varies with pressure or with displacement. Past attempts to make use of this principle for similar purposes met several vital difficulties: the contact resistance is erratic and its calibration cannot be depended upon; hysteresis effects make the indications of the instrument different when going up and down; the readings obtained are not directly proportional to the action measured. All these difficulties have been investigated in detail within the last two years, and means have been found to eliminate all of them to such a high degree as to make the apparatus well adapted to a great variety of engineering measurements. For the purposes of the civil engineer the most interesting application is to extensometers. Strains, accelerations, vibrations, and pressures can be measured by similar instruments; the instrument can be made either indicating or recording. In tests of large structural members and in connection with certain dynamometer work the Bureau of Standards has found the new instruments to be substantially equal in accuracy to anything heretofore available, with the great advantage that the reading can be obtained at a distance and can be made autographically. Both indicating and recording instruments of this type have been used by the Bureau of Aeronautics of the Navy Department for measuring stresses in airplane members and in parts of dirigibles, and instruments of 8-in. gage length are being used to measure the web strains in the wide-web column tests now being carried out for the Delaware River Bridge Commission by the Bureau of Standards.

Strength of Boiler Steel Independent of Rate of Loading

Tests by H. J. French at the Bureau of Standards reported in Technologic Paper 219, just issued, showed that the tensile properties of firebox steel at normal temperature and also at temperatures up to and including the blue-heat range (565 deg. F.) are independent of the rate of loading. The tests were made at varying rates of stretch, up to 1.6 in. per minute. There was little noticeable change in either tensile strength, elastic limit or ductility even up to the highest temperature of testing, 865 deg. F., though the author records a slight increase in tensile strength with rate of loading at this temperature. Exceedingly slow loading, in which the applied load was increased 100 lb. at five-minute intervals while testing the proportional limit and somewhat beyond, with subsequent ruptures at normally slow testing machine speed, was also tried. In these tests the increase of stress was at the rate of about 10,000 lb. per square inch per hour. At moderate temperature, 350 deg. F., this slow loading gave somewhat increased strength and slightly reduced ductility, but at temperatures of 563 and 865 deg. F., the effects were the opposite.

Slide Rule Solution of the Cosine Formula

By John R. Jahn
Williams and Jahn, Consulting Engineers, Berkeley, Calif.

THE usual formula for finding the length of the third side of a triangle when two sides and the included angle are known is unwieldly and can be simplified for slide rule checking. This can also be used for finding the distance between points located by stadia sights where lengths of rays and bearings to points are read.

In the formula $c^2 = a^2 + b^2 - 2ab \cos C$, a and b represent sides of a triangle and C the included angle.

Then $$c^2 = ab\left(\frac{a}{b} + \frac{b}{a} - 2\cos C\right)$$

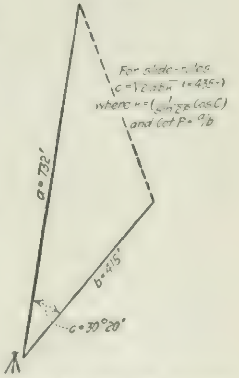
but $\frac{a}{b} + \frac{b}{a} = \frac{a}{b}\left(1 + \frac{b^2}{a^2}\right)$ and if $\frac{a}{b}$ is represented by cot P

then $\frac{a}{b} + \frac{b}{a} = \cot P \sec^2 P = \frac{1}{\sin P \cos P} = \frac{2}{\sin 2P}$

and $$2K = 2\left(\frac{1}{\sin 2P} - \cos C\right)$$

and $$C = \sqrt{2a\,b\,k}$$

On the Manheim slide rule the A and B scales represent the squares of the D and C scales. Scales T and S are on the reverse side of the rule and are to be read opposite the index in the "window" of the reverse side. Perform $\frac{a}{b}$ where $a > b$ and read angle on T. Double this angle and set on S scale. Read $\frac{1}{\sin 2P}$ on the A scale opposite **1** on the B scale. Then set the S scale to read **(90° — C)** (or cos C) and note value on the B scale under 1 at the right-hand side of the A scale. The difference between these two readings equals k. Then perform $2 \times a \times b \times k$ with the A and B scales, bearing in mind that the left half of either the A or B scales is for numbers 1-10 and 100-1,000 and the right half for numbers 10-100 and 1,000 to 10,000. The answer, or the length of the side "c," will be found on scale D opposite the above product.



STADIA PROBLEM SOLVED BY SIMPLIFIED METHOD

k may be written

$$\left[\frac{1}{\sin(180° - 2P)} + \cos(180° - C)\right]$$

for angles greater than 90°.

When $a/b > 10$ use the A and B scales instead of C and D and read angle on the S scale which is very nearly the same as cotangent for small angles.

In the example $a/b = 1.76 +$ and T reads 29° 33′ (= P). $2P = 59°\ 06'$ and $\frac{1}{\sin 2P} = 1.165$. Cos C is found to be 0.854 and $k = 1.165 - 0.854 = 0.311$.

Then $C = \sqrt{2 \times 732 \times 415 \times 0.311} = 435$ —

The answer found by the long method is 434.85, which the slide rule result checks.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Free Engineering Advice

Sir—I have before me a tract sent out by a manufacturing company to boost its product. It contains copies of the replies to letters which the mayor of a certain town wrote to numerous engineers and public officials throughout the country for advice as to the type of pavement advisable to use in paving one of the streets of his city. I have no fault to find with the product or the advertising of such products. What I do want to call attention to is the generosity of engineers in giving advice gratis.

The replies received were numerous and gave the opinions of the writers as to what was the best pavement to use. Some of the replies were qualified as suitable to certain conditions.

Now, how many replies would the mayor have received if he had sent out a circular letter to various attorneys throughout the country asking for their opinion on a legal matter? We think that the replies of all the attorneys would have been to "consult your local attorney." Only two of the more than fifty replies received from engineers advised consulting their local engineer or getting paid engineering advice.

After getting all this free engineering advice, the local authorities evidently considered that the advice was worth exactly what they paid for it—nothing, so they decided to call in another body of "experts," the abutting property owners, who decided the matter finally.

Various attempts have been made to have engineers live up to a certain code of ethics but with very little success. However, I am going to propose, not an addition to the code of ethics, but a simple motto—"If your advice is worth nothing, then don't give it. If it is worth something then don't give it—for nothing."

Pittsburgh, Pa., March 27, 1923. N. F. Hopkins.

Protest Against Giving Name O'Shaughnessy to a Second Water-Works Dam

Sir—In *Engineering News-Record*, April 12, 1923, p. 685, it is stated that the Board of Supervisors of San Francisco on March 26 adopted a resolution providing that the Hetch Hetchy Dam shall hereafter be designated as "O'Shaughnessy Dam" in honor of its builder, M. M. O'Shaughnessy, city engineer of San Francisco. It is greatly to be regretted that the Board of Supervisors has chosen a name the exact duplicate of one already selected for another dam and adopted officially more than two years prior to the action taken by the San Francisco officials. I refer to the "O'Shaughnessy Dam" now under construction in connection with the enlargement of the water-works of Columbus, Ohio.

Following the death, early in 1921, of the late Jerry O'Shaughnessy, superintendent of water-works of Columbus (Mr. O'Shaughnessy served that city for nearly fifty years in the water-works department), the City Council, by a resolution unanimously adopted on Feb. 7, 1921, designated that the new storage dam to be built across the Scioto River should be named the "O'Shaughnessy Dam"; and in the *Engineering News-Record*, Feb. 24, 1921, p. 349, brief mention was made of the fact that the new dam would be named in honor of Jerry O'Shaughnessy.

It might be well to state that the "O'Shaughnessy Dam," and by that name I mean the new dam at Columbus, is a masonry structure of the overflow type, and will be about 70 ft. in height to the crest of the spillway. The dam will have a total length of about 1,500 ft., of which length about 1,000 ft. will be of masonry. A roadway will cross the dam, and over the spillway section it will be supported by twelve arches of reinforced concrete, each having a clear span of 64½ feet.

That the new dam at Columbus is known in the engineering press as the "O'Shaughnessy Dam" is evidenced by the following references to the *Engineering News-Record*, all but the first of which are in the Construction News Section:

March 23, 1922, p. 510. Brief note referring to the construction of the dam, and stating that bids would be opened on Apr. 20, 1922.

March 23, 1922, p. 128, bids for the dam desired.

April 27, 1922, p. 198, bids had been received.

May 4, 1922, p. 215, contract had been awarded to the Columbus Construction Co.

May 11, 1922, p. 232, new bids desired, first bids having been rejected.

May 18, 1922, p. 845, statement that the bidder to whom the contract was awarded had refused to sign the contract, and that new bids would be received.

May 18, 1922, p. 255, schedule of bids as received on Apr. 20, 1922.

June 1, 1922, p. 275, contract awarded to the Thompson-Starrett Co.

June 15, 1922, p. 307, schedule of bids (main items), as received on May 25. 1922.

In each of the items just mentioned the work is referred to as the O'Shaughnessy Dam.

The contract for the work is known officially as Contract No. 10, for "The O'Shaughnessy Dam and Appurtenant Works," and in the contract is included the mounting of two bronze tablets on the dam. One of these tablets will give the names of the officials connected with the work; the other will bear the following inscription:

> O'SHAUGHNESSY DAM
>
> BY RESOLUTION OF THE COUNCIL OF THE CITY OF COLUMBUS, ADOPTED FEBBUARY 7, 1921, THIS DAM WAS NAMED AND DESIGNATED THE "O'SHAUGHNESSY DAM" IN HONOR OF THE LATE JERRY O'SHAUGHNESSY WHO SO FAITHFULLY AND WELL SERVED THE CITY AS SUPERINTENDENT OF ITS WATER WORKS FOR MANY YEARS.

It is unfortunate that the San Francisco officials, in renaming the Hetch Hetchy Dam, should have chosen the name "O'Shaughnessy Dam"; but from what has been presented above, it would seem clear that the City of Columbus, officially, has first claim on the name "O'Shaughnessy Dam," and therefore it would appear appropriate for the Board of Supervisors of San Francisco to rescind their action and honor M. M. O'Shaughnessy in some other way.

Baltimore, Md., April 16. John H. Gregory,
Consulting Engineer, Bureau of
Water-Works Extension, Columbus, Ohio.

Expansion Joints and Cemented Beds for Granite Blocks

Sir—Cracks and subsidences in stone block pavements are common and are caused commonly and respectively by expansion and contraction and by the shifting of the sand bed on which the blocks are laid. To lessen these damages the writer in a recent new specification for granit block pavement on concrete base and with grouted joints, has stabilized the sand bed by adding cement and has called for transverse expansion joints. The two clauses are as follows:

> CEMENT SAND BED: Not less than ten days after the concrete foundation has been completed, there shall be spread upon this foundation a bed of cement and concrete masonry sand, consisting of one part cement and four parts of concrete masonry sand of which the depth shall not be greater than 1 in. after rolling. The sand and cement must be thoroughly mixed dry before placing either by an approved type of mixer, or by hand on a mixing board or pan. The material shall be thoroughly mixed until a uniform color is obtained and should be spread on the foundation in this condition. The cement sand bed shall be struck off with a template and be brought to the exact form and section shown on plans to the required depth below the finished grade. After the bed has been leveled off it shall be rolled with a hand roller weighing about 300 lb. If any depressions develop they shall be filled in and the bed again leveled and the rolling shall be repeated as many times as are necessary to compress the sand bed. Tramping upon the cementbed is prohibited. The inspector shall keep the block culled and the contractor shall make the necessary changes and replacements so that the work at all times shall be ready for the grouting within 100 ft. of the pavers.
>
> All the block laid must be rammed ready for grouting at the end of the working period and each day's work must be completed in full.

Before the grouting is applied the rammed block shall be thoroughly wet by sprinkling. It is important that the blocks be well wet so as to set up the cement-sand-bed. An excess of water over that required and taken up by the cement-sand cushion must not be used.

EXPANSION JOINTS: Expansion joints shall be placed along each curb and shall extend from the surface to the subgrade and shall be ½ in. in thickness. Any suitable pour-tarred joint or premolded joint expansion material satisfactory to the engineer may be used. A transverse joint ¼ in. in width extending through from the surface to the sub-grade shall be made between each 50-ft. section or at such other spacing as may be directed by the City Engineer. The tarred felt transverse joint material will project above the finished pavement and when the pavement has obtained its hard set, the projection of tarred felt above the finished pavement will be struck off with a suitable cutting tool, so as to leave a slight projection of the tarred felt above the finished surface of the pavement.

In general the proposed cement-sand bed is commended by those who have reviewed the new specification but few are ready to agree that expansion joints are needed. It is suggested that a wider expression of opinion than the author has been able to secure personally would be of value.

Watervliet, N. Y. WILLIAM J. HEALEY.

April 2, 1923.

Garbage and Refuse Disposal at Seattle

Sir—Absence from my office has kept me from sending to you earlier the following notes on garbage and refuse disposal in Seattle, which are supplementary to the article published in your issue of Nov. 23, 1922, p. 876:

In early days Seattle made use of what was called the sanitary fill and never entirely departed from that system. About 1888, there arose a great outcry against the making of these sanitary fills and the city built a boat with a hopper bottom and caused all refuse to be hauled down to the beach and deposited in this boat, which was towed a number of miles up the Sound and then discharged. At a little later date a second boat was built and there were disposal wharves in both the southern and northern parts of the city. About 1896 these boats were turned over to me for operation in connection with other duties as city engineer. At that time the collection was made by private parties who contracted with private citizens to remove their refuse and convey the same to the boat landings for certain sums of money. The haul was so long from a considerable part of the residential district that we permitted these private contractors to make sanitary fills in low-lying territory, along lines where we knew there must be many feet of fill to be made in streets which were not yet opened.

In 1904 there was a great deal of summer camping along the shores of Puget Sound, and from these campers many and serious complaints were entered because of the amount of refuse which, being discharged from our boats, was washing up on the shores, fouling the beaches and interfering with bathing in the sound. There was also protest being made against the sanitary fills. At this time all the collection work was still being done by private contractors —the city doing nothing but dispose of the material by discharging it into the Sound. About that time it was determined that the city should take over both the collection and disposal and I was authorized to examine the method of disposal in the densely populated European cities. As a result I made a trip to Europe in 1905 and spent some six months in the examination of the results of incinerator operation. It was several years before an incinerator was constructed. When it was put into operation, it was found that of a truth it would burn anything that could be burned and without offensive odors. As a result two others were built and land purchased on which to construct several others. These worked perfectly, reducing every class of refuse to clinker, but, as in the case of disposal by boat, the long haul made it too expensive to bring all of the materials to these incinerators and the cost of construction and operation compared with the scattered population of the suburban districts made it unreasonable to expect that enough incinerators could be built throughout the city to produce short haul.

As a result the sanitary fills were continued, but were put under the inspection of the Health Department. Under careful inspection it was found that this refuse after a week or two, if covered with thin film of earth, would create a temperature of some 50 to 60 deg. C., at which time openings would be made in the earth cover and some offensive odors would be emitted. It was found that by reasonable watchfulness these openings were quickly closed by the use of a little earth and all offensive odors prevented. As a rule a little pinolin was sprayed over the fill on the day that the heat reached its maximum, but this operation was never regarded as very serious because an extra fill of earth quickly cured the trouble.

After the most exhaustive investigations we were able to affirm positively that no house flies were bred in these fills, because the heat generated in the fermentation was such as to cook their eggs.

On the days that a little odor was manifested, a fly, ordinarily termed the bottle fly, used to put in an appearance in quite a good many numbers, but the spray of pinolin seemed to dissuade them from making the dump their residence, and other than this appearance of the bottle fly we have never been able to notice any offense being created by the maintenance of these sanitary fills.

Owing to the expense of long hauling compared with the opportunity offered by sanitary fills, two of our incinerators were closed down in 1913 and the third in 1915 and up to the present date there has been no feeling of a necessity for re-opening either of them, and so far as I can see there will be no attempt to re-open until the population has become very much more dense and we can afford to build such numbers of incinerators as would give a short haul.

All the slops, and in fact all the real garbage from the central part of the city, is collected under the supervision of the Health Department and is sold in bulk to the managers of a large hog farm, who furnish their own trucks and make the collection without any cost to the city, whatsoever. At the present time this hog farm is paying for this material by the ton, the price being fixed at five times the price of pork on foot in the Eastern markets. For instance: If the price of pork on foot in Chicago for today should be 8c. per pound, the hog farm must pay us 40c. a ton for this material. So long as the slops and hotel refuse can be disposed of in this way, it leaves our sanitary fills free from much of the material which might be considered peculiarly offensive. During eight months of the year 60 to 70 per cent of our material is coal ashes. During the summer our consumption of vegetables is much less than that in Eastern cities, as we have to buy corn and melons brought from long distances and the per capita amount used is very small compared with Eastern cities. The vegetables most used here are celery, lettuce, cabbage, potatoes, spinach and beets, and there is very little left of any of these vegetables.

We have complaints against our sanitary fills now and then, but an investigation always proves them to have been unjustified.

I cannot look into the future so as to give any certain statement as to what will happen after awhile. Personally I feel that we ought to return in time to the incinerators, but there are still vast areas here where the sanitary fill can be continued, therefore the return to the incinerators is probably a long way off.

R. H. THOMSON.

Seattle, Wash., March 10, 1923.

[Mr. Thomson was city engineer of Seattle for twenty years and some time afterwards he became a member of the City Council. According to an article published in our issue of Nov. 23, 1922, p. 876, the first of the three refuse destructors of the British (Meldrum) type was built in 1908 and used for five years and the other two were built in 1911 and 1912 respectively, and used three years each. The article cited, based on notes made by a member of the editorial staff of this journal, stated that all three destructors have been "disposed of"; that one of the buildings was torn down, one remodeled for a carpenter shop and one leased for storage. It also appears from the previous article that the hotel and restaurant garbage is collected by owners of a hog ranch; by inference, it appears that all other garbage is collected by the city and goes to the sanitary fills.—EDITOR.]

Grout and Gravel Packing Around Tunnels

Sir—The article by W. E. Thompson, "Effects of Grouting and Gravel Packing Around Tunnels," in your issue of April 5, contains information of great value in conneccontion with shield tunnels in sandy ground, since the construction of the station at Willoughby and Lawrence Sts. is the first time that the ground overlying a tunnel in which gravel packing and grout had been used was excavated from the surface of the street to the bottom of the tunnel. As Mr. Thompson was engaged on the original tunnel work he also speaks with authority as to the results obtained at the time the tunnels were driven.

In the original work, after the Flinn-O'Rourke Co. drove the tunnels, timber drifts like that shown in Fig. 1 of the article were driven for about 600 ft. above the tunnels in Clark St. and Montague St. for the construction of inter-track stations. At that time the space between the tunnels was excavated from the top drift down to the bottom of the tunnels and three segments of cast-iron lining were removed from each side. During this work the gravel packing on the sides and top of the tunnel was uncovered and conditions were found similar to those described by Mr. Thompson. The penetration of the grout was only known to the top of the drifts, but it is likely that it penetrates much higher, as in the case of Willoughby St. As this grout was injected to refusal, the character of the ground would naturally fix the height to which it would ascend, and in some parts of Willoughby St., near Flatbush Ave., the grout actually came through the joints in the paving blocks, where the underlying ground was looser than that found at the Lawrence St. station. On Henry St., near the St. George Hotel, where an inrush of sand had occurred at one point, the head of the shield was shoved past the hole left by the escaping sand; the cavity was filled with gravel through tubes through the skin near the front end of the shield, and grout was subsequently forced through these same tubes before the shield was moved. This grout finally appeared in the cellar of the building alongside. Thus, the quantity of grout that can be used above a tunnel necessarily depends upon the amount of spaces the ground naturally contains.

It was also found that the grout did not mingle with the sand and gravel but segregated itself in lumps, some of which were hollow like a bottle because the men did not shut off the compressed air as soon as the grout had been forced out of the grout machine but allowed it to follow up the grout and expand it into a hollow lump. The Transit Commission, I believe, has specimens of these hollow grout lumps.

This method of gravel packing around a tunnel was originated by me some time before the contracts were obtained by the Flinn-O'Rourke Co., and the fact that the shields were provided with gravel tubes at the front end as originally built is evidence that the method was fully in mind before any tunnel work was begun.

Mr. Thompson says, "The overlying cover, about 34 ft., being thick enough to eliminate danger from the release of air at the high pressure of 90 lbs. per square inch necessary to inject the gravel * * * *." Fig. 2 of his article shows a gravel tank with an air line reaching to a tee on a pipe at the bottom of the gravel tank to the other side of which the gravel hose is attached, and connected to a grout hole in the lining at the tail of the shield with a steel nipple. This hose was usually about 25 ft. in length, and the compressed air line was connected to an air supply at the power house. When this question arose as to the possible effect of high-pressure air upon the overlying ground, the writer questioned that the air retained its pressure through the hose and exerted it against the ground outside the nozzle. He had a special nipple prepared containing a valve and air gage. When the valve in the nozzle was closed and the air valve beyond the gravel tank was opened the gage showed full pressure. Air was then shut off and the nozzle valve opened, when the gage dropped back to zero. The usual method of starting the gravel blast was then gone through with, that is to say, the air supply valve was first opened and then the valve in the pipe at the bottom of the gravel tank was opened, permitting the gravel and water in the tank to drop in a stream into the flowing air, which blew it through the hose into the space outside the tunnel. The gage in the nipple remained at zero all the time, showing that the air had fully expanded in the 25 ft. of hose before reaching the nozzle. Therefore no danger need be feared of ill effects from the high pressure used in blowing the gravel, since this pressure released itself in the hose, which it had to do in order to give the velocity with which the air and gravel reached the hose.

The fact that there was no pressure at the nozzle was further shown by holding the nozzle inside the tunnel while the gravel was being blown through it. The stream of gravel and spray was as smooth as a jet of water. The contact of the gravel with the steel nipple like flint with steel made a continuous line of sparks out of the nozzle similar in appearance to a Roman candle, in spite of the spray that was being discharged at the same time. A similar condition may be perceived in the familiar operation of sandblasting the face of stone buildings. If it were true that the 100-lb. pressure used in gravel packing remained unchanged throughout the hose the velocity would be only one-seventh what it is when fully expanded, which expansion would have to be resisted by the gravel acting as a valve to maintain this pressure, which is obviously absurd. Therefore, the only pressure that the gravel-blowing method exerts is what might be due to the velocity of the air or the wind pressure, which would be less than 100 lb. per square inch. In the case of clay or other ground impervious to air, the space between the lining and the end of the shield can always be relied on to give a vent for the air from the gravel blast into the tunnel.

The reason for taking so much time to discuss this matter is the fact that this belief in high pressures is very much against the use of gravel in connection with subaqueous work, where no undue pressures should be introduced outside the tunnel lining, as these would have an unfavorable effect upon the overlying cover. However, anyone can prove to his own satisfaction that no such pressure exists, by simply placing a gage on the nozzle inside the tunnel, which would show a pressure if there were one. Being naturally very much interested in this matter of safe tunneling by the use of grout and gravel packing I feel under great obligation to both Mr. Thompson and *Engineering News-Record* for this publicity of the proof of their usefulness

New York City, April 10. JOHN F. O'ROURKE.

Gasholder Welded in England

Electric welding was applied in the reconstruction of a gasholder in England recently. The original holder, 200 ft. in diameter, and of 3,000,000 cu.ft. capacity, had been destroyed by fire, so that little of its structure could be salvaged. The brick tank, 200 ft. in diameter by 36 ft. deep, and a part of the guide framing could be used, the latter after extensive repairs. The three-lift holder, however, as well as the guides, had to be replaced. The three lifts, ranging from 191 ft. 6 in. to 197 ft. 6 in. in diameter by 34 ft. 9 in. deep, are made of $\frac{9}{64}$- and $\frac{1}{2}$-in. steel. All the sheets were connected by welding. The Z-shaped stiffener stays on the inside of the upper lift were also connected and attached by welding. It is reported that although the holder contains more than 20 miles of welded joint, only two or three small leaks were detected on test. Under the circumstances of the work, no definite cost comparison with riveted work could be made, but estimates by an experienced engineer of gas plant construction are quoted to the effect that the labor time amounted to less than half that which would have been required in riveting. The speed of the welding work is given as 15 ft. per hour on overhead and horizontal fillets and 12 ft. per hour on vertical fillets.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The Great Northern R.R. Co. is planning to spend $30,000,000 during 1923 on new equipment, terminal expansion and double tracking.

By the Provisions of a Measure introduced at Albany the time in which the licensing law in New York becomes effective would be extended from the present date, May 5 until August 1, 1923.

Bills Have Been Introduced at Albany, N. Y., to appropriate $740,000 for the completion of the state owned hydro-electric plant at Vischers Ferry, N. Y., $30,000 to complete the tailrace at the Crescent Dam plant, and $200,000 to construct a barge canal terminal at the city of Rensselaer.

The Wabash R.R. Co. Reports a net income of $1,210,388 for 1922 as against $1,281,361 for last year. The outstanding achievement during the year was the reduction of the ratio of expenses to revenues from 85.29 per cent in 1921 to 83.31 in 1922.

In a Referendum of the New York State members of the American Society of Mechanical Engineers, 1,630 members voted for and 185 against action by the society aimed at securing a postponement of the date on which registration of professional engineers becomes mandatory in New York.

Articles of incorporation have been filed with the Illinois Secretary of State by the National Transportation Institute. The purpose of the institute is to conduct non-partisan and impartial investigations into all kinds of transportation questions and to disseminate the facts so acquired to the public through the platform, press, motion pictures, and educational institutions.

Bids Have Been Called for by the Board of Estimate and Apportionment of New York to be submitted May 13 for the construction of the South Street Shaft, St. George, Staten Island. for the freight and passenger tunnel the city is building under the Narrows between Brooklyn and Staten Island. Contracts will call for the completion of the shaft within 12 months of the date the award is made.

The City of San Francisco has called for bids to be opened May 16 on 19½ miles of 5-ft. steel pipe for conveying water across lower San Francisco Bay, this crossing to be used immediately after completion by the supply being brought in from Calaveras sources and later to become a part of the Hetch Hetchy aqueduct. Bids are also to be opened on May 23 for the steel penstocks involving 7,900 tons of riveted steel pipe or 6,000 tons of welded steel pipe needed for the Moccasin Creek power house of the Hetch Hetchy project.

Pottery Makers Get Prison Terms

Eight members of the Sanitary Potters Association, New York, who last week were convicted of violating the Sherman anti-trust law by price-fixing, have been given both heavy fines and prison terms. Sentence was pronounced by Justice Van Vleet, of the Federal Court. Fines were imposed on 12 other defendants and on all the companies named in the indictment.

The heaviest sentence, ten months, was given the president of the association, Thomas Maddock, of Trenton, N. J. He was also fined $5,000. The other seven were given six-month terms and fined $5,000. Fines of $5,000 were imposed on most of the defendant companies. Total fines aggregated $169,000.

The defendants were charged with price-fixing, the indictment following disclosures made by the Lockwood Joint Legislative Committee on Housing. Samuel Untermyer, in commenting on the case, asserted that "this is the first contested case in the Federal Court in which there has been a conviction," adding that it would probably be a year at least before prison sentences were begun, inasmuch as an appeal will be taken.

New Jersey Conference Discusses Grade Crossings

The fact that the present method of protecting highway crossings is entirely inadequate was brought out at a conference held at Trenton last week under the auspices of the Board of Public Utilities Commissioners. The conference was attended by representatives of the American Railway Association, the State and Highway County Commissioners, and of the railroads operating in New Jersey.

The conference opened with a descriptive display of the types of track circuit signals and approach warning signs recommended by the Signal Section of the A.R.A. This was followed by a discussion of the dangers of the present methods of crossing protection, including gates and flagmen, with suggestions for the improvement of such protection. This led to the matter of approach warning signs and the need of removing all signs of an advertising nature, particularly signs with flashing lights, from the vicinity of all grade crossings. It was decided that this should be done for at least 500 ft. each side of every crossing and that the approach warning sign should be set 300 ft. from the crossing.

In concluding the conference expressed its approval of alternately flashing red lights as a warning signal to be displayed at grade crossings upon the approach of trains. It also approved of the offer of the railroad companies to supply approach warning signs for all crossings not already equipped, and recommended to the highway authorities that they keep in touch with the railroad officials so that they could erect the signs as soon as they were supplied.

Delaware & Hudson Co. Celebrates Centenary

Gala Dinner Brings Together Railroad Men, Bankers Industrial Leaders and Publicists

The 100th anniversary of the founding of the Delaware & Hudson Co. was celebrated in New York, April 23, at a gala dinner which brought together a distinguished gathering of railroad men, bankers, industrial leaders and publicists. The company was organized under charter from the New York Legislature to build a canal for the transportation of coal from the anthracite fields to the New York City market. Canal construction was begun in 1825 and, though locomotives were brought from England in 1829 for operating an 11-mi. stretch of railroad spanning a break in the canal system, steam operation was never effective because the locomotives were too heavy for the track structure. In 1867 the Delaware & Hudson Co. began the construction of its present steam railroad system.

The chief speakers at last Monday's dinner were L. F. Loree, president of the company, James S. Alexander, president of the National Bank of Commerce, New York, and H. W. Dickinson, of London, honorable secretary of the Newcomen Society and assistant to the director of the South Kensington Science Museum.

Mr. Loree, after tracing the development of railroad transportation in the United States and its influence upon national development, made a plea for a sane business attitude toward our railroad systems. Further progress in stifling regulation would lead to destruction.

Mr. Alexander discussed in detail the influence of transportation upon industrial and agricultural development, making a particularly striking point of the dependence of the liquidity of commercial credits upon regular and speedy functioning of our railroad system. Unless manufacturers' goods can be quickly transferred to the purchaser, the manufacturer cannot discharge his bank loans and thus make commercial credits available to other industrial units.

Among those present were Samuel Rea, A. H. Smith, Daniel Willard, Newcomb Carlton, Eugene G. Grace, Frank A. Vanderlip, Herman H. Westinghouse, Guy E. Tripp, Owen D. Young, Charles A. Stone, Charles M. Schwab and W. L. Saunders.

To Finish St. Paul Union Station

A contract awarded recently by the St. Paul Union Depot Co., St. Paul, Minn., to Foley Bros., of that city, provides for the completion of the new union station. The total cost of this work will be about $2,000,000, of which probably $900,000 will be spent this year, the remainder of the work being extended over the next two years. W. C. Armstrong is chief engineer of the company.

Am. Soc. C. E. Holds Successful Meeting

Three Days at New Orleans Devoted to Discussion and Inspection of Lower Mississippi and Its Problems

Engineering News-Record Staff Report

About 110 members were registered at the spring meeting of the American Society of Civil Engineers at New Orleans, April 18 to 20, but nearly twice that many guests, both men and women, swelled the attendance. The technical sessions, reported on another page of this issue, were devoted to a discussion of the problems of the lower Mississippi, and the nearby river was utilized as an exhibit. One whole day was devoted to a boat ride up the river above the port works and down to the site of the Poydras crevasse and through the not yet officially opened Industrial Canal into Lake Pontchartrain. The river was at high water, within three feet of the record of last year, so that the visitors could get an impressive reaction to the dangers and difficulties involved in passing so great a volume of water by a large city lying well below the high water level.

HOSPITALITY GENEROUS

The New Orleans engineers bore out their reputation for generous hospitality. Those who were in the city for the day before the opening, including the board of direction of the society, were entertained at luncheon and at dinner, while those attending the convention were taken for trips through the old French quarter, with appropriate entertainment, and for a ride around the city terminating at the country club, where the accompanying photograph was taken.

The action of the board of direction in the two days' session before the meeting was reported in last week's issue. No business was transacted by the society in its regular business session but future quarterly meetings were announced, as follows:

July 11-13, Chicago, subject, transportation;

October 15 or thereabout, two days at Richmond, Va., one day at Norfolk and one day at Washington, subject, highways.

N. Y. License Law Effective May 5

Little more than a week remains in which to file application for engineers' licenses in the State of New York. The law becomes effective May 5, after which date any engineer practising in New York State without a license is subject to fine and imprisonment. Also, after that date, an examination is necessary to obtain a license. The University of the State of New York advises that any application dated as late as May 5 and mailed prior to midnight of that date will be accepted as received in time, and that the board is taking the most liberal attitude toward the applications received, not being inclined to quibble over technicalities. Application forms may be obtained from John H. Dunlap, secretary, American Society of Civil Engineers, 33 West 39th St., New York City.

The New Jersey law went into effect April 8. In both laws the privilege of practice during thirty days in any calendar year is extended engineers registered in another state. Practice beyond that period requires separate registration and payment of the full registration fee.

Engineers or surveyors who are working as subordinates under a licensed engineer or surveyor are not required to take out a license.

Chicago Regional Planning Committee Named

Membership in the Chicago metropolitan planning committee of twenty-one named by the City Club of Chicago which will undertake to map out the expansion of Chicago to a city of 8,000,000 people expected in 1950 embracing an area of 1,000 sq. miles includes seven engineers and three architects. The engineers named are S. A. Greeley, consulting engineer, Charles B. Ball, chief sanitary inspector, Department of Health, Eugene A. Rummler, patent attorney, J. G. Wray, telephone consulting engineer, Herbert E. Fleming, industrial engineer, Langdon Pearse, sanitary engineer, Sanitary District of Chicago, Jacob L. Crane, Jr. city planning engineer. The architects on the committee are, Dwight H. Perkins, G. Herrick Hammond and Daniel H. Burnham, Jr.

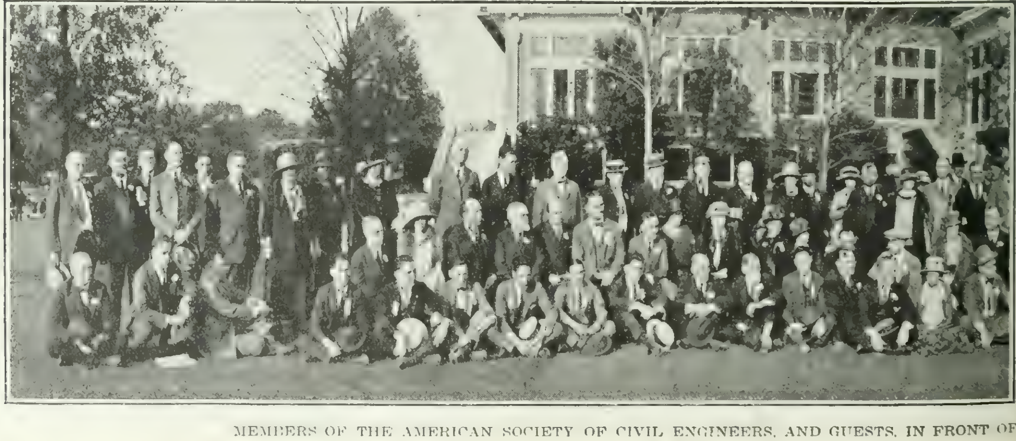
Contract for a 330-Mile Railway

One of the most important railway construction contracts that has been let for some years is that for the Wyoming North & South R.R. (organized as the Montana R.R. for the Montana portion of the line) from Casper, Wyo., to Miles City, Mont., a distance of 330 miles. The purpose of this road is largely the development of oil properties, but it will connect with two trunk lines at each end. Construction has been commenced, but final location for the entire line is not yet completed. With maximum grades of 1 per cent the earthwork is estimated at between 7,000,000 and 8,000,000 cu.yd. The contract for grading and bridging has been awarded to Roberts Brothers, Peterson, Shirley & Gunther, with offices at 17 North La Salle St., Chicago, and Woodmen Building, Omaha, Neb. D. C. Fenstermaker is chief engineer, and George M. Huss is engineer of construction.

New York Engineers Favor Benevolent Fund

Action in favor of a civil engineers' benevolent fund and in favor of continuing present co-operation in an engineering employment service was taken by the New York section of the American Society of Civil Engineers at an active meeting held on April 18. In both cases the action followed the presentation of thoroughly prepared reports of special committees. Ralph Modjeski and H. E. Blake were appointed to develop a plan for the reconstruction of High Bridge over the Harlem River to avoid the necessity of removing it in connection with improvement of navigation clearance on the Harlem. The proposal to remove the structure is now before the Board of Estimate of New York City, but the board has agreed to delay decision on the matter until representatives of the section and of the local chapters of the American Association of Engineers and the American Institute of Architects have opportunity to present a plan for saving the historic structure.

"Ancient Engineering" was discussed in a series of addresses by Prof. C. J. Tilden, Ralph Modjeski, Prof. William H. Burr, Gen. W. B. Parsons and others.



MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS, AND GUESTS, IN FRONT OF

Philadelphia Proposes Bills to Start Huge Water Program

Two ordinances are pending before the Council of Philadelphia, providing funds to make a start on a 15-year program for extensions and improvements of the water supply of Philadelphia to cost a total of some $75,000,000. The first of these ordinances appropriates $5,000,000, to be available in 1924, for the development of water in Perkiomen, Tohickon and Neshaminy drainage areas, together with the necessary extensions of existing works within the city limits to meet the growth and development of the city. The intention is to incorporate this $5,000,000 item in a comprehensive loan ordinance to be submitted to popular vote next fall. The ordinance states that the $5,000,000 appropriation is the first of four proposed similar appropriations to cover the first four years of the entire program. The second ordinance is $100,000, to be used on preliminary work looking toward the construction of the first storage reservoir on the Perkiomen at Green Lane. This sum would be available about June 1. A report on the extensions to the Philadelphia water supply made by a committee of consulting engineers, consisting of J. W. Ledoux, Philadelphia, chairman, George W. Fuller and J. Waldo Smith, New York City, and Joseph S. Hasskar, Philadelphia, was abstracted in *Engineering News-Record*, Oct. 14, 1920, p. 751. Carlton E. Davis is chief of the Philadelphia Bureau of Water.

Bonds to Finance Hudson River Bridge at Bear Mountain Offered

Bonds for financing the construction of a highway bridge over the Hudson River between Bear Mountain and Anthony's Nose, just above Peekskill, N. Y., were offered to the public during the past week by the banking firm of W. A. Harriman & Co. The bridge, whose preliminary plans were described in *Engineering News-Record* of Feb. 23, 1922, p. 326, is estimated to cost $5,000,000. The bond issue is for $3,000,000, at 7 per cent, and is offered at 98½. The common stock and an issue of $1,500,000 of notes has been taken by private subscription.

To Hold Engineering Exhibit

The Joint Committee on a National Museum of Engineering and Industry proposes to hold in the Engineering Societies' Building, New York, during the coming fall and winter an exhibit of records, charts, drawings, pictures, models and other material illustrative of the steps supplied by the engineer in the development of the United States. The primary object of the exhibit is to arouse interest of the engineers and the public generally in the project in hand with the Smithsonian Institution to establish a national museum of engineering and industry, with headquarters at Washington and branches in various sections of the country.

500,000 More H.P. in Sight

The Susquehanna Power Co. has applied to the Federal Power Commission for a license to construct a hydroelectric plant on the Susquehanna River at Conowingo, Md., the ultimate installation to be 360,000 hp. It is their intention to construct a dam 100 ft. high, which will create a pool extending 25 miles up the river to McCalls Ferry at Holtwood, Pa. It is also reported that the Pennsylvania Water and Power Co., will develop the power immediately above its Holtwood plant. Such a plan would develop slack water in the Susquehanna from tide water to the vicinity of Harrisburg, and would pave the way for the utilization of these pools for navigation.

On April 7 the Alabama Power Co., put its first 24,000 hp. unit into operation in Mitchell Dam at Duncan's Riffle on the Coosa River in Alabama. Two other units of the same capacity will be put into operation within the next two months. Work on the dam was authorized on July 14, 1921; the first concrete was poured in January, 1922; and the dam was completed on January 1, 1923. The company is also pressing its investigations on the Tallapoosa River in the hope of developing its large power resources in the near future, and has applied to the Federal Power Commission for a license covering the installation of a 5,000 hp. unit at Government Dam No. 17 on the Black Warrior River. License for a similar unit at Dam No. 16 will be asked in the near future.

Louisville & Nashville to Spend $50,000,000 on New Work

During the past few months the Louisville & Nashville R.R. Co. has authorized a total expenditure of nearly $50,000,000 for new work, and in addition it has under active consideration other projects involving many more millions of dollars, but the plans for the latter are not yet sufficiently definite for actual figures. The program definitely authorized contemplates the construction of fifty miles of second track and grade reduction work, the installation of new and enlarged terminal facilities, the building of additional side and passing tracks, new bridges, and various other projects designed to enlarge and improve the service. Although some of the work has been completed, the greater part consists of improvements now under way and scheduled for completion during the current year.

In regard to equipment, this company has under contract for delivery during 1923 a greater amount than in any other similar period during its history, having recently authorized a total of 86 locomotives, 11,000 freight cars and 51 passenger cars of various classes. Some of this equipment has already been delivered.

It is explained by the president, W. L. Mapother, that this company does not employ the budgetary system but undertakes to authorize and prosecute its improvement work as conditions require or future prospects seem to justify: "We are quite cognizant of the decidedly optimistic trend of business activity and are exerting every effort to increase our transportation plant in order to meet the present and prospective requirements."

North Carolina Contracts Large Highway Mileage

On April 3 the North Carolina State Highway Commission let contracts for sixteen projects, totaling 126.37 miles, and costing $2,697,754, exclusive of the usual 10 per cent for engineering and contingencies. Of this mileage 54.97 miles were either of concrete, or asphaltic surface on 5-in. concrete base. The average cost per mile for this work was $31,644.

THE NEW ORLEANS COUNTRY CLUB DURING ANNUAL MEETING OF SOCIETY, APRIL [illegible]

Traffic Association to Meet in New York, May 10

The 1923 annual meeting of the National Highway Traffic Association will be held at the Automobile Club of America, 247 West 54th St., May 10. The afternoon session will be taken up with the reports of eight committees, following which an informal dinner at the club will take place. The evening meeting will be devoted to a continuation of the hearing of committee reports. In all, the following twelve committees will report:

(1) On traffic center lines on roadways, (2) status of the construction of highway curves and recommended practice to increase safety to traffic, (3) highway danger signs, (4) mechanical devices for highway traffic regulation, (5) regulations covering speeds, weights and dimensions of motor trucks and trailers, (6) regulation of overloading of motor trucks, (7) rural motor express, (8) highway transport clearing houses, (9) safety regulations at railroad grade crossings, (10) equitable distribution of cost of construction, interest on bonds, replacements, and maintenance of state highways, (11) highway transport franchises, and (12) the demand for national transportation and the function of streets and highways.

Engineering Library Dedicated in Denver

On Apr. 7 representatives of the Denver city library, of the state and of the engineering profession, attended exercises at which a technical library of applied science was dedicated in Denver, Colo. Acquisition of such a library has been one of the objects of the Colorado Engineering Council, of which L. G. Carpenter is president, ever since its organization.

The need for such a collection of books for reference has been felt for years by engineers in the West, whose nearest collection of such volumes was at least a thousand miles distant. This distance from the largest center has made it difficult for engineers either to keep up with current developments or to take advantage of consulting books when they are doing investigation work.

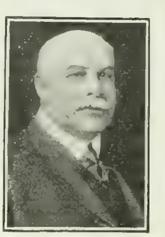
The new library is maintained in the City Library Building and the collection of books is loaned from private engineering libraries and by the state, which has purchased with money from its State Board of Engineering Examiners fund a number of volumes. The State Board of Architects also supplied money with which to purchase part of the library.

It is hoped to make the library available as a loaning collection to engineers in Colorado whose fees have contributed to the collection.

Engineer on Morris Canal Board

Cornelius C. Vermeule, consulting engineer of New York City, has been named by Governor Silzer, of New Jersey, one of five members of a board to investigate the problem of what shall be done with the Morris Canal. This state board, together with five men appointed by municipalities through which the canal passes, and two members of the State Board of Conservation and Development, were scheduled to hold their first meeting yesterday.

Dr. Burgess Named Director of Bureau of Standards



Dr. George K. Burgess has been appointed director of the U. S. Bureau of Standards. Since 1913 he has been chief of the Bureau's Division of Metallurgy. Born in Newton, Mass., Jan. 4, 1874, George K. Burgess received the degree of B.S. from Massachusetts Institute of Technology in 1896, held a fellowship there from 1898 to 1900 and obtained his Sc.D. at Paris in 1901. He served short terms as instructor at the University of Michigan and at the University of California before coming to the Bureau of Standards in 1903.

After two years as associate physicist there, he was physicist from 1905 to 1913. In the latter year he was raised to the rank of chief of division.

Dr. Burgess has been active in the work of the National Research Council. During the war, in addition to his regular duties, he was an advisor to the requirements division of the War Industries Board and to the Ordnance Department of the Army. In 1917 and 1918 he was chairman of the light alloys committee of the National Advisory Committee for Aeronautics. During the same period he was a member of the National Aircraft Standards Board. He was the recipient of a silver medal at the Pan American Exposition held in 1915. He is this year's president of the American Society for Testing Materials.

California Stadium Under Way

A stadium with a seating capacity of 73,000 is now under construction in the Berkeley hills adjoining the University of California campus and the intention is to have it ready in time for the Thanksgiving day Football game this year between the University of California and Stanford University. The location is in a small valley where by sluicing earth from the uphill side and diking the downhill side an oval can be laid out in which about two-thirds of the seats will be placed directly on earth foundation. The remainder, chiefly on the ends and the westerly or "downhill side," will be supported by a concrete structure whose outer wall will be treated architectually so as to give the stadium the outward appearance of an early Roman Coliseum.

The playing field is of elliptical form with major and minor diameters of 459 and 267 ft. respectively. The seats, supporting structure and outer wall on the downhill side will be of concrete. About 300,000 cu.yd. of earth and rock is being moved to form the substructure and this work was about 25 per cent complete on April 15. The material is being excavated and placed hydraulickally at the rate of 3,000 cu.yd. per day with the aid of two 4½-in. monitors. The total cost is estimated to be about $1,100,000.

E. E. Carpenter, consulting engineer, is the engineer member of the Stadium Commission under which the work is being done. The contract on earth moving is held by Bates and Borland.

Postpone Colorado River Action

Washington Correspondence

No action will be taken on water power projects on the Colorado River at this time. Formal action to this effect was decided upon Monday by the Federal Power Commission after the matter had been the subject of discussion at a meeting of the President and his cabinet. This decision of the commission is a victory for the State of Colorado in particular. Colorado is anxious that this pressure be brought to bear on Arizona in the hope that speedy ratification of the compact will follow. The staff of the Federal Power Commission insisted at the meeting that there is no reason other than that of holding a club over Arizona, why rights should not be granted for the more urgent of the projects.

The commission also decided to withhold action on the Flat Head Lake project until the Goodwin commission will have reported.

Will Investigate Fatigue of Copper and Non-Ferrous Alloys

Extension in a new direction of the fatigue-of-metals investigation which has been in progress for several years past at the University of Illinois has just been announced. The work so far has been done by co-operation between the Illinois Engineering Experiment Station, Engineering Foundation, and the National Research Council, with support by the General Electric Co., and has been confined to rolled steel, but it is now to be extended to the fatigue of copper, brass, bronze, and other metals, in collaboration with the Copper and Brass Research Association, the General Electric Co., the Western Electric Co., and other concerns. A fund has been provided to make this research extension possible, and the experience and commercial assistance which the co-operating corporations can render will be available. Efforts are also in progress to extend the research to steel castings. The work will continue under the direction of Prof. H. F. Moore. Its active promotion is in care of Alfred D. Flinn, director of the Engineering Foundation.

Plan Survey of Government's Building Needs

Washington Correspondence

A systematic survey of the building needs of the federal government throughout the country, with all possible construction by the government delayed in order to give private contracts priority in the demands upon materials and labor, and the beginning of the government program when activity in the building industry slackens, are recommended in a plan proposed by Representative Martin B. Madden, chairman of the House appropriations committee.

The Madden plan is in harmony with the suggestion of Secretary of Commerce Hoover expressed in a recent letter to the President. (See *Engineering News-Record*, March 12, p. 562.)

While these moves are under way, the Public Buildings Commission of Washington, of which Senator Smoot is chairman, has announced that when Congress convenes it will urge the appropriation of $15,000,000 for the erection of buildings in Washington.

Engineering Societies

Calendar

Annual Meetings

NATIONAL CONFERENCE ON CITY PLANNING, New York; Fifteenth Conference, Baltimore, April 30-May 2.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

NATIONAL FIRE PROTECTION ASSOCIATION; Boston; Annual Meeting, Chicago, May 8-10.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION, New York; Annual Meeting, New York, May 10.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Meeting, New York, May 15.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Detroit, Mich., May 21-25.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; Annual Convention, Ithaca, N. Y., June 23-25.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

The Electric Steel Founders Research Group met at East Aurora, N. Y., Apr. 13 and 14. W. H. Worrilow, of the Lebanon steel foundry, presided. The following papers were read: "Electric Steel Castings for Specialties" by W. J. Nugent, Chicago; "Properties of Electric Steel Castings and Where They Should be Used" by T. S. Quinn, of Lebanon, Pa.; "Cost Accounting" by L. S. Persgoy, Milwaukee; "Salesmanship" by J. C. Redmond, of Detroit. Discussions dealt with co-operative effort in steel foundry research, with systematic production planning, with progress in the effort to maintain and improve the quality of electric steel castings, with new uses for electric steel castings, and related subjects.

The Detroit Engineering Society will hold its twenty-ninth annual meeting and banquet at the Cadillac Hotel, April 28. Dean F. Paul Anderson, of the University of Kentucky, Mayor Frank E. Doremus, of Detroit, and President David Friday, of the Michigan Agricultural College, are among the speakers.

Personal Notes

FRED G. SIMMONS, recently appointed state engineer of Oklahoma to succeed Max L. Cunningham, gained his early professional experience in Denver, Colo., where from 1889 until 1897 he was in charge of tracks and paving for the Denver Tramway Co. In 1897 he moved to Milwaukee, Wis., where he became engineer of way and structures for the Milwaukee Electric Railway & Light Co. This position he held for fifteen years. In 1912 he was appointed commissioner of public works of the city of Milwaukee and after 5½ years resigned and entered consulting practice. Mr. Simmons is a past president of the American Electric Railway Engineering Association. He assisted in the organization and is past president of the Engineering Society of Wisconsin. For many years he was a member of the American Railway Engineering Association, prominently identified with committee work.

L. A. MILLER, since 1920 with the Massillon Bridge & Structural Co., has been made chief engineer of that company. He was formerly in the office of the supervising architect in Washington, and previous to that with the Worden Allen Co. of Milwaukee, Wis.

EDWIN J. BEUGLER, for the past three years with The Foundation Co. and for the previous fifteen years with Westinghouse, Church, Kerr & Co., as consulting engineer and as chief engineer, has established consulting engineering offices in Cheshire, Conn. Particular attention will be given by Mr. Beugler to railway, water-power and foundation examinations and reports.

E. C. HINGSTON, formerly in engineering work in Chicago, has become associated as general superintendent with the Flick Construction Co. of Herington, Kans. The Flick company has recently been awarded the contract by the Rock Island system for its double-track grading between Topeka and Herington.

C. N. MONSARATT, consulting engineer of bridges, Toronto, Ont., has been appointed consulting engineer of the operating department, Canadian National Rys., Montreal.

H. RINDAL, district engineer of the British Columbia district, Vancouver, has been appointed district engineer of the Alberta district, Canadian Pacific Ry.

F. B. GOEDIKE, a graduate of Queens University, has been appointed engineer of the Township of York, Ont.

S. A. SEELY, formerly supervisor of bridges and buildings for the New York Central R.R. at Watertown, N. Y., and most recently the assistant division engineer of the Adirondack and Ottawa Division of that road has been appointed division engineer of the same division, with headquarters at Utica.

DWIGHT P. ROBINSON & CO., INC., engineers and constructors, New York City, have opened an office in Philadelphia, under the direction of **CARL A. BAER**, recently with the firm of Baer, Cook & Co., engineers.

WALTER B. CALDWELL has associated with him **W. G. KIRCHOFFER** of Madison, Wis., for the practice of civil engineering with special attention to sewerage and water supply work in the eastern district of Wisconsin. Mr. Caldwell maintains consulting offices in Waukesha.

PHILIP B. HILL has disposed of his engineering practice in Little Rock, Ark., where he has been established for the past seventeen years, to **GLENN D. DOUGLASS**, also of that city. Mr. Hill has become associated with the Continental Rock Asphalt Co. in Big Clifty, Ky.

BENJAMIN F. LAMSON has been appointed city engineer for St. Catharines, Ontario, Canada.

GEORGE F. STAAL has resigned as city engineer of Milwaukee, Wis., and will take up private practice at Denver, Colo. He has served three terms of three years each and his third term expired April 17. He was assistant city engineer for some time and previously was engineer of maintenance-of-way for the Milwaukee Electric Railway & Light Co.

J. A. STALLINGS, formerly of the North Carolina State Highway Commission has been appointed county highway engineer for Wake County, N. C., with headquarters at Raleigh.

THE BURNS & MCDONNELL ENGINEERING CO., of Kansas City, Mo., for the past twenty-five years specialists in municipal engineering problems, have opened an engineering office in Los Angeles, in the Marsh-Strong Building, with Chester A. Smith, a member of the firm, in charge.

C. I. FELPS has resigned as assistant state highway engineer of Kansas, the resignation taking effect April 1.

RUDOLPH P. MILLER, former superintendent of buildings for Manhattan and the first chairman of the Board of Standards and Appeals of the City of New York, has resumed private consulting practice at 25 West 45th St., New York City. Matters relating to the construction, use and occupancy of buildings are the special field in which Mr. Miller offers his services. Particular attention will be given to appeals and petitions to the Board of Standards and Appeals, interpretations of the laws relating to buildings, inspection and survey of buildings, soil examinations, testing of materials of construction, arbitration of disputes, expert testimony in litigations, formulation of building codes, and the preparation of zoning plans for municipalities.

Obituary

ADISON LINDSLEY, civil engineer of Portland, Ore., and formerly one of the locating engineers of the Northern Pacific R.R., died in Portland, April 13. At one time Mr. Lindsley was city and county engineer at San Francisco, Calif.

BENJAMIN F. THOMAS, who had been in the service of the United States Engineering Department for the past forty years, died at his home in Catlettsburg, Ky., Apr. 14. He had resigned from the service the day before his death. He was 67 years of age.

FRANK A. RAPP, bridge engineer for city of Seattle since 1912, despondent because of an incurable illness, shot and killed himself at his home recently. Mr. Rapp designed nearly all of Seattle's important bridges, including the three bascule type bridges that cross the Lake Washington ship canal, plans for the Spokane street steel bridge now under contract, steel arch over Ravenna Park Ravine, and concrete arch that carries the penstock across Cedar River.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Machinery Export Plans for 1923—The Far East

Markets of Asia Expanding—Volume of Machinery Trade in 1921 Totaled $64,400,000

By W. H. Rastall
Chief, Industrial Machinery Division,
U. S. Department of Commerce

(The following article is the third and last of a series on the world markets for American industrial machinery and the outlook for 1923. The first article (Feb. 8, p. 279), outlined the foreign-sales problem for 1923 in its more general aspects and contained a table showing the comparative value of the more important machinery markets of the world, as indicated by American export statistics for 1910, 1913, 1919, and 1921. The second article (Feb. 22, p. 370), discussed the Latin American markets. The third and final article, which follows, deals with the Far Eastern markets for American machinery and should be considered in connection with the tables, charts, and information published in the two issues of "Engineering News-Record" previously referred to.)

NOTWITHSTANDING the fact that Japan, the best of the Asiatic markets for American machinery, ranks only fourth among the markets of the world, it should be emphasized that the Asiatic group shows signs of rapidly increasing importance and possibly deserves more attention than the present volume of business might suggest. All five of the leading Asiatic markets rank better than 13 among our machinery markets. Of our total machinery exports the Asiatic markets took 7.4 per cent in 1910, 6.8 per cent in 1913, 22.9 per cent in 1919, 18.5 per cent in 1920, and 26.1 per cent in 1921. In other words, the comparative importance of the Asiatic group, as expressed in percentages, has expanded about three and one-half times in the last decade, and, as was indicated by the table published in the Feb. 22 issue of *Engineering News-Record*, the value of American machinery absorbed by Asia rose from $3,800,000 in 1910 to $64,400,000 in 1921.

Markets of Asia Expanding

As contrasted with the markets of Europe, which are contracting, the markets of Asia are showing most satisfactory expansion, and it would appear that constructive sales effort would yield the best returns when applied to expanding markets. Most of the countries of Asia are very densely populated and show indications of being capable of marked industrial development, as contrasted with markets in many other parts of the world in territories that have been developed more recently, where there is a lack of adequate population, even when it is known that the natural resources justify exploitation. South America, Australia, and other sections have their immigration problems, but with Asia it is more a matter of raising the standard of living, and very rapid progress is being made in this direction.

It is a mistake to think of Asia as the "unchanging East." Railways are being developed, shipping increases rapidly from year to year, mines are being opened, industries are being established, highways are being constructed, automobiles and trucks are being placed in service, and in a great many other ways the entire continent is showing signs of absorbing an ever-increasing volume of mechanical equipment of great variety. In mapping out a sales program for the current year the foreign-sales manager should make ample allowance for these and many other factors.

Japan—This country ranked 4, 4, 8, 10 among the world markets for American machinery in 1921, 1919, 1913, and 1910, respectively, as indicated by the table published in the issue of *Engineering News-Record* for Feb. 8, p. 280. For many years Japan has surprised the world by its industrial development. There is something remarkably consistent about the way in which Japan has developed, and the increase in the volume of machinery that has been absorbed, whether measured in dollars or in the relative importance of this market. Japan is being industrialized. The standard of living for its people has risen very rapidly during the last several decades. Thirty years ago it was a cheap country in which to live; it has become one of the most expensive in the world.

The country is on a gold basis and the exchange situation has not become a problem. On July 30, 1914, the exchange value of the yen was $0.499; on July 31, 1920, it was $0.515; and on Dec. 1, 1922, it was $0.485. Probably the exchange will not get far from the par value, which is $0.4985.

American machinery is rapidly increasing in popularity in this market. In 1910 the United States supplied 20.1 per cent of the machinery absorbed by Japan. In 1919 the share of the United States had increased to 75.4 per cent, but conditions then were abnormal. In 1921 our participation was 52.9 per cent. These figures seem to indicate that more business awaits the American manufacturer in this market if he will take the steps necessary to secure it. Even with this lower participation in the trade, the total volume has been so large as to represent a very remarkable increase in the American share, which has expanded from about $1,700,000 in 1910 to nearly $21,000,000 in 1921.

China—In 1921, 1919, 1913, and 1910, China ranked 5, 7, 28, 15, respectively, among our machinery markets, the volume having increased from about $642,000 in 1910 to more than $18,000,000 in 1921. It would be difficult to find a better record for expansion in both volume and rank.

Chinese exchange always fluctuates very rapidly and widely, as the currency is practically on a silver basis and follows the silver-bullion market. The Shanghai tael on July 30, 1914, was worth $0.60; on July 31, 1920, it was worth $1.065; and on Dec. 1, 1922, $0.713. In the face of disturbed political conditions, unsatisfactory currency systems, inadequate transportation, and a number of other disturbing factors, trade in China expands rapidly in many directions and industrial activity shows rapid development. Moreover, American equipment is becoming increasingly popular in China. Our share of the total machinery trade of that country was 5.8 per cent in 1911, 8.3 per cent in 1914, 30.4 per cent in 1918, and 54.1 per cent in 1920.

British India—This country ranked 8, 15, 22, 19 among our machinery markets in 1921, 1919, 1913, and 1910, the volume of American machinery absorbed by British India having increased from $500,000 in 1910 to $10,700,000 in 1921. Exchange in India has been fluctuating very widely. On July 30, 1914, the value of the rupee was about 32c.; on July 31, 1920, it was 37.25c.; and on Dec. 1, 1922, it was 30.03c. The currency is fast approaching stability.

The industrialization of India has become the avowed policy of both the Government and the public. The imports of machinery are expanding very rapidly, and during recent years the American participation in this trade has shown a marked increase. During the fiscal year 1913-14 the total im-

Road Builders to Meet in New York May 15

The annual meeting of the American Road Builders Association at which time election of officers and directors for the year 1923-24 will take place, is to be held at the Automobile Club of America, 247 West 54th St., New York, May 15. The special nominating committee named in accordance with a temporary constitutional provision, has submitted its list of candidates, and ballots have been distributed among the membership. The vote will be canvassed prior to the general meeting. Following is the list of official nominees:

President, Frank Page; vice-president, northeastern district, E. L. Powers; vice-president, southern district, W. F. Keller; vice-president, central district, S. F. Beatty; vice-president, western district, Samuel Hill; treasurer, James H. MacDonald; directors for one year, northeastern district, J. R. Draney and W. A. Van Duzer; central district, Frank T. Sheets; directors for two years, northeastern district, E. J. Mehren, I. W. Patterson, and W. R. Smith; southern district, H. K. Bishop and J. H. Cranford; central district, C. M. Babcock; and western district, H. S. Carpenter; directors for three years, northeastern district, S. T. Henry, R. Keith Compton, and Fred A. Reimer; southern district, Charles M. Upham and H. G. Shirley; central district, Will P. Blair; and western district, Frank Terrace.

Frank Page, chairman of the North Carolina Highway Commission, who is slated for the presidency of the association, will speak and there will be addresses, also, by other prominent representatives of the highway field.

ports of machinery into India were valued at £6,000,000, of which the United States furnished 1.8 per cent. During the war imports fell off, but the American participation increased rapidly. During the year 1919-20, when the forces of reconstruction had begun to operate, the imports were £8,600,000, of which the American share was 29.3 per cent. During the year 1920-21 the machinery imports were £25,300,000, and although the volume from the United States increased, the percentage fell to 13.7 per cent.

India may be expected to show very rapid development along all industrial lines that its population and resources can support. In spite of the fact that there is a very large volume of native capital available, it should be noted that British capital is flowing into the country at an ever-increasing rate, and the markets of India may be expected to absorb increasing volumes of industrial machinery from now on. Unfortunately the machinery users of India have a very inadequate knowledge of the types of machinery produced in the United States and the uses to which they may be put. India is a large market that deserves careful sales work of a character suited to its development.

Philippine Islands—Among the markets for American machinery the Philippines ranked 11, 8, 11, 18, respectively, in 1921, 1919, 1913, and 1910, and the value of American machinery absorbed increased from $500,000 in 1910 to $5,500,000 in 1921. This represented most of the machinery taken by the archipelago, the American share of the total having expanded from 73.1 per cent in 1915 to 97.3 per cent in 1920. In fact, American influence in this territory is so strong as to make it almost part of the domestic field.

The exchange situation is independent of that of Europe. On July 30, 1914, the Philippine peso was worth 49.9c.; on July 31, 1920, 47.25c.; and on December 1, 1922, 48.2c. Currency has reached reasonable stability.

The sales manager's problem in this territory is one of development, which has been very rapid since the American occupation of the Philippines. In this market one will find endless problems, not the least of which is the comparative scarcity of labor. But, on the other hand, the sugar industry has been expanding rapidly and in the years to come will probably show much further development. In many other directions this market shows great possibilities.

Netherlands East Indies—In 1921, 1919, 1913, and 1910, respectively, the Netherlands East Indies ranked 13, 17, 25, 27 among our machinery markets, value of American machinery exports expanded from $84,000 in 1910 to $5,000,000 in 1921. This has been due largely to the fact that American machinery has become better known in the country since the beginning of the European war. Circumstances connected with the war served to introduce our equipment there, and since then American machinery has been very popular. Satisfactory development of this market, however, depends upon careful sales work.

Excluding machinery for sugar factories, America's share in this trade was less than 2 per cent up to 1914. At that time, however, important progress began and by 1919 (the last year for which data are available), American participation was 34.5 per cent. Of the machinery for sugar factories, the United States supplied less than 1 per cent up to 1915, but its share increased to 36.8 per cent by 1918, after which it fell off rapidly to 4.1 per cent in 1920.

This market offers a difficult sales problem, but inasmuch as it absorbs more than $5,000,000 worth of our machinery a year, and as conditions indicate that a larger participation might be developed, it would appear that the trade deserves the necessary attention. Conditions in this market are obviously related to those in the Netherlands, and the two should be considered jointly.

Exchange is on a reasonably satisfactory basis. On July 30, 1914, the guilder was worth 40.9c.; on July 31, 1920, it was worth 34.4c.; and on Dec. 1, 1922, it was worth 39.6c.

Business in this market has been confronted with very serious problems during recent years. Sugar is one of the most important products, and the reaction of the sugar market has been felt seriously, but as the price of this commodity now approximates 4c., it would appear that the industry is again on a profitable basis. The fluctuations in the rubber market have also seriously affected this archipelago, but in this respect, also, conditions have improved greatly. Java is one of the garden spots of the world, and it would appear that reconstruction has now advanced to such a point that important development may be expected.

Other Asiatic Markets—Conditions in the smaller Asiatic markets, such as the Federated Malay States, Ceylon, Siam, and Indo-China, are to a greater or less extent reflected by those indicated above, and it will be noted that the conditions in the entire territory encourage the expectation of very important developments in the near future. No general rule can be laid down that will apply to the marketing of all kinds of machinery, and obviously it would be folly to expect these markets to employ the more specialized types that have been developed for use in the United States. On the other hand, there is a very definite opportunity to expand the sales of those other types that are suitable for use in these countries.

The machinery markets of Asia are so important and the extension of American participation there during recent years has been so great that a special report on this subject has been prepared by this bureau and will be ready for distribution in the near future. The subject has been treated rather exhaustively, the report totaling 332 pages, well supplied with illustrations, charts, diagrams, and several maps that have been specially prepared to indicate the size and importance of these markets. The volume of the trade of each country, the kinds of machinery absorbed, the nature of industrial development needed, and the methods by which the business should be secured and handled have been treated with very great care. This report is entitled "Asiatic Markets for Industrial Machinery" and can be secured from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a cost of 60c.

Steady Service the Best Index of Equipment Value

Manufacturers continue discussion of policy of featuring "record runs"

By C. F. Messinger

Second Vice-President, Chain Belt Co., Milwaukee

WHILE we certainly are not in favor of the manufacturer advertising record or feature runs, we do believe in performance story advertising. This is based on the thought that the only way to prove to anyone that an article will do certain things is to show that it has done them. We feel that this is the information that purchasers want. On the other hand this information should be qualified and no drastic statements should be made. By this we mean that no mention should be made of a particular day's run but a story of what was accomplished on a given job over a period of time, giving information as to the thickness and width of the concrete road and also the number of actual working hours is justifiable, according to our policy.

By Carl F. Ebert

The Osgood Co., Marion, Ohio

THE policy of the Osgood Co. has been one of strictly adhering to straight line advertising; that is, to develop the merits and capabilities of Osgood products in their true light. The company refrains from publishing record runs or exceptional performances of its machinery because it is recognized that the conditions under which such performances are made are more or less ideal and, therefore, exceptional. If such performances were used as a basis of advertising it would lead to misunderstanding on the part of the prospective users of equipment.

Our machinery is sold purely on its merit, and it is believed that it is so built and constructed that it is unnecessary to use advertising of a doubtful nature in order to put the product on the market. The company makes use of letters in the form of testimonials only through its accredited representatives and direct to the prospective purchaser, thus leaving no possibility of a misunderstanding of the conditions under which the performances are made.

By G. A. Rees

Manager Publicity Department, Chicago Pneumatic Tool Co., New York

IT HAS never been the policy of our company to feature what you term "record runs." We have, however, always been great believers in meritorious performance where equipment has established a record over a period of weeks, months or years. Occasionally mention has been made of some unusual performance for a day, covering probably a riveting operation where one enthusiastic riveter drove an unusually large number of rivets. It is the incentive and the man behind any equipment that count. Much must be left to the imagination in any event. Almost any equipment today will, if there is any manual effort connected with it, perform 50 to 100 per cent more work than it is humanly possible for a man to get out of it, because he cannot stand up to the work day in and day out and match the capacity of the machine, although he may do so for a few days. The human element must always be considered along with the equipment.

The only way that we can arrive at the true merits of anything is by comparison. If we have a piece of equipment that is doing certain work, and we read in an advertisement that some similar piece of equipment is doing 50 to 100 per cent more work, we conclude that something is radically wrong in our organization. If attention were not drawn to meritorious performance we would go along in blissful ignorance, losing money day in and day out. As soon as we realize what others can do, we set about to do it ourselves.

Not many months ago one of our customers had a riveting job of considerable magnitude, but it was so located that hot riveting could not be done; the rivets to be driven were ⅝, ¾ and ⅞ in. Notwithstanding the fact that we have been manufacturing riveting hammers for more than 20 years, we had never encountered a cold riveting job larger than ½ in., and in consequence we did not realize that the Boyer riveting hammer would drive these larger rivets cold. It was a case of absolute necessity, and in consequence the customer obtained very low carbon rivets, had them carefully annealed before they were used, with the result that the Boyer hammer drove the rivets and made a good watertight job. This was the first time this practice had been attempted for twenty years, so far as our knowledge extended. It was information which should be conveyed to the multitude of users of pneumatic tools, and the only way we could do it consistently was through the advertising pages. It developed great interest and has since solved the riveting problems on many different occasions. We do not consider that it was a "record run," but we do consider it meritorious performance. The customer who started this large work realizes that if a hammer can stand up for three or four months under this exceptional severe task, it earns its value several times over. Some unthinking individual might expect the hammer to stand up for two or three years, just the same as on hot riveting, and in that event an erroneous impression would have been conveyed in his mind, but we cannot record our acts for the unthinking.

BY THE ADVERTISING MANAGER
Of a large company making mining and quarrying machinery

THERE is no doubt but that unscrupulous advertisers may make improper use of "record runs" in an effort to capitalize some performance which their machine has made. On the other hand, most careful advertisers are alive to the danger of such a situation and know that they will be the first ones to be hurt if they make use of material which is capable of misconstruction. The use of record performances is always attended with opportunities for misunderstanding and in order to be valuable and accurate all circumstances of a test or record performance must be stated in the advertising.

However, when properly used—that is, covered by complete statement and with due regard for the truth—such records have a definite value.

Business Notes

UNITED ALLOY STEEL CORP., Canton, O., announces the appointment of the Andrew Carrigan Co. as sales representative on the Pacific Coast. The Carrigan company has offices in San Francisco, Los Angeles and Seattle. It will handle steel and Toncan metal sheets manufactured by the Stark Division of the United Alloy Steel Corp.

LEHIGH PORTLAND CEMENT CO., Allentown, Pa., will construct a complete portland cement plant at Birmingham, Ala., having an annual capacity of 1,000,000 bbl. Dwight P. Robinson & Co. have been engaged to design and construct the plant.

S. C. WILSON has resigned as district manager of the Pittsburgh office of the Whiting Corp., manufacturer of cranes and foundry equipment, to become associated with the Hockensmith Wheel & Mine Car Co., at Penn, Pa. H. E. Reynolds takes his place as district manager in the Whiting Corp.; Mr. Reynolds' previous service was as sales engineer in the company's Chicago office.

H. E. MARKS CORP., Pittsburgh, manufacturer of gypsum roofs, announces the appointment of James M. Hawkins, with offices at 705 Ellicott Square, Buffalo, N. Y., as its Buffalo and Western New York State representative.

THOMAS J. CLAFFY, for more than 26 years a sanitary engineer in the employ of the Chicago Board of Health and for the last 20 years assistant bureau chief, has resigned to open a consulting office.

ALFRED J. FORSCHNER CO., Philadelphia, has been appointed representative for Eastern Pennsylvania, Delaware and Maryland of Sauerman Bros., Chicago, makers of cableway excavators.

Equipment and Materials

Trench Excavator in New Model

A new trench excavator known as the Model 30, designed to meet all requirements on water main and small sewer trenches, is announced by the Parsons Co., Newton, Iowa. This machine is equipped to dig from 18 to 30 in. wide and to a depth of 12 ft. Overall dimensions and wheelbase are reduced to a minimum producing a small compact machine with large working capacity. Power is furnished by a 40-hp. engine. One feature of the trench excavator is the new patented cushioned boom crowding device.

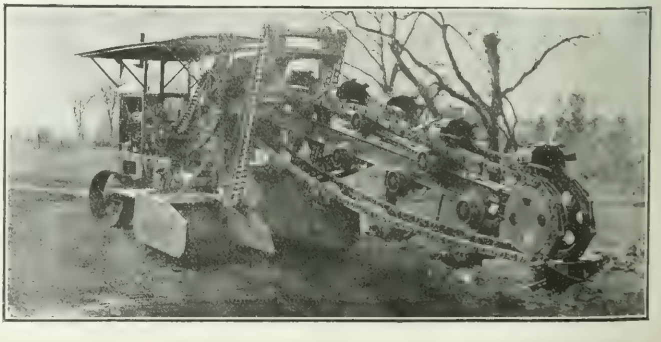
The Model 30 is gear-driven and the main machinery is assembled in one unit with high speed gears, worms and worm gears enclosed and running in oil. The slow traction feed gearing permits three speeds forward and one reverse without adjustments, similar to the automobile gear shift. Steel slat or rubber belt conveyor is optional.

The light weight of this machine, 20,000 lb., makes it adaptable to drainage work.

Masons Trestle of Steel Has Folding and Extension Features

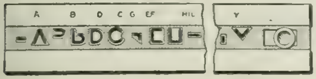
To permit of repeated use on construction work and the transport from job to job in loads of minimum bulk a folding steel trestle, in two models, is being manufactured by the Economy Scaffold Co., of Chicago. The two models are similar in design, except that one has a sliding adjustment by which the height may be varied 2 ft. by increments of 3 in.

These trestles come in a variety of standard sizes. The legs are of high carbon steel tubing and the cross bar is a steel T. All parts are riveted except at the folding joints, where steel hinged plates are provided. In the adjustable trestle the height may be varied by raising or lowering the tubing and inserting a pin at the required height on either side, as illustrated in the photograph. For this type of steel trestle the manufacturer claims long life, saving in cartage and storage, and a minimum of labor for erection.



Guide for Lettering Drawings

For lettering drawings the Wood-Regan Instrument Co., Inc., New York, manufactures transparent celluloid strips in which openings are cut to guide a lettering pen in forming the letters of the alphabet and numerals. Some of the characters are made with a single motion of the pen, while others require the guide to be shifted to the right or left to complete the character.



The celluloid strip is grooved on its under side so that it may be moved from one letter to another without smearing the ink. Separate guides are provided for several sizes and styles of lettering. The method is known as the Wrico lettering system and for it the manufacturers claim uniformity in the finished work and greater speed than is possible by freehand lettering. For use with the celluloid strips the Wrico lettering pen is recommended.

Publications from the Construction Industry

Piledriving Equipment—UNION IRON WORKS, Hoboken, N. J., has just issued a 92-p. catalog, illustrated, of its piledriving and excavating machinery, grout mixers and equipment for subaqueous foundation work. After a general description of the details of the piledrivers, which are operated by steam or compressed air, the text and illustrations are devoted largely to showing the practical application of the equipment to a varied range of construction operations. Union hammers were used to put down the interlocking steel sheet-piling forming the cofferdams which featured the work of raising the battleship "Maine" sunk in Havana Harbor during the Spanish-American War. Several pages of the catalog are devoted to piledriver leads, one of them mounted on a turntable and another on a derrick car.

Concrete Curing Compound — CAL CHEMICAL CO., INC., Hagerstown, Md., has issued a loose-leaf catalog folder describing the properties and uses of Cal, the oxychloride of calcium in the form of a dry powder which is added to concrete mixtures to reduce the time required for set, increase the strength, and add to the workability and weatherproofness of the mixture.

Construction Mixers—KOEHRING CO., Milwaukee, presents an unusually complete description, with illustrations, of its line of construction mixers, both large and small, in a 94-p. catalog. In addition to general views of each unit, there are illustrations and descriptions of all of the more important mixer parts. The catalog contains a number of useful tables giving such information as quantity of aggregate per batch for different proportions of concrete, quantity of concrete in slabs of various thicknesses, beams, girders and columns, etc. The text includes some useful suggestions on operation of concrete mixers.

Traveling and Gantry Cranes — WHITING CORP., Harvey, Ill., in a new 87-p. illustrated catalog describes its electric traveling cranes for foundries, machine and structural shops, power and coaling stations, and gantry cranes for outdoor service where overhead runways would be expensive. Several pages are devoted to sketches and descriptions of lifting attachments, including chain links, plate hooks, I-beam hooks, plate grips, rail tongs, and grab hooks.

Construction Work — FREDERICK SNARE CORP., New York City, has issued a book of photographs illustrating the varied character of heavy construction work it has executed. Organized in 1900, the corporation, formerly the Snare & Triest Co., has completed about 1,500 different contracts ranging in size from small repair jobs to work involving millions of dollars, both in the United States, the West Indies, and South America. Among the types of work illustrated are piers, lighthouses, foundations, dams, industrial plants, bridges, railways and subways, tunnels, waterworks, and hydro-electric plants.

Piledriving Machinery — VULCAN IRON WORKS, Chicago, in a new 72-p. illustrated catalog, describes its various types of piledriving equipment. The Warrington-Vulcan hammer consists of a heavy ram which is raised by steam but falls by force of gravity only. Detailed operating directions are given. The company manufactures a double-acting hammer, similar in construction to an air drill, designed especially for driving wooden planking or steel sheet piling. The text includes a number of sketches and descriptions of piledriving rigs for various purposes, together with details on standard and special sheaves, head blocks, turntables, pile caps, followers, and pile points or shoes. For cutting off piles at any distance below water surface a pile-cutting saw is manufactured.

Concrete Floors—PORTLAND CEMENT ASSOCIATION, Chicago, has issued a leaflet containing a tabulation of quantities of material per 100 sq.ft. for various types of concrete floor. Assumed unit stresses are stated and the types of floor for which the tabular values are given are illustrated in a page of cross-sectional views.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Gary Sees Economic Danger in Immigration Laws

Existing laws restricting immigration are "the worst things for the country's economic future" that could have occurred, according to the report made by Elbert H. Gary, chairman of the board of directors, to the annual meeting of stockholders of the United States Steel Corporation, held in Hoboken, N. J., April 16. Labor abroad is plentiful, Mr. Gary said, and if given the opportunity would gladly come to this country to relieve the present shortage of common labor.

Construction Equipment Exported

Concrete mixers numbering 49 and valued at $56,764 were exported from the United States to foreign countries during December, 1922, according to the records of the U. S. Department of Commerce; 18 of these mixers, costing $28,795, went to Japan, and 13, valued at $16,729, to British India.

In the bucket and belt conveyor field, December exports totalled 110 installations at $24,445, Japan again being the leading consumer.

Dredging machinery weighing 556,500 lb. and costing $78,193, was exported in December, British Honduras receiving the largest quantity of this equipment, amounting to 160,632 lb. costing $33,958.

During the same month 9 cranes costing $60,171 were exported, 3 of them going to Cuba and 2 to Japan.

Hoist and derrick exports for December involved 514 units costing $48,808.

During the same month construction equipment not otherwise specified totalled 817,708 lb. valued at $130,377.

Steel Pipe List Prices Given

List prices, per foot, for full standard weight, black and galvanized, wrought-steel pipe, manufactured by the National Tube Company, Pittsburgh, Pa., are shown in the accompanying table.

STEEL PIPE LIST PRICES

Size	List Price per Foot	Diameters External	Diameters Internal	Thickness
⅛	$0.05½	0 405	0 269	0.068
¼	.06	0.540	0.364	0.088
⅜	.06	0.675	0 493	0.091
½	.08½	0.840	0.622	0.109
¾	.11½	1.050	0.824	0.113
1	.17	1.315	1.049	0.133
1¼	.23	1.660	1.380	0.140
1½	.27½	1.900	1.610	0.145
2	.37	2.375	2.067	0.154
2½	.58½	2.875	2.469	0.203
3	.76½	3.500	3.068	0 216
3½	.92	4.000	3.548	0.226
4	1.09	4.500	4.026	0.237
4½	1.27	5.000	4.506	0.247
5	1 48	5.563	5.047	0.258
6	1 92	6.625	6.065	0.280
7	2 38	7.625	7.023	0 301
8	2.50	8.625	8.071	0.277
8	2.88	8.625	7.981	0.322
9	3.45	9.625	8.941	0.342
10	3.20	10 750	10 192	0 279
10	3.50	10 750	10 136	0 307
10	4.12	10.750	10.020	0.365
11	4.63	11.750	11.000	0.375
12	4 50	12 750	12 090	0 330
12	5 07	12 750	12 000	0.375

Discounts applying on this list are covered by the Pittsburgh basing card of Apr. 19, 1923, published in part in the first issue of *Engineering News-Record* in each month. Warehouse discounts also appear in the Weekly Construction Market, on the last editorial page, covering nine important cities.

Indiana Outlines 3-Year Road Program to Cost $28,000,000

A 1,000-mile state road paving program to cost $28,000,000, has been agreed on by the Indiana state highway commission for 1923, 1924 and 1925, Charles L. Zeigler, commission chairman, has announced. The announcement was made after several days of conferences with Governor McCray and John D. Williams, director of the state highway department. In addition to the paving program the commission will improve about 300 miles of roads.

Cement Prices and Shipments

Portland cement declined in price (exclusive of the cost of bags) from $1.89 a barrel in 1921 to $1.76 a barrel in 1922, according to the latest figures compiled by the United States Geological Survey, but not heretofore made public. Shipments for January and February this year indicate that the consumption of cement in 1923 will be even greater than last year. In these two months shipments totalled 11,382,000 bbl. as against a total of 6,216,000 bbl. in January and February, 1922, and 5,870,000 bbl. in 1921.

To take care of the increased demand for cement which is looked for in 1923, present plans call for seven new mills of substantial capacity to be in operation this year, which, with a number of smaller units, should increase the country's capacity to 150,000,000 bbl. It is estimated that actual production will be 20,000,000 to 25,000,000 bbl. over that of 1922.

There should be no shortage of Portland cement this year, according to the industry's spokesmen, providing purchasers do not concentrate their orders in the peak months of July, August, September and October.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of April 5; the next, on May 3.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.44	+$4.30	$4.50	$3.30	$3.55	$4.20	$3.85	$4.10	$3.75
Structural rivets, 100 lb	4.00	+5.00	5.25	3.75	4.25	5.15	+5.00	4.50	6.00
Reinforcing bars, ¾ in. up, 100 lb	3.34	+4.25	3.15	3.22½	3.45	3.85	3.40	4.10	3.50
Steel pipe, black, 2½ to 6 in. lap, discount	+49%	+50%	45%	59½%	+53-5%	+36%	38.2@50.2%	45%	32.76
Cast-iron pipe, 6 in. and over, ton	58.50	58.00	57.00	58.20	60.50	67.00	60.00	60.00	60.00
Concreting Material:									
Cement without bags, bbl	2.80	3.25	2.25	2.20	2.39	2.85	2.71	2.90	2.68
Gravel, ¾ in., cu.yd	2.25	1.90	2.25	2.25	1.75	1.90	2.15	1.25	1.50
Sand, cu.yd	1.00	1.24	1.90	2.25	1.00	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd	1.75	2.00	2.50	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	65.00	40.00	53.00	60.00	45.75	42.75	+41.00	31.00	95.00
Lime, finishing, hydrated, ton	16.80@17.10	23.00	22.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	3.00@3.25	1.40	2.50	1.50	1.25	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	13.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.0893	.115	....	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1314	.0893	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal	1.16	1.28	+1.42	1.25	1.34	1.41	—1.24	.86	—1.15
Common Labor:									
Common labor, union, hour	.75	.35	....	......	....	.50@.55	.56¼	....	......
Common labor, non-union, hour	....	.30	.30@.50	.72½	.35@.50	.35@.50	.50	.30@.70	.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 81¼c.; building laborers, 75c.; minimum for pick and shovel men, 50c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine casing. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.20). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Wrought-steel pipe discounts down two-points on new Pittsburgh basing card of April 19. Rise reflected in similar reduction in warehouse discounts at New York, Atlanta, Minneapolis and Denver.

Present price of steel plates not under $2.75 per 100 lb., Pittsburgh, for spot deliveries in the open market. As high as $2.90, however, named on some shipments. Quotations of $2.45 still hold for railway car orders in substantial tonnages. Considerable inquiry for steel plates at mills, mostly from car builders. Structurals, $2.50@$2.65; increasingly difficult to place orders at $2.45. Steel bars, $2.35@$2.75. Atlanta reports advance of 10c. on steel shapes and 15c. on rivets and bars; San Francisco quotes rise of 25c. per 100 lb. on rivets, during week.

Concreting materials, brick, lime and hollow tile showing uniform firmness in the nine cities reporting weekly to *Engineering News-Record.*

Douglas fir timbers, base sizes, quoted at $41 in San Francisco, against $39 per M. ft. b.m., last week. Telegraphic reports to the Lumbermens' Bureau from New York, state that while the "yellow pine demand is a bit slacker, prices might be expected to drop off, but short stocks and chaotic deliveries have offset any declines."

The National Lumber Trade Barometer, April 20, shows actual production nearly 5 per cent above normal, with shipments about 109 per cent and orders 100 per cent of normal production.

Linseed oil dropped 1c. in Montreal and 10c. per gal. in San Francisco, but advanced 7c. in Dallas.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

Volume 90 NEW YORK, MAY 3, 1923 Number 18

Going Up!

ONCE more the *Engineering News-Record* cost index has gone up. The rise from 213.5 to 216.7 in the month is a fair reflection of the general rise in prices, which has been obvious but not startling. To those who are afraid of a runaway market there is the comfort that the 1923 cost curve looks more like 1918 than 1920 and that so far at least we are not embarked on the steep gradient of rising prices of that wild year. So long as we stick to necessary construction, do not over-order and maintain a self-preservative sense of decency as to prices there is no reason why we cannot keep the curve of construction progress near the desired horizontal.

The Student Chapter as an Honor Society

WHEN the civil engineers at the University of Michigan came to organize a student chapter of the American Society of Civil Engineers a few weeks ago they adopted a novel scheme which will bear watching. In effect they are converting the chapter into an honor society. At Michigan, students in civil engineering are rated on a perfect mark of 4, with a pass mark of 2. As it happens now, an average of all the students marks is 2.3. The new chapter will take in as members only those upper classmen whose rating is 2.6 or above, and on that basis has been organized with 35 seniors and 20 juniors. It remains to be seen how this will work out, but it has the excellent feature of making the society student membership something that has to be worked for, while at the same time the criterion of acceptance is not placed so high as to exclude all but the brilliant student.

Checking Duplicate Orders Difficult

AS WAS to be expected, our comment of last week on the desirability of a non-cancellable or penalty-for-cancellation form of contract for buying building materials has been met by the statement that the manufacturers are taking precautions to see that no more material is ordered for a particular job than that job requires. The objection is not a sound one and whatever inspection is in progress is not sufficient to prevent the over-ordering and duplication evil. So far as we have learned, the non-cancellable or penalty contract affords the only full protection. It is true that the cement companies in particular, acting individually, are trying to check up as to the quantity of cement ordered from them for specific jobs. For work in large cities, this quantity check is possible. It is not feasible, however, on outlying work. Moreover, as to all classes of work, either in cities or in the country, there is no means of ascertaining how many companies have duplicate orders for a given job. The inspection organizations which operated prior to the Hardwood Lumber decision, received information from all of the cement companies so that the duplication as between companies could be prevented. These associations are not now in existence and the amount of checking up that can be done, therefore, by individual manufacturers can stop only part of the over-ordering abuse and none of the duplication. The inspection method of checking abuses, moreover, is economically unsound. It erects an expensive checking system in order to stop the abuses that flow naturally from an unsound practice relative to contracts. The sound procedure is to change the trade practice and adopt a sound contract form which will prevent the abuses from developing. The remedy, in other words, should be sought by prevention and not by repression after the abuse has developed.

Navigable Waters Again

THE time is fast approaching when the Supreme Court must lay down some basic principle on which can be established the exact rights of the federal government in the matter of navigable waters. The question is becoming of paramount interest in the administration of the Federal Water Power Act, especially as regards the collateral question of the jurisdiction of the states, but it is having ever widening implications in other fields. Two instances are at hand, in both of which the federal authorities claim control of an artificial canal as a navigable stream. In the first case, the government attorney submits that the New York State Barge Canal, as a power factor, is a navigable stream and therefore under the jurisdiction of the Federal Power Commission; in the other a similar attorney claims the right for the government to order a railroad to extend and pay for the extension of a bridge to cross the Chespeake & Delaware Canal, which the government is widening purely for navigation purposes. No navigable water naturally exists at either location. How far can the famous interstate commerce sentence of the Constitution be stretched?

History of Engineering

NOTHING is more fascinating or more elusive than the pursuit of the history of engineering. The vastness and endless detail of the subject and the fact that relatively few engineers leave adequate if any historical data make rare anything more than mere fragments of engineering history. This being so the efforts of the Newcomen Society of England, whose first formal Transactions was noted in our Engineering Literature Section Feb. 15, p. 311, deserve support. Until recently the society had the merest handful of members in this country, presumably because it was young and little known. The membership has increased of late. Doubtless it will grow materially now that its honorary secretary, H. W. Dickinson, has visited this country and met a considerable number of men interested in the history of engineering, as noted in our news section. Among the benefits imparted by adequate history of various branches and elements of the history of engineering and technology the two greatest are help and inspiration—help through the lessons of experience and inspiration from achievement against great odds. Probably no adequate history of engineering will ever be written, so scanty are the materials of the remote past and even of a half century ago; but in the newer branches, such as airplane and automotive engineering, fuller records are available and most of the makers of such history are still alive. Liberal appropriations for technical research in these newer fields are freely made. Why not appropriations for historical research and record as well? Associations in engineering fields new and old have an opportunity to contribute to the history of engineering that should not be lost. The least of them can well afford to give their support to the Newcomen Society. In so doing they will be fully rewarded, first as is any one who helps a good cause and second by the society's publications. Engineering societies large and small can do far more than this. They can take more pains to make sure that the papers presented before them are of real historical and technical value, instead of being mostly categorical details of matters which at best are of local or personal interest. Some of the technical societies could, through proper committees, provided with modest funds for secretarial and other expenses, do a considerable amount of historical research.

Municipal Home Rule Gains

THE recent passage in New Jersey of an act giving the municipalities of that state the right to decide for themselves whether they will adopt the city manager plan and the adoption by the New York Legislature for the second of the two requisite years of a resolution submitting to the state-wide popular vote a constitutional amendment providing for a considerable measure of municipal home rule are gratifying signs of progress towards a greater but still reasonable degree of municipal freedom. For years past the New Jersey Legislature has smothered or sidetracked proposed legislation permitting its cities and towns to adopt city manager charters. Even now it is only by a lucky last-minute legislative-rush chance that a vote was gained that gave the bill a majority of one in the senate and sent it to the governor. The opposition in New Jersey seems to have come from the politicians generally and from the hosts of commissioners in the many cities where the commission plan, without its frequent manager accompaniment, is in force. These commissioners have larger salaries than will be paid under the manager plan and in addition each commission is the head of an important administrative department—ignorant and inexperienced in city administration as most of the commissioners are when elected. The new law will give New Jersey cities the option of substituting a single trained manager in place of a group of untrained department heads, and will also make that clear-cut separation of legislative and administrative powers that has been considered advisable by most students of government for decades past. The New York home rule amendment, if adopted by the people next November, will free the legislature of a mass of local legislation that consumes time needed for other purposes and affords endless chances for log rolling. Besides that it will give the municipalities of the state the right to settle purely local affairs to suit thir own conceptions of their needs, which they should know better than some scores of men at Albany. Matters of state-wide concern will still remain with the legislature, for control through general laws.

Staking Out the Road to Rehabilitation

JULIUS BARNES, president of the Chamber of Commerce of the United States, has recently returned from Rome with a report of the principles laid down for world reconstruction at the meeting of the International Chamber of Commerce. Those principles are not new. Quite the contrary, they are so fundamental as to be elementary; yet it is heartening to hear them restated so clearly, so authoritatively and so unanimously. And now, with business and industrial sentiment beginning, at least, to rally to their support, there is room for hope that sound business counsel may yet prevail over political opportunism and expediency.

The primary need, all agree, is to restore stability and revive general confidence. What can be accomplished even through this measure alone is indicated by the experience of Austria, where, Mr. Barnes reports, a stabilized currency has inspired industry, stimulated the earning power of the people and revealed a totally unexpected capacity for saving. A revival of general saving and of investment is bound to expand employment and to stimulate production, which alone can raise European standards of living from the depths to which they had fallen. Many, of course, had already reasoned thus far. But the Rome conference was not content with this broad and general statement. It went on to point out how necessary it is to make sure that expansion of employment actually will leave us a net increase in production. For it is only out of net production that standards of living can be raised, and only out of surplus earnings that capital can be made available for further investment and thereby renew the cycle of prosperity.

To this end the conference approved a code of five principles, designed to point the way to maximum production. The first of these calls for "the adoption of every invention and mechanical device that offers economy of production." Herein is a reminder of the unfortunate truth—at once the pride and the despair of the engineer—that inventive and engineering genius has outstripped our administrative capacity, both political and industrial. Despite the forces and appliances that technical science has put at its disposal, mankind has not yet learned how to derive from them the fullest measure of human happiness. The second and third principles demand "the elimination of restrictions on individual output" and "the stimulation of individual effort by payments which reflect the relative individual effectiveness." Here we find embodied the basic principle that, after all, the motive power of industry resides in the individual and will be proportionate to the strength of individual incentive, stimulated by individual reward.

The fourth principle commends "the advantages of private ownership and operation as contrasted with the record made by state ownership and operation" and the fifth advocates "immediate steps to divert men now engaged in non-productive pursuits into productive labor as soon as possible." These conclusions, according to Mr. Barnes, reflect the recent experience of Europe, notably that of Italy and Austria. In Italy, Premier Mussolini—five years ago the foremost Italian socialist editor—has already dropped 40,000 from the rolls of the state railways and now demands that the state divest itself of all those functions that could be discharged by private enterprise. In Austria 100,000 have been eliminated from the public services and in Great Britain, Mr. Barnes tells us, the return of the railways to private operation has appreciably increased their service to British industry.

The recommendations of the conference as to the specific problems of international finance naturally are designed chiefly to restore stability and to remove unnecessary burdens from the shoulders of those to whom we must look for production. With regard to reparations, the sentiment was unanimous that Germany must acknowledge her liability for wanton aggression and pay to the limit for her resources and earning power; that reparations must carry some security for their payment; and that security against similar aggression in the future must be provided.

It was agreed that in settling allied debts, the ability of debtors to pay should be considered, without subscribing to any doctrine of general cancellation or remission. It was agreed that national finances must show a proper relationship between revenue and expenditure and that taxation for revenue must not be permitted to stifle productive industry. International loans by governments should be discouraged, the conference declared, so that they may be considered on a business rather than a political basis. No confidence was felt in the artificial stabilization of exchange by governments and the opinion prevailed that the goal of exchange should be gold parity through natural processes.

Here, then, are the goals and here are the roads that lead to them. Human necessity is the motive power. It remains to be seen whether human statecraft and the administrative ability command the vision and the skill to fashion a vehicle that will bear the distracted people of Europe out of the economic morass in which they find themselves and into substantial prosperity.

Good Roads and the Financiers

A BOND issue of $100,000,000 is a large obligation for any state to assume. This is the sum which, however, it is proposed that the state of Illinois shall add to its present indebtedness of $60,000,000 for the improvement of public roads. Opposition has developed. The question is raised: How large a paved highway system does the state require immediately? Time of construction it is to be particularly noted is as much the essence of this question as is volume. On one side are the bankers and large financial and commercial interests and on the other are the state administration, the farmers and the town residents. The unusual situation exists, moreover, that the financial and big business interests are opposing and the farmer and rural town taxpayer are proposing the extended expenditure of borrowed money.

Why are the financial interests opposed to a bond issue for road construction in Illinois? There is no doubt that this is the fact. The state administration, as is stated in the staff dispatch in this week's news columns, is advancing the new highway financing plan and the banking and commercial associations are opposing it as organizations. They are conducting their campaign with skill and in force. Again, what is the reason for this concerted action?

Local conditions do not explain it. The strategy of state politics is a factor but not a controlling one. No other local influence stands out. Indeed the action can be explained only by a motive whose influence is general. Is there a banking movement to deflate public credits? There are indications that support such a belief. The volume of non-taxable securities is reaching alarming proportions. Increasing business makes highly desirable a liberal extension of commercial credits. In a score of ways developing conditions urge conservatism in construction undertakings.

On every side there is much to confirm the belief that the bankers' action against extending the borrowing power of Illinois for public road work is a manifestation of general banking policy perhaps in part not yet consciously formulated. If this is a fact then the opposition in Illinois sounds a warning of curtailed credits everywhere for highway improvement.

It is asserted by the bankers that the administration plan cannot be carried out regardless of funds. Their contention that further borrowing is bad financing rests on this argument and on the asserted need of sound economy in public expenditures. The weakness of their argument is that they are not in possession of facts to prove it. In this respect the highway department is at an advantage because it has made some kind of a survey of the construction market. But neither disputant is in a position to assert convincingly that there are or are not and will or will not continue to be, enough contractors, materials, labor and transportation to carry through the enormous program of a thousand miles of paved road construction each year for five or six years.

About the same conclusion seems necessary in the question of how large a paved road system the state requires immediately. The highway department is at an advantage in the argument because all over the country traffic has developed so rapidly that no amount of roadbuilding that a state can find means to do is likely to be too much. However, no one knows and no one can know, without a transportation survey exceeding in scope and detail any which has been made anywhere, whether a 7,800-mile paved road system is required in Illinois or how soon it should be constructed. The situation is no different in any state. Everywhere the planning of state road systems is a process no more certain or definite than a sagacious guess.

The highway situation which has developed in Illinois is of large significance. It introduces new elements into road improvement. One is the critical attention of the money interests. Road development plans have not merely to engage the support of the mass of the people which is uncritical and impulsive, but to sustain the exacting requirements of those who control investments and credits. The second element is traffic knowledge. There is no such knowledge yet although it is beginning to be obtained by research like the Connecticut traffic survey. Economic planning of highway systems requires data on traffic volumes and character and speed, on traffic trends and on its periodic ebb and flow and on transport co-ordination. This research is an essential future phase of highway administration.

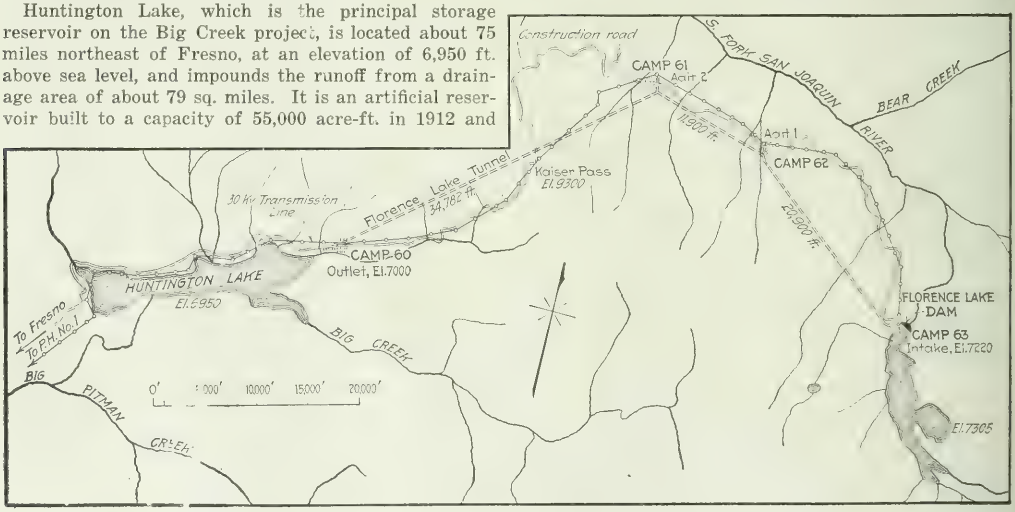
An outstanding lesson of the Illinois situation, then, is that traffic knowledge needs to be acquired by highway departments. Until state highway engineers can bring to their support the results of surveys which are more than mere counts of vehicles, they are in an unfavorable position to assert that certain mileages are demanded in a certain state or to assert what the proportionate mileages of paved or unpaved roads should be.

Methods and Progress in Constructing the 13-Mile Florence Lake Tunnel in California

New Tunnel Will Drain 320-Sq. Mile Area Into Huntington Lake Whence a 4,719-Ft. Drop Is Utilized by Chain of Hydro-Electric Plants—Location Is Longer But Can Be Built Quicker Than Direct Route

By D. H. Redinger
Resident Engineer, Southern California Edison Co., Cascada, Calif.

RAPID increase in population and in the industrial and agricultural activities of Central and Southern California during recent years has trebled the power demand in the area served by the Southern California Edison Co. Every effort has been made to increase plant capacity to meet these demands and increases in the installed capacity of all of the power houses on the Big Creek project have been planned, together with the construction of additional plants at points where more power can be developed.



MAP SHOWING RELATIVE LOCATION OF THE TUNNEL AND THE TWO RESERVOIRS

Huntington Lake, which is the principal storage reservoir on the Big Creek project, is located about 75 miles northeast of Fresno, at an elevation of 6,950 ft. above sea level, and impounds the runoff from a drainage area of about 79 sq. miles. It is an artificial reservoir built to a capacity of 55,000 acre-ft. in 1912 and 1913; the three dams which retain the waters of the lake were raised in 1917, making its present capacity 88,000 acre-ft.

Three powerhouses, No. 1, No. 2 and No. 8, with a combined capacity of 140,000 hp., now utilize the water from Huntington Lake through a total fall of 4,719 ft. Powerhouse No. 3 is under construction, scheduled for operation in the early fall of 1923, with 100,000 hp. A third generating unit rated at 22,000 hp. is being installed in powerhouse No. 1, making a total additional plant capacity of 122,000 hp. being installed during the present year, which will be supplied by the Huntington Lake reservoir.

The ultimate plans for the development of all of the power available on the streams below using water drawn from Huntington Lake call for slightly more than 1,000,000 hp. To make possible the development of this amount of power it was necessary to increase the drainage area supplying Huntington Lake, by tunneling into another drainage basin.

Early in 1920 plans were completed for tunneling Kaiser Ridge, which lies to the northeast of the lake, and thus tapping the upper reaches of the south fork of the San Joaquin River. Kaiser Ridge, with a crest elevation of 10,000 ft. above sea level, separates the Huntington Lake Basin from the area drained by the San Joaquin River.

It is about 11 miles in a straight line from Huntington Lake to a point on the south fork of the San Joaquin whence water can be diverted to the lake by gravity. At that point on the river a dam 120 ft. high is to be built to form a storage basin with a capacity of 43,000 acre-ft. This new reservoir will be supplied by a drainage area of about 320 sq. miles, extending eastward to the high altitudes of the Sierra Nevadas, where snow lies for almost the entire year. A small natural lake, called Florence Lake, which will be submerged by the new dam, gives the new tunnel its name.

Rather than attempt to drive a straight tunnel 11 miles long, which could be worked from the two portals only, it was decided to locate the tunnel parallel to the river for about 7 miles from the intake and at this point turn southwesterly for a 6½-mile tangent under Kaiser Ridge to Huntington Lake. Although this plan increases the tunnel length by about 2½ miles, the additional length is more than offset by the advantage of having two adits which tap the tunnel on the northerly slope of Kaiser Ridge, cutting the tunnel into three sections, the longest of which is 6½ miles. By constructing the tunnel in three sections, six working headings are made available, cutting down the construction period to that required to drive the longest tangent. It is estimated that it would take approximately two years longer to construct the tunnel in one tangent,

SITE OF FLORENCE LAKE RESERVOIR, EL. 7,200 FT.

which would not be economical from a construction standpoint and would not meet the requirements of the power market served.

Actual construction was started in 1920, and it is planned to have the tunnel in operation by the Spring of 1926. The total cost will be approximately $16,000,000.

When work on this tunnel was begun the country between Florence and Huntington Lakes was covered with virgin forest, with no means of communication other than steep mountain trails. Camp 60 was established at the outlet portal at the eastern end of Huntington Lake in July, 1920, and at the same time work was started on the road to climb from Huntington Lake through Kaiser Pass, El. 9,300 ft., and thence down the northerly slope to the site of the adit at Camp 61.

Road work was carried on from five camps, and within about two months 11½ miles of good dirt road had been completed connecting Camp 60 at the outlet portal with Camp 61. Here a permanent camp was established for carrying on the tunnel work during that winter. At this elevation there are seldom more than five months during the year when snow does not lie on the ground in depths ranging up to 10 ft. By Oct. 1 a permanent winter camp (Camp 60) was completed at the outlet portal and an open cut begun at that end of the long tunnel tangent. On Oct. 15 the first set of timbers was placed and underground work was begun. By the middle of November Camp 61 was completed and ready for the winter's work, and an open cut was commenced in sand at the adit's portal. Thus it was possible to continue work at both ends of the long tangent during the winter of 1920-21.

ROAD WORK NEAR KAISER PASS, EL. 9,300 FT.

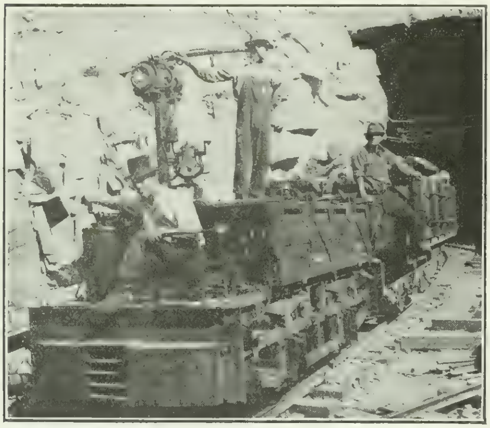
Excavation carried on from both these camps was at first slow and difficult and required heavy timbering. At the adit at Camp 61 soft running sand was encountered, and at the outlet portal the rock was wet, decomposed granite, sand and boulders. By April 15, 1921, 395 lineal ft. had been driven at the outlet heading and 306 lineal ft. in the adit at Camp 61. Various methods of attack were employed at both headings, but the work was chiefly confined to hand labor in small timbered drifts with breast boards and a large amount of piling to hold back the flowing sand and caving ground. Mucking was done with Shuveloders, and tramming with storage battery electric locomotives hauling between four and six 1-cu.yd. dump cars. For the purpose of double tracking the adit was made the full size of the tunnel cross-section, which is 15 ft. wide with a central height of 15 ft., the bottom being square and the roof arched on a 10.8-ft. radius. This section, unlined except in the portions where soft material is encountered, is calculated to give a flow of 1,000 sec.-ft. on the grade of 3 ft. per M.

RADIO STATION AT CAMP 63, ONLY MEANS OF COMMUNICATION

After six months of continued effort the adit at Camp 61 was less than one-third completed and, of course, no excavation had been made in the tunnel. It was then decided that some means of speeding up the work was imperative and a 45-deg. incline shaft into the main tunnel line west of the adit was sunk. This incline was located 1,655 ft. toward the outlet portal from the point of intersection of adit and tunnel. It was begun on April 15, 1921, and after traversing 247 ft. in hard granite was completed down to tunnel grade on July 23. From the bottom of this incline the tunnel was driven toward the outlet portal by ordinary hard-rock methods, using the heading-and-bench system. Very good progress was made in spite of the handicap of having to remove all material by a skip operating by an air hoist at the head of the incline.

Due to the slow progress on account of the sand in the adit extending from the portal to a point about 800 ft. in, a 13 x 22-ft. vertical shaft was sunk to the adit grade. The shaft was about 87 ft. deep and was located in the adit about 170 ft. from the point of tunnel intersection where rock outcrop on the surface indicated solid material. This shaft was started June 25, 1921, and was completed to tunnel grade in 49 days. This made two more headings possible, one along the adit so as to attack the sand from both ends, and the other heading along the adit towards the tunnel.

On Dec. 17, 1921, the small pioneer drifts in the adit holed through and two months later the adit excavation was completed, allowing muck trains to be hauled out through the adit. Mucking through the vertical shaft was then discontinued. On April 6, 1922, the 1,600-ft. section of tunnel which was started west from the vertical shaft broke through at the bottom of the incline shaft. By that time the heading going west from the bottom of the incline had been advanced 1,300 ft., bringing the total progress at Camp 61 up to 2,900 lineal ft. of tunnel and 1,086 ft. of adit. At the outlet portal the heading being driven east advanced 2,925 lineal ft. during the same period.



ELECTRIC LOCOMOTIVE WITH 4-CU.YD. DUMP CAR
On this job combination locomotives are used arranged for operation either by storage battery or trolley. Ordinarily much is hauled out in 5-car trains.

With mucking through the vertical and incline shaft at Camp 61 no longer necessary, attention was concentrated on a single heading going west from the adit. With a better organization and more uniform rock, as well as improvements in equipment, better progress was made from that time on. For the first six weeks in 1923 this heading was advanced an average of 83 ft. per week. In the same period at Camp 60 the average heading progress was 112 ft. per week.

At both headings the heading-and-bench method with drills on both horizontal and vertical bars is being used. The horizontal bar is used when the bench is being drilled and two vertical columns are used for drilling the top heading. The depth of holes in the top heading varies from 10 to 14 ft., and the total number usually about 40.

Three 8-hour shifts are found to be the most satisfactory arrangement, particularly since the 8-hour law limits work underground to 8 hours. It is not the easiest kind of an arrangement to schedule, because one crew cannot get the holes completed before their 8-hour shift period is up and the result is that two crews have to work on the same round of holes. This is rather unsatisfactory; it would be simpler and speedier to have each shift complete the round which it started.

Because the Florance Lake tunnel is a long and costly job, it was thought worth while to fit the equipment to the tunnel size. Beginning with the cross-section of the tunnel and setting aside that part of it required for the operation of an air-driven steam shovel, dump cars were built of the maximum size that could be operated in the remaining available space. Their height had to be kept down in order that they could be loaded through the bottom of the steam shovel dippers. The special cars built have 14-in. wheels and are about 4½ ft. high. Several improvements that were factors in increasing progress may be cited as follows:

(1) Supplanting of the smaller capacity Shuveloders in August, 1921, with a special type No. 25 Marion steam shovel operated on compressed air. The special features of these shovels are chiefly minor changes in standard design that enable the equipment to work effectively in a 15 x 15-ft. tunnel. The time required for mucking was greatly reduced when these shovels were put into operation.

(2) The substitution of dump cars with a capacity of 4 to 6 cu.yd. for the 1-cu.yd. dump cars and also the improvement of trackage facilities. At the present time trains of five cars, carrying about 20 cu.yd. per train, are being handled. These larger dump cars were not practicable until the air-operated shovels were brought to the job.

(3) Supplanting the storage battery locomotives with combination storage battery and trolley type locomotives, permitting trolley operation to within about 800 or 1,000 ft. of the heading. This made it possible to haul heavier trains and enabled locomotives to go wherever the track is clear, without flexible leads or trolley wires, which are subject to destruction by flying rock fragments. The locomotives are Baldwin-Westinghouse 8-ton machines, and in addition to the regular trolley are equipped with Hobbs 17-plate storage batteries rated at 220 ampere-hours and 275 volts, the same as the trolley voltage.

(4) Replacing the 12-in. steel ventilating pipe with 24-in. wood stave pipe, and installing larger blowers, which clear the tunnel of gas after blasting in less time. The wood stave pipe was chosen for two reasons; with the wood pipe there is no danger of collapse from concussion and when a heavy rock fragment falls on the wood pipe the result is only a hole broken through over which a patch can readily be placed, whereas in steel pipe any fragments crush the pipe and repair requires renewal of the section. Of course, very large rock would put either out of commission. The 24-in. wood stave blower pipe is now suspended from the center of the roof in order to give more room along the sides of the tunnel.

At present the blowers are supplying air to the headings 6,500 ft. distant, but some time in the summer of 1923 it is expected that larger-capacity blowers will be installed. Several No. 3 Root type blowers are in use. At Camp 60 a No. 6 Root blower is used. Camps 62 and 63 at the upper adit and intake portal are to be equipped with No. 11 American blowers, the latter with a rated capacity of 9,000 ft. of fresh air per minute at a distance of 5,000 ft. under 2-lb per sq.in. pressure.

At the outlet portal 900 ft. of the tunnel had to be timbered before reaching rock solid enough to be self-supporting. In the adit at Camp 61 sand and boulders and some quicksand were encountered, requiring timbering for 600 ft. In the main tunnel at Camp 61 about

FREIGHT IN WINTER IS HANDLED BY DOG TEAMS

500 ft. has been timbered to date, due to bad seams and blocky granite. From indications thus far it is estimated that perhaps about 2 per cent of the total length of the tunnel will require concreting. The 800 ft. in soft material at the outlet portal has already been lined with concrete, using the pneumatic concrete gun, a minimum thickness of 12 in. being placed.

A sawmill with a capacity of 1,000,000 ft. b.m. per month is in operation at Camp 61, where all lumber used on the east side of Kaiser Pass, including tunnel timbers, has been cut. During the summer of 1922 the construction road was continued to Florence Lake, and by late fall Camps 62 and 63 had been established and were well stocked with supplies, equipment and materials for their eight months of winter isolation. Supplies for an eight-month period for these three camps total about 15,000 tons, all of which went in via motor truck over the construction road through Kaiser Pass during the open season. Work underground has progressed favorably through the winter. Up to Feb. 17, 1923, at Camp 63 with 200 men working one shift there was 339 ft. of tunnel excavated. At Camp 62 with 217 men, working three shifts in the tunnel since Aug. 9, there was excavated 830 ft., which is the total length of the adit and 468 ft. of the tunnel, working toward the intake.

A 30,000-volt transmission line was built from Cascada, the nearest power house, to the several tunnel camps early in the construction program, and thus far this power line has been kept in service through the winter with only occasional interruptions of short duration. A telephone line through this rough country was considered too uncertain, particularly for the emergencies of winter service to such remotely situated camps, and radio communication is therefore used exclusively. A radio transmitting and receiving station in each camp, and at construction headquarters at Cascada, is open for twenty-four-hour service. The radio installations were described in *Engineering News-Record* July 14, 1921, p. 57.

As a means of "keeping the men happy" on the isolated work, each camp is provided with a recreation hall and reading room equipped with phonograph, pool table, magazines, etc., and once a week a moving picture is shown twice, the hours being arranged so that all shifts have an opportunity to see it.

According to the present schedule the tunnel tangent between the intake and adit 1 and the tangent between adit 2 and the outlet should be completed in the fall of 1925. Work on the 2¼-mile section between adit 1 and adit 2 will be started in ample time to be completed by the time the two longer sections are finished. This will make the tunnel available for conveying the 1926 runoff which will be diverted into the tunnel for the first year or two by a low timber crib diversion dam.

Imhoff Tank and Sprinkling Filter Studies at Plainfield Works

Joint Investigations of New Jersey Agricultural Experiment Station and New Jersey State Board of Health

By Dr. William Rudolfs
Chief, Sewage Investigations, Agricultural Experiment Station, New Brunswick, N. J.

Abstract of a paper read before the New Jersey Sewage-Works Association.

THE WORK in the sewage substation of the New Jersey Agricultural Experiment Station and the New Jersey State Department of Health was begun about a year and a half ago with the study of chemical changes occurring in the sewage filtration plant at Plainfield, N. J. Dr. R. O. Smith, then chemist in charge, started work with the sprinkling filters in the hope that chemical analysis would produce sufficient evidence for a more detailed study of the plant. Alongside, quantitative determinations were made of the fauna (protozoan, annelids, etc.) occurring in the filter. A part-time botanist was employed to determine the species of fungi and algae adhering to the stones. In October, 1922, the interdependence of the flora and fauna was recognized, and a chemist, bacteriologist, zoologist and botanist were employed to carry on the different lines of study.

Our interest in the sewage flora and fauna is a very practical one. We want to find out: (1) what organisms are present in sufficient numbers to carry on the digestion processes, and (2) how these organisms accomplish purification. This work necessarily calls for a study of the organisms present and of the chemical changes involved.

Imhoff Tank—Although the studies of the botanist have not gone very far, we know that but very few fungi and algae are found in the Imhoff tank. Unfrequently masses of filamentous bacteria occur in the scum, and we do not know as yet whether these slimy organisms are colonies of bacteria attacking gelatine material, or whether they are a special kind of fungi.

We have some interesting information about the protozoa occurring in the Imhoff tank. Table I gives an idea of the distribution at different depths of protozoa. It is quite apparent that with increasing depth the numbers of animals increase. As a rule, the scum formed in the vents of the tank does not contain protozoa at all. It is interesting to note that the numbers of flagellates in the influent are ordinarily the same as the numbers in the effluent. The same is the case with ciliates.

TABLE I—FLAGELLATES AND CILIATES IN THE IMHOFF TANK
[illegible]

Depth in Feet	Flagellates	Ciliates
1	0	0
2	[illegible]	2
[illegible]	[illegible]	20
7	[illegible]	90
10	[illegible]	200
[illegible]	[illegible]	400
[illegible]	[illegible]	800

In the [illegible] about 75 c.c. [illegible]

Table II shows the relative numbers of bacteria representing the proteolytic activities and also nitrogen transformation. Liquefaction of proteins is that change by which solid and insoluble organic material is converted into a soluble condition, furnishing thereby a food supply for bacteria which are producing ammonia, hydrogen sulphide and those which attack albumen. The reduction of sulphates, which are usually present in sewage, together with the sulphur from the proteins, give rise to the production of sulphuretted hydrogen.

The value of bacteria presented in Table II represents averages of from 18 to 24 samples. To obtain the value of bacteria in one sample it was necessary to prepare seven dilutions ranging from the concentrated material into the various groups. Eleven different media were used. Each medium was then inoculated with the dilutions just mentioned.

TABLE II—RELATIVE PREVALENCE OF PRINCIPAL GROUPS OF BACTERIA IN AN IMHOFF TANK

Type of Organisms	Organism per c c	
Proteolytic		
Digestion of peptone with NH_3 production	1,000,000	
Digestion of gelatine with liquefaction.	700,000	
Digestion of peptone with H_2S production......	350,000	
Digestion of coagulated albumen with liquefaction	200,000	
Reducers of nitrogeneous compounds		
(*a*) From nitrate to nitrite.....................	200,000	
(*b*) From nitrate to nitrogen gas	100,000	
(*c*) From nitrate to ammonia.....	250,000	
Total denitrifiers		650,000
Oxidizers of nitrogenous compounds		
(*a*) From ammonium salts to nitrite...........	200,000	
(*b*) From nitrite to nitrate	250,000	
Total nitrifiers		450,000

From the table it can be seen that the more abundant bacteria are those which attack the most easily digested protein material, like bacteria which attack soluble protein with the production of ammonia. These bacteria were always present even in the highest dilutions used. There is no doubt that bacterial numbers bear some relation to the character of the protein molecule. This seems to be shown by the fact that bacteria which produce sulphides from soluble proteins are less prevalent than bacteria which produce ammonia from the same substances.

Another interesting feature brought out in this table is the oxidation of nitrogen. The nitrogen is oxidized to the nitrate stage, still at the same time organisms are present which reduce nitrate nitrogen to nitrite nitrogen and finally to ammonia. In the Imhoff tank this latter group is in ascendance. In addition to the groups of bacteria mentioned, other organisms have also been found, namely: (1) Bacteria producing sulphides from inorganic sulphates. (2) Bacteria oxidizing thio-sulphate to free sulphur and sulphates. (3) Bacteria which digest cellulose. (4) Bacteria which split fats. The bacteria producing sulphates might be of importance since the sulphates exert influence upon all reactions involved in the tank. If the sulphate organisms become numerous, acidity in the tank increases and the activities of other groups of organisms might be partially or totally inhibited. On the other hand, when no sulphates are formed a tank becomes too alkaline and phenomena familiar to the sewage operator, like foaming, etc., occur. The bacteria which split fats have considerable importance for the digestion of the scum formed on top in the tank. The fermentation of cellulose gives rise to the production of gases. For that reason it is very important that gas determinations be made.

Besides chemical analysis of the Imhoff influent, the scum, the liquid layer between scum and partially digested sludge, etc., we are also determining the exact acidity and alkalinity of these materials. We find that in nearly every case the scum is decidedly less alkaline than the influent and in nearly all cases less alkaline than the preliminary sludge. The scum ranges from pH 6.8 to 7.6, while the influent changes but little, namely from pH 7.5 to 7.8. As far as we are able to determine at present the tanks are working better when the effluent is slightly more alkaline than the influent.

Bacterial action causes considerable production of carbon dioxide, which gas is partially dissolved in the water forming carbonic acid. At the same time the sulphur organisms producing H_2S, and the sulphates present or produced by bacteria, cause a reduction of alkalinity of the material. This explains why we usually find that the liquid layer is slightly less alkaline, or some times neutral, as compared with the influent. The foaming which a practical operator observes, has no doubt connection with the amount of gas produced.

The foaming might be caused, as has been pointed out above, by certain chemical reactions and by the production of large amounts of gases. Therefore, organisms producing large quantities of gas, although they are beneficial in small quantities, can be the cause for the poor operation of a tank. For that reason it is very important that the relative numbers of the different groups of bacteria remain constant.

Our chemist is engaged in making periodical gas analyses. Some typical examples of such analyses are presented to show the relative abundance of the gases. These samples are taken in successive weeks from the same tank, which was in operation during this time, and from the same compartment of this tank.

	CO_2	CH_4	N_2
Feb. 24	29.4	65.7	4.9
March 3	32.6	64.6	2.8
March 10	31.4	65.4	3.2

It is very interesting to note the total absence of oxygen and hydrogen. Analyses by other investigators usually show a little oxygen and hydrogen. Our samples were taken with unusual care into glass stoppered containers so that no atmospheric gases could penetrate. The tank from which these samples were taken was a fair working tank, although on the verge of foaming. At the time the sample of March 3 was taken, the weather was fairly warm and this might account for the rise in CO_2 production. The two other samples were taken at days when a rather low temperature was prevailing.

Sprinkling Filters—Samples were taken from the surface sprinklers, also at depths of 1, 2 and 3 ft. in the beds, and from the effluent. The slimy film which accumlates on the stones of sprinkling filter beds is known to play a very important rôle in the purification of the sewage which passes through the filter. This film is composed largely of a host of bacteria, a great variety of microscopic animals and occasionally an abundance of fungi. During the greater part of the year, the biological activities within this film are such that the sewage passing over it is sufficiently purified, however, there are periods of the year when the film does not act properly, and the purification is not as good as is produced at other times. This undesirable condition of the filter bed is usually associated with a very heavy film on the stones which finally breaks up and passes through the bed as suspended matter. Our investigations showed that considerable amounts of fungi are associated with these heavy films.

The film on the surface is characterized by the great predominance of algae. The algae are not present in great variety but are extremely abundant in quantity. At all points where the spray from the nozzles falls directly on the stones, the surface is covered with a bright green algae growth. Very near the nozzle and again all around the region of heavy spray fall, there are zones of brown to grayish brown or greenish brown. The green zone consists almost entirely of a well branched filamentous green algae of the Stigeoclonium species. Associated with the green filamentous algae are always a large amount of one-celled green algae of the Protococcus type. The brown film of the inner and outer zones is composed almost entirely of the blue green algae, Oscillatoria. Fungi were never found in great abundance on the surface.

Around the stones within the filter bed itself almost no algae are found but the film contains large quantities of fungi. There is no marked difference in the kind or amount of fungi present at the different levels of the filter bed. The seasonable fluctuations upon the fungi seem to be quite important. During March, April and the first part of May fungi became very abundant, the maximum being reached about the last of March. This was just before the spring slough took place. The same was noted again in the fall during the sloughing period.

When fungi are abundant, it is quite obvious that they act as a network in holding the film together. However, fungi are not the only apparent binders. As the fungi disappear (after the sloughing) there are increasing amounts of filamentous bacteria and of protozoa (Opercularia) which help to hold the film together. A branched filamentous zoogleal bacterial mass also becomes an important binder. During this time stalked protozoa helped considerably in building up the film. Living in this film, in addition to bacteria and fungi, are protozoans, nematodes, annelid worms and arthropods. Exact acquaintance with these organisms is necessary for an understanding of the operations of the film, and may conceivably be of use in its control. It must be emphasized, however, that it is the living aggregate of associated organisms constituting the film, rather than any simple type of creature which is significant for purification of the sewage. Although certain types of chemical activity may be correlated directly with the occurrence of particular sorts of protozoans we cannot conclude that these types are responsible for the chemical changes, but when we study the different groups of organisms and certain specific changes occur we can fairly well predict what changes will take place. It is extremely interesting in this respect to see (Table III) that during and shortly after the sloughing periods the protozoans are disappearing.

TABLE III—OPERCULARIA AND NEMATODES IN FILTER BED, THROUGHOUT THE YEAR

(Individuals per c.c.)

Months	Opercularia	Nematodes
July	65,000	70,000
Aug.	33,000	71,000
Sept.	70,000	70,000
Oct.	170,000	60,000
Nov	235,000	60,000
Dec.	100,000	60,000
Jan.	72,000	72,000
Feb.	80,000	100,000
Mar	100,000	76,000
Apr.	235,000	60,000
May	350,000	50,000
June	150,000	72 000

Nitration as shown by Table IV increases rapidly after the slough and when the film around the stones becomes thicker nitration decreases.

With the disappearance of Opercularia in the natural film nitrification becomes better. This might be caused by the fact that after their disappearance an abundant food supply is left for the bacteria. We found that these protozoans eat large quantities of bacteria and these known factors together might count for the increase of a more stable effluent. The numbers of nematodes are fairly constant throughout the year. The moving about of the nematodes in the film serves to make it more porous and probably also aids in loosening the film and thereby accelerating the slough.

TABLE IV—NITRATION IN SPRINKLING FILTERS DURING AND AFTER A FALL SLOUGHING PERIOD

(Parts per Million)

Date	Surface	Effluent
Oct 10	0 18	5 7
Oct 17	0 07	4 2
Oct 23	0 07	[illegible] 65
Oct 27	0 26	[illegible] 35
Nov 6	0 01	8 6
Nov 14	1 0	5 2
Nov 27	0 50	7 8
Dec 4	0 30	7 1
Dec 11	0 20	7 4
Jan 2	1 8	4 9

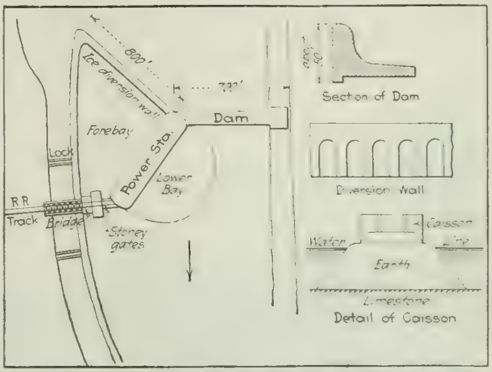
The bacterial work on the filter beds is not sufficiently advanced to permit the drawing of conclusions.

Dehydration Studies in sludge by means of chemicals (alum and sulphuric acid) have been carried on both in the laboratory and field. The practical application was tried during December but owing to the heavy snowfall no definite conclusions can be presented. The experiments will be repeated as soon as the weather opens up. We are reasonably sure, however, that the drying time can be materially reduced.

Hydro-Electric Plant Near Petrograd

CONSTRUCTION of an 80,000-hp. hydro-electric plant 80 miles east of Petrograd, on the Volchov River (spelled Wolko on most maps) is well under way, writes Max Kadinsky, a young Russian engineer who is a graduate of the University of Illinois and formerly worked for consulting engineers in Chicago on grain elevators. Part of his letter is as follows:

Here on the River Volchov is under construction a hydro-electric power station with a head of about 40 ft. It will have eight vertical type turbines of 10,000-hp. capacity each, which it is estimated will have an average yearly output of power of 40,000 hp. It is to be delivered to Petrograd, a distance of about 120 versts (verst = $\frac{2}{3}$ mile), at 110,000 volts. There is also under construction a canal to make the Volchov navigable. The canal will be about 1 verst long. The power station will consist of a masonry spillway dam, an ice diversion wall and a reinforced-concrete building housing the electrical units.



VOLCHOV (RUSSIA) 80,000-HP. HYDRO-ELECTRIC PLANT
Foundations built under compressed air because of a porous limestone ledge and to speed up work. Gas engines of total 1,400-hp. capacity used for constructing power plant.

The foundation for the power house, dam and ice diversion wall is being carried on by the use of compressed air caissons. One reason for the use of this method is because it is the quickest and the surest way of getting the job done under the present conditions. The second reason is that the bottom of the river consists of a limestone ledge with porous layers so that the use of the open cofferdam method would be extremely difficult. The portion indicated as the power house in the sketch is to have reinforced-concrete caissons built on soil especially formed for them.

So far we have about one-third of the earthwork for the canal done, four caissons for the power house have been sunk and we are now ready (Jan. 30) for sinking almost all of the others for the power station and for the ice diversion wall. In order to get this work accomplished quickly, a town of wooden frame buildings was constructed around the works for housing the workers. Material storage, powder magazines and a dining house, club, bath house, fire department and a school have been provided.

To supply the works with the required energy a power house with gasoline engine delivering 800 hp. has been set up. A similar one is under way to give 600 hp. and a third steam power plant will be completed in the spring furnishing 500 hp. In addition, we have two plants for compressed air having a capacity sufficient to sink five of the large reinforced-concrete caissons 18 x 100 ft. in plan and 13 ft. high.

Mr. Kadinsky states that he occupies the modest position of head of the sub-department of technical statistics. He registers all of the facts dealing with the labor, materials, economy of work and similar things.

Timber Treating Plant Operates Different Processes

Creosote or Zinc for Ties and Timbers—Tie Yard and Tracks—Cylinders Rest on Slides and Have Exterior Heaters—Site Convenient to Large Timber Tracts—Many Roads Served

INCREASING demand for treated ties, piles, poles and bridge timbers in railway work has led to the construction of a new wood-preserving plant at Louisville, Ky., by the Producers Wood Preserving Co., which has been organized for this purpose by the Ayer & Lord Tie Co., Chicago, and Bond Brothers, Louisville. Both of these firms are producers of ties and timber, so that the plant will be operated mainly as a part of their general timber business. Some railroads are sending their own ties to be seasoned and treated at this plant, but others purchase ties from the company. In either case the treatment is carried out according to the specifications of the individual railroads, for which reason the plant is designed for operation with creosote-oil or zinc-chloride and with a variety of modifications in either process. The treating capacity is from 4,000 to 5,000 ties per 12-hour day. A general view of the plant is given in Fig. 1.

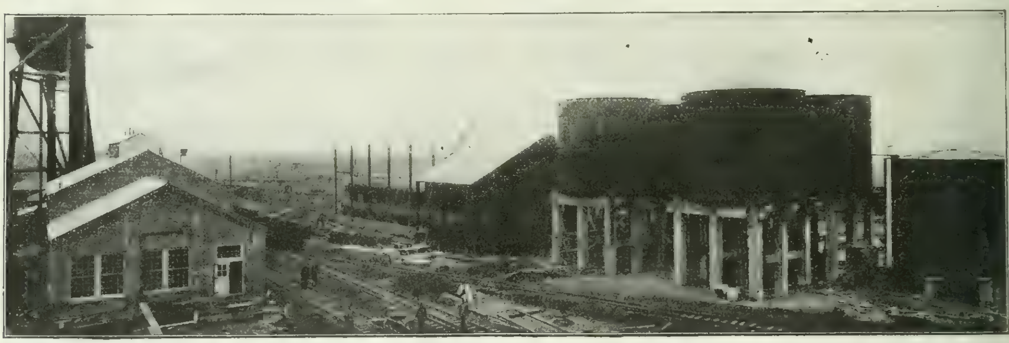


FIG. 1—TIE AND TIMBER TREATING PLANT AT LOUISVILLE, KY.

Cylinder house (uncompleted) and pump house in center. Four working tanks on concrete towers and zinc solution tank at right. Power house with stack and elevated tank at left.

The selection of Louisville as the location of the plant was made with a view to serving a large number of railroads in the central and eastern states, since this is a convenient point for both the collection and distribution of timber. Oak, pine and beech will be the principal woods treated. The site is about 4½ miles from the city, in open country where there is ample room for expansion. Good drainage is assured as the land is 8 ft. above the maximum flood level of the Ohio River. Railway service is provided by branches from the Kentucky & Indiana Terminal Ry. and the Illinois Central R.R. An area of 150 acres provides ample space for the storage and seasoning of about 1,500,000 ties for treatment. Little or no storage space is required for treated ties, as these are usually loaded directly from the tie trams into cars for shipment to the owners. In general the seasoning period is nine months. The layout of the yard and plant is shown in Fig. 2 and that of the plant is shown also on a larger scale in Fig. 3.

Tie Yard—In the storage yard all tracks have three rails to accommodate standard gage railroad cars and 36-in. gage tie trams, so that ties can be unloaded and stacked directly from the cars and loaded directly from the stacks into trams for delivery to the treating plant. Rails of 70-lb. per yard are used for the standard gage, three-rail tracks and narrow-gage tracks, with ties 8 ft. long for the tram tracks. All switching of main line cars at the plant is done by the two railroads. For handling the tie trams and trains there are two 35-ton, four-wheel steam locomotives which are equipped with special spark-arresting devices. The yard area now occupied is graded level and covered with about 12 in. of cinders. Watchmen keep the yard cleared of waste paper and other litter, as a precaution against fire.

Parallel tracks spaced 110 ft. c. to c. extend through the yard, each track being in an open passageway 17 ft. wide between stacks of ties. Alternating with the tracks are passages or roadways about 8 ft. wide and in these the water mains may be placed later. Ties are stacked according to size and on the 9 to 1 system, unless otherwise specified by the owner, with about 700 ties to each stack. In length, 8-ft. and 8½-ft. ties are found to be required in about equal quantities. A minimum space of 4 ft. is left between adjacent stacks to provide ample circulation of air for seasoning.

Ties purchased by the timber companies and those sent by the railroads are usually inspected before delivery, but all are marked by paint or a hammer stamp to show the month and year of arrival at the yard. Gondola cars average 300 to 400 ties according to cubic capacity, as usually there is not sufficient space to load them to their weight capacity. Box cars average 300 to 500 ties according to the rated capacity in weight.

Handling Ties—All unloading and loading of ties is done by hand, colored labor being plentiful and the men quickly becoming expert. As it is piece work they can earn much or little as they desire, and as they are paid daily they are generally well satisfied. Manual labor is considered preferable to the use of mechanical conveyors or appliances under these conditions, especially as ties are delivered in both box cars and open cars, so that different appliances would be required. It is stated that one man working steadily can unload and stack about one carload of 300 to 500 ties in an 8-hour day.

This unloading is done as a rule by two-man gangs,

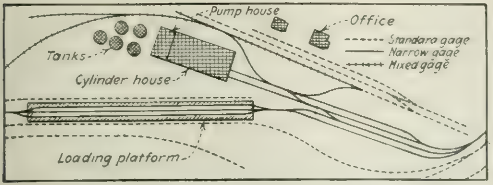


FIG. 3—TRACK PLAN AT CYLINDER HOUSE AND LOADING PLATFORM

each gang unloading two cars, or the equivalent of one car per man. For each car received the number of ties is shown on the waybill. The foreman in charge of unloading assigns the men to the cars and counts the ties as soon as they are unloaded. He checks his count with the men and at the end of the day he turns in to the office his account of the number of ties unloaded by each man.

In the layout of the treating plant and its yard connections the experience of several years with other similar plants operated by the Ayer & Lord Tie Co. has been a guide, but there is one departure from the usual track plan in order to facilitate movement of the tie trains. Ordinarily the train pulled out of the cylinder is backed down to the unloading platform, the empty train being then pulled forward again from the platform and backed into the yard. But in the Louisville plant, the tracks at the loading platform are continued back to the rear of the tie yard (see Figs. 2 and 3). Thus an empty train can be pushed directly to the end of the yard, and then pulled into any desired track for reloading. In this way the switching work around the plant is reduced materially.

Treating Cylinders—Two treating cylinders are provided and there is space for four, as shown by Figs. 4 and 5. Each cylinder is 7½ ft. in diameter and 131 ft. long, built of ⅞-in. plate with double-butt straps triple riveted. All riveting was done with a gap riveter exerting a pressure of 150 tons on each rivet and the cylinders were tested to 300 lb. pressure at the builder's shops, while the maximum working pressure will be about 180 lb. One end is closed by a steel head and the other is fitted with the usual swing door, this door being forced tight when closed by forty 2¼-in. T-head bolts hinged to the end ring of the cylinder and fitted to slots in the door ring. Each cylinder was shipped complete with all fittings attached, occupying four flat cars, and was set in place by means of jacks and blocking.

Double angle irons riveted to the shell of the cylinder form the track for the tie trains and along the bottom are laid the heater pipes. A shallow pit is required in front of the cylinder to give clearance for the door. When the cylinder is open, this pit is bridged by short pieces of rail which are placed and removed by hand.

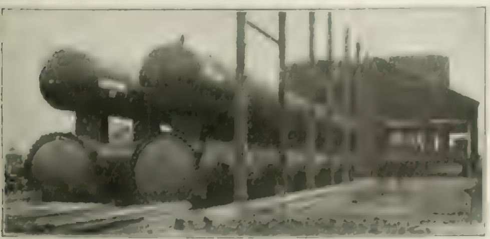


FIG. 4—CYLINDERS AND TANK EQUIPMENT

Treating cylinders below and pressure cylinders above. Space at right for [illegible] [illegible] [illegible]. [illegible] [illegible] [illegible] working tanks [illegible]

Above each treating cylinder is a pressure cylinder 7½ ft. in diameter and 131 ft. long, built of ½-in. steel plates with double-riveted lap joints and tested to 150 lb. This cylinder is filled with oil or solution when the first air pressure is applied in the main or treating cylinder, the air being then admitted to the top of the pressure cylinder to force the oil into the main cylinder. The upper cylinder is mounted on steel brackets riveted to the shell of the main cylinder so that both cylinders are free to expand and contract independently. After treatment, the surplus oil in the main cylinder is blown back to the working tank.

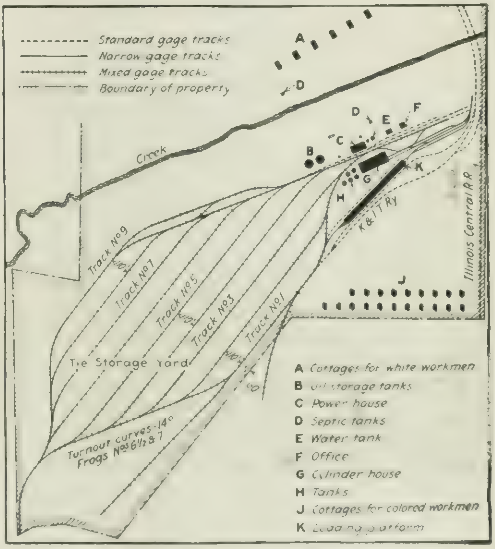


FIG. 2—PLAN AND TRACK LAYOUT OF TIE YARD AND TREATING PLANT

An unusual feature is the application of cylindrical heaters with steam coils for heating the oil rapidly after it enters the treating cylinder. Each heater is 12 in in diameter and 12 ft. long, placed diagonally at the side of the cylinder (see Fig. 4), the lower end being connected to the bottom of the cylinder and the upper end to the side of the cylinder, thus providing for oil circulation in the heater. Practically all movements of the oil or solution in the piping systems are by gravity or air pressure, pumping being used only to fill the working tanks from the large storage tanks.

The tie trams are of cast steel with hinged hoops to hold the ties in place. Each tram will hold about 70 ties 7 x 8 in. A cylinder charge consists of sixteen trams with 8-ft. ties or fifteen trams with 8½-ft. ties. The trams are moved in and out of the cylinder by the narrow-gage locomotives.

Free longitudinal movement of the treating cylinder in expansion and contraction is provided for by a special form of support which dispenses with rollers or rockers. The cylinder is not anchored at any point but rests on nine cast-iron saddles having their bases machined and resting on two continuous lines of 110-lb. rails on concrete pedestals. Two of these saddles are riveted to the cylinder shell, but the others are not fastened in any way, so that the shell may move in the saddles or the saddles may slide along the rails. All pipes connected to the cylinders have swivel joints interposed to give ample flexibility to allow for these longitudinal movements of the cylinder.

Cylinder House and Pump Room—The cylinder house has a concrete floor and low side walls supporting steel columns and roof trusses (see Fig. 5). The sides are of asbestos-metal sheathing and the roof is covered with corrugated asbestos. Across the rear of this shed is the pump and compressor room, with two steam-driven air compressors to give the pressures for the treating cylinders and for forcing the oil or solution to and from the cylinders and working tanks. There is also a vacuum pump for use when vacuum is required as part of the treating process. Two electric generators are provided, one driven by steam and the other by an oil engine for use when the boilers are shut down. In this room also are the recording gages and instruments. A concrete basement contains the pipe connections between tanks and cylinders. It forms a concrete tank with a drain for carrying off seepage water. In case of failure of a pipe connection the oil would flow into this basement. Since an iron grating forms the upper floor, any such leakage would be promptly noted by the attendant, who would drop a gate valve closing the drain. The oil could then be salvaged by pumping.

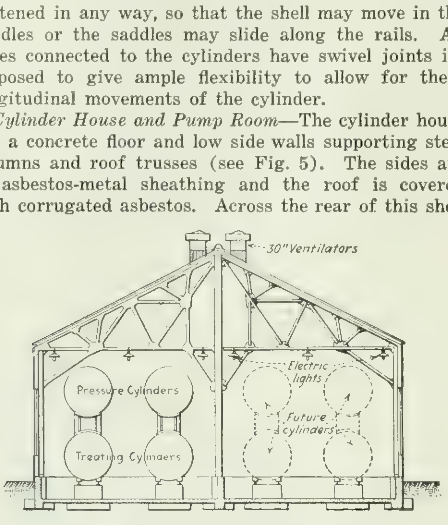


FIG. 5—SECTION OF CYLINDER HOUSE

Tank Equipment—Concrete towers 22 ft. high support four steel working tanks, 28 x 24 ft., of 100,000 gal. capacity each (see Fig. 1). Each treating cylinder with one tank for creosote and one for zinc solution forms a complete unit which can operate any desired treating process. There are no cross connections between these units, thus avoiding possible mischance in connecting a cylinder to the wrong tank. The third zinc tank on low foundations, is for storage of a 55 per cent zinc solution. A tank 5 ft. in diameter and 10 ft. high is provided for measuring definite quantities of the 55 per cent solution to be mixed with water in the zinc-solution working tank which is connected with the treating cylinder, the strength of the treating solution being from 2 to 4 per cent.

An open tank 10 ft. in diameter and 6 ft. high receives water from the well, and from this the water is pumped to the elevated tank. There is also an air receiver 5 x 15 ft. for 100-lb. working pressure and a 20,000-gal. fuel-oil tank 10½ ft. in diameter and 32 ft. long. For storing creosote oil brought in by tank cars there are two 285,000-gal. steel tanks 45 ft. in diameter and 24 ft. high, on ground foundations. A steam pipe is led to the oil-car track for heating the oil in the tank cars to facilitate pumping in cold weather. Most of the oil now used is imported from Europe, the domestic supply being inadequate.

Loading Platform—Adjacent to the cylinder house is a roofed loading platform 35 x 460 ft. consisting of an earth fill between concrete retaining walls (see Figs. 2 and 3). On this platform are three 36-in. tracks for tie-tram trains, their rails being 4 ft. above the rails of standard gage tracks along each side of the platform, as shown in Fig. 6. A steel shed roof with long eaves forms a protection from the weather, the high roof and open sides giving ample ventilation in summer. Snowfalls are rare but the roof is given a steep pitch in order that dry snow will slide off.

Miscellaneous Facilities—A power house contains three 200-hp. boilers and two large fire pumps and has also a machine shop for general plant repair work. This building is of concrete frame construction with red brick curtain walls and corrugated asbestos roofing on steel trusses. Steam pipes are led through a tunnel to the pump house of the treating plant. Coal is shoveled from cars on an outside track to the firing floor, no large storage supply being provided. As shown in Fig. 7, the steel stack is braced by a structural steel frame or tower in order to avoid the use of guys, since these might be pulled down by the 20-ton locomotive crane which is used in handling piles and timbers and for handling cinders, filling, etc., with a grab bucket. For the same reason there are no overhead wires about the plant.

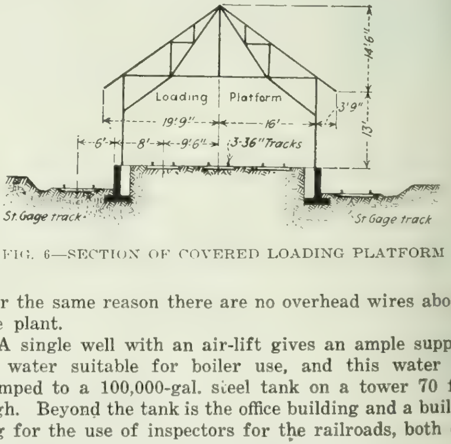


FIG. 6—SECTION OF COVERED LOADING PLATFORM

A single well with an air-lift gives an ample supply of water suitable for boiler use, and this water is pumped to a 100,000-gal. steel tank on a tower 70 ft. high. Beyond the tank is the office building and a building for the use of inspectors for the railroads, both of these being of hollow-tile construction.

Living accommodations are provided for the employees. On the north side of the plant are six cottages of hollow-tile construction for the white workmen and on the south side are seventeen four-room frame buildings for the colored workmen. A low rent is charged for these houses. Each group has water service, electric light, sewers and a septic tank. A third septic tank serves the toilets of the treating plant. With the exception of the residences for the colored workmen the entire plant is of fireproof construction, the extra cost being balanced by the greater safety and the saving in maintenance.

Grading, tracklaying and much of the smaller construction work was done by the company with its own forces. The treating cylinders, pressure cylinders and all steel tanks were built by the Reeves Brothers Co., Alliance, Ohio, using its own designs and details. After the general plan had been prepared under the direction of A. M. Smith, superintendent of treating plants of the Ayer & Lord Tie Co., structural designs were worked out by the Leonard Construction Co., Chicago. All construction work was carried out under the supervision of Mr. Smith, with L. L. Craig as resident superintendent for the Producers Wood Preserving Co.

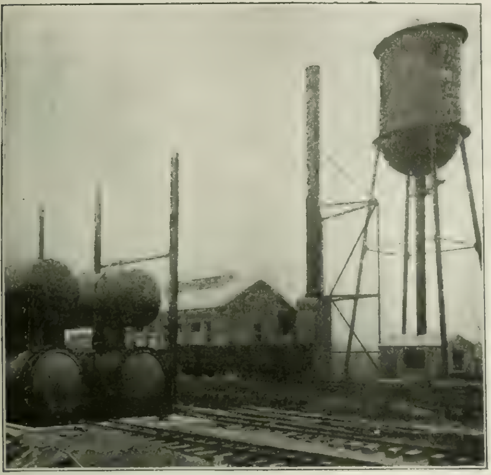


FIG. 7—TREATING CYLINDER AND POWER HOUSE
Note steel tower for bracing smokestack.

Responsibility for Loss from Transmitted Fire

An important change in the French laws governing responsibility for fire originating on one property as causing damage to a neighbor has been made in a law published last year and noted in *Le Génie Civil* recently. The law as it existed up to the present held every person responsible for damage resulting from his own acts or those of his subordinates, or originating in his property. The apparently all-inclusive scope of this law was tempered by judicial interpretation, under which the application of the law was limited to cases where the person in question was in some measure at fault; two years ago, however, the highest court rendered a decision which in effect wiped out this limitation. Thus, a fire originating on a given piece of property without the slightest contributary fault of the owner would yet render him liable to all his neighbors for damages caused them by the fire or by happenings in connection therewith. The result of the decision was a sharp rise in insurance premiums to cover the added risk. Resulting protests have now led to the passage of a supplementary law which explicitly provides for the limitation of the old law to cases of culpability. Under the supplementary law the owner (or tenant) of the premises in which the fire originated is not responsible for outside damages unless the fire was due to his fault or that of persons for whom he is answerable. This supplementary law, unlike the main law, refers only to fire, not to all forms of disaster.

Electrification Project Recalls Maltrata Location

Famous Incline on Road from Vera Cruz to Mexico Monument to Skill of Captain Talcott, American Railroad Engineer

By Emile Low
U. S. Assistant Engineer, Buffalo, N. Y.

The recent award of a contract for electrical equipment to be installed on a section of the Mexican Ry. from Vera Cruz to Mexico City not only marks the commencement of the first railroad electrification in Mexico, but also reminds the engineer of one of the most noteworthy pieces of railroad construction of which there is record. This is the so-called Maltrata incline on the line of that railroad between Orizaba and Boca del Monte.

This railroad is 264 miles long, the eastern terminus being at Vera Cruz on the Gulf of Mexico and the western at the City of Mexico. The original survey was made by Capt. Andrew Talcott in 1858 for Señor Antonio Escandon, a Mexican capitalist, but the unstable conditions in Mexico at the time of the presentation of Captain Talcott's report, in March, 1859, prevented for the time being the construction of the proposed road.

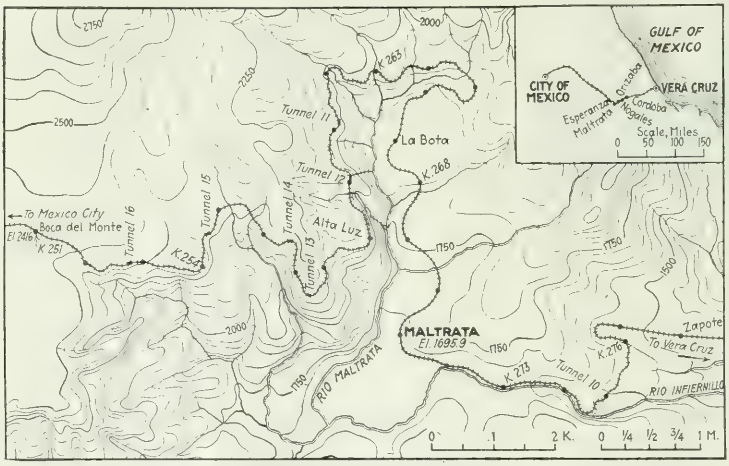
European Intervention in Mexico—The question of a joint intervention in Mexican affairs by Great Britain, France, Spain and Prussia was mooted in 1860, and on Dec. 14, 1861, a Spanish fleet appeared before Vera Cruz, which was at once occupied by the Spanish troops under General Prim. The French arrived soon after, and in September, 1862, more French troops arrived. In view of the unhealthfulness of Vera Cruz, the convention of Soledad was concluded with the Mexican government, permitting the foreign troops to advance to Orizaba.

The French, on their arrival in Mexico, found no railroad except the few miles of track operated by mules from Vera Cruz. This was used to transport passengers and their baggage about nine miles to Tejeria, whence transportation to the interior was over old Spanish highways that at many points were almost impassable during the rainy season. Efforts were immediately directed towards the construction of a railway across the Tierra Caliente.

Construction Begun—Captain Talcott did not return to Mexico until March 1, 1862, having left Charleston, S. C., on Jan. 9, 1862 on the blockade runner "Carolina" for Nassau. He then reached Vera Cruz vìa Havana and on his arrival resumed his duties in connection with the construction of the Mexico and Pacific R.R., as it was then called, for which Señor Escandon held the concession. It was not until after the arrival of Emperor Maximilian, at Vera Cruz, May 28, and at the City of Mexico, June 19, 1864, that more rapid construction progress was made. The name of the railroad was changed to "The Imperial Mexican Ry. Co." and a contract entered into with Smith, Knight & Co., Ltd., who undertook to "complete and construct a railway from Vera Cruz to the City of Mexico and a branch railway to Puebla, according to the plans, sections and specifications in that behalf made by Captain Talcott." Captain Talcott severed his connection with the Imperial Mexican Ry. on Feb. 10, 1867, arriving in New York April 5, 1867. He was then seventy years old.

After the downfall of Maximilian and the withdrawal of the French army, the Mexican government, on Nov. 27, 1867, made a new contract with Señor Escandon. This contract was again modified on Nov. 11, 1868, and the railroad was completed on Dec. 31, 1872, under the Escandon grant, sixteen years after his first contract was made. It was formally inaugurated on Jan. 1, 1873, by President Sebastian Lerdo de Tejada.

Captain Talcott—Between Orizaba and Boca del Monte lies the famous Maltrata incline, which, as an engineering achievement, is without parallel in railroad construction. This section, together with other portions of the railroad, is an everlasting monument to the ability of Captain Talcott, who located the line and constructed the major portion of the road. Captain Talcott was born in Connecticut, April 20, 1797. He was graduated from the West Point Military Academy and promoted in the United States Army to brevet second lieutenant, Corps of Engineers, July 24, 1818, and to captain, Dec. 22, 1830. He resigned his commission in the army Sept. 21, 1836. During his civil life he served among many other engagements, as adjunct chief engineer, New York & Erie R.R., chief engineer Richmond & Danville R.R., and chief engineer, Eastern Division, Ohio & Mississippi R.R., resigning from the latter position to become chief engineer of the Mexico & Pacific R.R. Dec. 1, 1857, at a time of life when most men think seriously of retiring from active duties.



THE MALTRATA INCLINE BETWEEN VERA CRUZ AND MEXICO CITY

The corps of engineers organized by Captain Talcott landed in Vera Cruz Jan. 4, 1858. The problem proposed for their solution was to find the most direct and practicable line for a railroad between the commercial and the political capitals of the republic.

The Location Problem—The route was evidently difficult, because there was a mountain to be climbed. The broad table-land of that part of Mexico is, in round numbers, 8,000 ft. above sea level. This great elevation is reached in the first one hundred miles from the coast. If the slope of the land were uniform and unbroken, an average rise of 80 ft. in each mile, while troublesome, might not be thought a serious obstacle; but the ascent is neither even nor uninterrupted. At 95 miles, it has risen to 5,500 ft. Then, suddenly, within a distance of five or six miles, as the wagon road runs, the mountain raises itself 2,500 ft. higher still, up to the *cumbres* or sharp edge of the table-land which stretches away in the nearly level plain for 400 miles.

The stage route climbed the mountain by the pass at Aculcingo by a series of ten or twelve extended zigzags. A railroad could hardly do that. After one height was reached, there was another beyond it, and the attempted line of survey became hopelessly involved in a veritable tangle of hills. A month was spent in trying the possibilities of the ground and the result was failure. Then the scouting party reported that a few miles to the north was another pass up from Maltrata, and on the further side of it, a very long mountain spur thrust out for miles into the lower country, a kind of buttress to the table-land. Thither the party turned. They found no carriage road in the Maltrata Pass and the zigzag turns for horse and mule trains were even more numerous than at Aculcingo, but hope was fixed on that prolonged spur of the mountain, the side of which towered half a mile above the village and was as yet unexplored and covered with low trees and tangled brush. After climbing up the path to Boca del Monte, the mouth of the mountain, the transit was set at a downward gradient of 200 ft. to the mile and with this as a guide, the mountain side was explored.

The leveling instrument was close behind. At last, after eleven miles of sharp descent, the low level of the village of Maltrata was successfully reached, but there was more to come. The water drainage of the valley is through a narrow gorge, so wild that the local name for it is the Barranca de Infiernillos, or in English, the Ravine of Little Hell. Down this rocky gorge the line plunged on, turning and twisting, until at last, in the valley of Encinal, it came out into the midst of smooth fields and ten miles of a straight course brought it to Orizaba. In twenty-five miles the descent is 4,000 ft. The average of that is 160 ft. to the mile, but many miles are on a grade of 211 ft. and even more.

The original line was run by William R. Eastman, chief of party, under Captain Talcott. He is still alive and for many years lived in Albany, N. Y. One of the principal engineers connected with the construction of the Maltrata incline was Sebastian Wimmer, who died Nov. 30, 1921, at an age of nearly 91 years. Mr. Wimmer, who arrived on the work April 26, 1865, was first in charge of the seven upper sections of the line, and afterwards in charge of additional sections, lower down, near Maltrata. The Emperor Maximilian visited the work April 29, 1865, and was a guest at a dinner given by the contractors, Smith, Knight & Co. During the dinner he was apprised of the assassination of President Lincoln, it having taken two weeks for the news to reach this place.

Paris Stadium Design Has 131-Ft. Cantilever Roof

Government's Chief Architect Is Collaborator in Plan of Unique Structure Submitted as Olympic Games Possibility

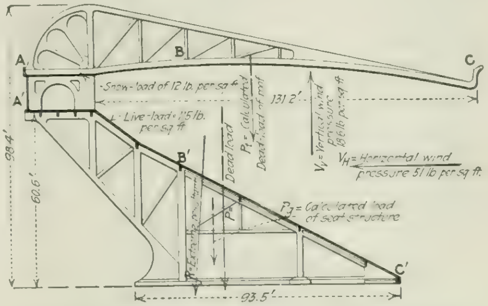
The following article, taken from a recent issue of Le Genie Civil presents with little detail, except as to forces involved, a design for the Paris stadium which it is proposed to construct in order that the large crowd expected at the 1924 Olympic games may be accommodated. At the present time there is no stadium in Paris or in the environs capable of taking care of more than 20,000 or so spectators. The Olympic committee, after making an examination of available structures with a view to their enlargement, decided that an entirely new edifice was preferable. The structure herein described is the joint design of G. Tronchet, architect in chief of the government, and of Henry Lossier, a well-known Paris engineer. According to Le Genie Civil this joint design is the most acceptable of all that have so far been submitted. Obviously there are structural details which the American engineer would be interested in discovering: For instance, dimension details of structural members and how the cantilever roof and seating structure are joined.
—EDITOR.

AMONG the designs for a new stadium submitted to the French Olympic committee charged by the International Committee of Olympic Games with arranging for the 1924 athletic carnival in Paris, perhaps the most interesting and what the committee believes to be the most daring as well as structurally sound design, has been submitted by G. Tronchet, chief architect of the government, and Henry Lossier, a well-known Paris engineer. The structure, a rectangular stadium with semi-circular ends, would be entirely of reinforced concrete and offer a seating capacity of 80,000. The seating area is entirely covered by a cantilever roof with a span of 40 m., or a little more than 131 ft. This daring design therefore allows clear vision for each of the 80,000 spectators. The design contemplates the most extreme conditions of loading, both dead-load and live-load, of vertical and horizontal wind pressures and of snow loading.

As indicated in the accompanying figure the calculated load of the roof acts in a direction indicated by the vertical line P_t, while the calculated dead-load of the seats themselves follows P_g. The resultant of these two forces passes through the center of gravity of the section. Theoretically it would suffice to eliminate any point of support to the right of this force in order to assure the stability of the structure under permanent load.

However, as varying snow load, the pressure of the wind and the load of the seats themselves tend to displace their resultant within certain limits of the center of gravity of the loaded structure, it would be necessary to give to the base of the structure a sufficient width to assure its stability under the most unfavorable conditions of loading. These most unfavorable conditions are believed to be realized by the simultaneous action, in the most extreme conditions, of the following elements: Horizontal and vertical wind action, snow load and dead- and live-load of seating area.

Wind Action—It is generally admitted that, conforming to the regulations laid down in 1903 for governing construction of railway stations, wind pressure is able to attain 28 lb. per sq.ft. on the surface normal to the wind direction, and that in certain instances there is brought into play in addition to the direct horizontal pressure of the wind, a suction acting on the opposite wall, whose value varies in general from 5 to 6 lb. per square foot. With this in mind M. Lossier has incorporated in the design conditions much more severe than these, considering them to be acting simultaneously. These conditions are a direct pressure of the wind of 51 lb. per sq.ft., acting in a horizontal direction from the interior toward the exterior of the structure, and an under pressure acting in a vertical direction against the under side of the roof of 18.6 lb. per square foot. The two engineers feel that with such excessive wind pressure they have a wind factor of safety that would safeguard the structure from overturning on that account.


A
B
C
A'
B'
C'
Snow-load of 12 lb. per sq. ft.
Live-load = 115 lb. per sq. ft.
131.2'
P_t = Calculated Dead-load of roof
Dead load
V_V = Vertical wind pressure 18.6 lb. per sq. ft.
V_H = Horizontal wind pressure 51 lb per sq. ft.
P_g = Calculated load of seat structure
98.4'
60.6'
93.5'

DARING CANTILEVER DESIGN FOR PARIS STADIUM

Snow Load—According to a building regulation passed in February, 1903, snow load is reduced to about 6 lb. per sq.ft. when it acts simultaneously with wind pressure. However, M. Lossier has applied on that portion of the cantilever, marked in the accompanying figure, *A-B*, a snow load of 12 lb. per square foot. The point at which this snow load is presumed to be concentrated (see accompanying figure) in the design is the most unfavorable so far as its action is concerned toward overturning the structure toward the exterior.

Live-Load—The live-load which is imposed by the crowd, presumed to be 80,000, has been fixed at 115 lb. per sq.ft., a design which corresponds to a regulation laid down in 1915 relative to the calculation of stresses in metallic bridges. This live-load has been applied only on the zone marked in the accompanying figure *A'B'*, that is to say, on that part of the cantilevered seating structure and the promenade at the top. The concentration point of this live-load also is the most unfavorable from the standpoint of overturning action.

The resultant *R*, found then by simultaneous action of:

1. The dead-load of the structure.
2. Horizontal pressure of the wind of 51 lb. per sq.ft.
3. An upward vertical pressure of the wind of 18.6 per sq.ft. acting on the under side of the roof.
4. A snow load of 12 lb. per sq.ft. acting on the section *A-B*, and
5. A live load of 115 lb. per sq.ft. concentrated in the

center of the section $A'B'$, is found to pass to the right of the center of gravity of the section, thereby insuring the stability of the structure under the most adverse circumstances.

The roof would be constructed of reinforced-concrete tile. In building the structure utilization of standard elements, formwork, etc., to permit of a reduction to minimum in delays of execution in spite of the exceptional dimensions of the structure, would be made.

The cost of the structure as designed would be, according to its designers, in the neighborhood of 480 francs a square meter. Inasmuch as there are 33,000 sq.m. of seating area this would mean an expenditure of more than a million dollars. According to M. Drouge, inspector-general of Ponts et Chaussées, charged with making a report upon the various plans submitted, this price could be considerably lowered by putting in a line of supporting columns about 15 ft. from the back tier of seats.

Causes of Distortion Failures of Asphalt Pavements

Extracts from a paper by H. W. Skidmore, Consulting Engineer, Chicago Paving Laboratory, Inc., presented to annual convention of the Iowa Engineering Society.

DISTORTION under traffic is of two kinds, forward displacement and lateral displacement. The latter occurs on thoroughfares which are subjected to swiftly moving traffic. Forward displacement is developed under heavy traffic moving at a comparatively slow rate.

Undoubtedly the most fertile cause of displacement so far as the mixture composition alone is concerned is too much bitumen and insufficient fine mineral or filler. Although it is not the only factor which affects the stability of the composition, high density does more to insure freedom from displacement than any other one thing, when it is accompanied by a bitumen content just sufficient to coat the particle.

Example 1—The pavement had been in service only a few years, carrying heavy arterial, highway traffic in the vicinity of Chicago. Heavy trucks during hot weather caused excessive rolling but only in certain sections of the road, and by no means could it be called general. The following analyses, taken from two different rolled sections, show that about 3 per cent too much bitumen was used. Comment on the grading of the aggregate is superfluous.

Sample	I	II
Bitumen, per cent	11.7	12.0
Mineral passing 200 mesh, per cent	12.7	12.5
Mineral passing 80 mesh, per cent	14.1	13.0
Mineral passing 40 mesh, per cent	27.5	25.5
Mineral passing 10 mesh, per cent	9.0	8.0
Mineral passing 4 mesh, per cent	18.0	23.5
Mineral passing 2 mesh, per cent	7.0	5.5

Example 2—Another example of a badly rolled asphaltic concrete pavement is represented by the following analysis of a sample taken in an Iowa city:

Bitumen, per cent	11.2
Mineral passing 200 mesh, per cent	13.9
Mineral passing 80 mesh, per cent	12.0
Mineral passing 40 mesh, per cent	19.8
Mineral passing 10 mesh, per cent	25.2
Mineral passing 4 mesh, per cent	15.5
Mineral passing 2 mesh, per cent	2.4
Specific gravity of mixture	2.32

Again we find the bitumen entirely out of proportion. The specific gravity in this case seems relatively high and indicates good density; but the virtue of density is destroyed by the excess of bitumen, which bears out a previous statement that density must be accompanied by the proper amount of bitumen. The underside of this sample was worn smooth from slipping on the concrete base.

Example 3—Another example of rolled mixture is given below, and in this case a somewhat different condition arises, as the bitumen content would not have been excessive had the fine mineral been sufficient. The most obvious defect in this mixture is the shortage of 80-mesh particles, which undoubtedly detracts from the stability of the structure:

Bitumen, per cent	7.7
Mineral passing 200 mesh, per cent	7.1
Mineral passing 80 mesh, per cent	4.0
Mineral passing 40 mesh, per cent	11.6
Mineral passing 10 mesh, per cent	18.8
Mineral passing 4 mesh, per cent	33.3
Mineral passing 2 mesh, per cent	17.5

Example 4—Rutting may occur in a mixture which would ordinarily be considered fairly good for normal or moderate traffic. The case of the sheet asphalt pavement which rutted badly in two years of service under boulevard (or swiftly moving) traffic as given below, will serve to illustrate this fact. The first of these analyses is of a sample from a badly rutted section and the second is from a portion which showed slight rutting at the end of four years; both are from the same street.

Sample	I	II
Bitumen, per cent	11.3	11.7
Mineral passing 200 mesh, per cent	10.9	14.1
Mineral passing 80 mesh, per cent	23.4	26.5
Mineral passing 40 mesh, per cent	34.7	33.9
Mineral passing 10 mesh, per cent	18.2	12.7
Mineral passing 8 mesh, per cent	1.5	1.1
Specific gravity	2.14	2.18

Asphalt cement of 60 penetration used.

The higher gravity of sample No. 2 is easily accounted for by the fact that it shows a much more balanced grading than No. 1. While No. 2 carries slightly more bitumen than No. 1, the grading of the aggregate and the pressure of more filler explains why it did not rut as badly as No. 1 Undoubtedly the penetration has a great deal to do with encouraging the distortion of this mixture, as the pavement is not shaded at any period of the day. The penetration in this case should have been about 35 instead of 60.

Failure of Two Small Dams

RECORDS of the failures of dams are always of interest, even in the case of small structures, and in the case here noted the failure of an old timber dam resulted in the loss of an earth dam and hydro-electric plant a mile below it. This accident occurred Dec. 12, 1922, at Iron River, Wis., about 25 miles west of Ashland, Wis.

A timber dam was built at Iron River about 1870 to provide power for operating a sawmill, but in 1921 the Iron River Water, Light & Telephone Co. replaced this old structure with an earth dam carrying about 17 ft. head and having concrete flumes and wasteways. Immediately below this dam was located the steam plant which had been used to supply the village with light and water. A new hydro-electric generating station was also built in 1921, but the old steam plant was retained. About a mile above the Iron River dam was located the Mud Lake dam, an old wooden structure originally built for log driving and holding about 6 ft. of water. This also was owned by the Iron River Water, Light & Telephone Co. and was used to impound water as storage for the dam and new plant at Iron River. Another storage dam was located still farther up the stream. The Mud Lake dam is said to have been in poor repair, not having been put to any use since old log-driving days until a year or two ago.

About 7:30 a.m. on Dec. 12 the Mud Lake timber dam gave way. There was considerable storage behind this dam, while the capacity of the reservoir above the Iron River dam was small. As a result the rush of water was so great that the Iron River dam was carried away. With it went the new hydro-electric generating station as well as the old steam generating and pumping plant. The loss is said to be estimated by the company at $75,000. It is reported also that the company suspects the dam was tampered with and weakened.

City Planning and Zoning in Old Communities

By-Passing Through Traffic, Store-Door Deliveries, Decentralization of Department Stores and Office Buildings Suggested

By George H. Herrold
City Plan Engineer, St. Paul, Minn.

Abstract of a paper before the Minnesota Federation of Architectural and Engineering Societies.

The problem of a city planner in an old city is to make the most of existing streets by (1) the regulation of and routing of traffic; (2) by widening certain streets, revising grades and straightening alignment to increase the economies of transportation; and (3) by assigning the use of property along the street after due consideration of land values, topography, proximity to railroads, waterways, existing improvements, etc. The surveys or research work required for the solution of these problems cover a wide field.

Under traffic studies we have traffic counts, origin and destination of traffic, kind of vehicles, their weight and size, commodities carried, cost per ton-mile, location of principle traffic sources, method of expressing traffic in units of obstruction value, time losses due to circuitous routes, time losses due to congestion, and left-hand turns, power losses due to grades and road surfaces, special traffic such as freight house traffic, number of vehicles in service, street widths and capacity of streets.

From these data deductions may be made in a scientific manner as to the location of truck routes, general traffic routes, belt-line streets and by-passes with roadway widths expressed in lines of traffic and width for parking and ranking, methods of increasing transportation movements by regulation, establishing arterial streets, one-way streets, platoon system of moving traffic, store-door delivery of freight by railroad companies to reduce the number of trucks on the streets.

A number of problems are introduced which may be matters of policy or leniency. For instance, can streets dedicated for public use be consistently used for ten-hour storage of cars or are they to be considered as traffic ways for the use of moving cars and necessary stops only for transacting business. Is it a legitimate function of a municipality to go into the storage business, financing storage garages or creating storage areas? Can public squares dedicated as such have storage space constructed under them by a municipality if the park spaces are maintained above without losing their rights to these parks?

Traffic Congestion—By-passing traffic is a legitimate way of reducing traffic in congested areas. Traffic studies have proven that through traffic has little buying power, notwithstanding the erroneous viewpoint of storekeepers. This traffic can be by-passed around the congested area without any loss to the storekeeper.

In St. Paul there is one motor vehicle for each ten persons. In 1920 there was one motor vehicle for each thirteen people and in 1915 one motor vehicle for each fifty-six people. It is estimated that the point of saturation will be reached when there is one motor vehicle for each five persons, which will double the number of the local vehicles on the street, but this number will still further be increased by another situation. In the days of horsedrawn vehicles the area tributary to a city within a day's journey or 15 miles radius was 700 square miles—today with the automobile the radius is 80 miles or an area of 20,000 square miles.

Store-Door Deliveries—The number of traffic vehicles on the street will be lessened by railroad companies making store-door deliveries. At the present time each firm has its own truck that makes numerous calls at the freight station getting little jags of freight and hauling them through the streets to the owners' place of business. A railroad truck fully loaded making one trip over the street and making store-door deliveries might eliminate as many as ten trucks belonging to these firms. Union freight stations are ideal from the shipper's standpoint. They facilitate delivery of outbound freight, but require large paved areas around them and complete regulation of time of deliveries.

There are now under consideration by traffic men in St. Paul joint consolidating and forwarding stations to serve all railroad lines entering the city.

Decentralization of Department Stores, Office Buildings, Etc.—Heretofore stores have been located where street car traffic and pedestrian traffic was the heaviest. The automobile is now rapidly changing this viewpoint, too dense a traffic is no longer an asset. Safety no longer exists and the difficulty of finding a parking place for a car within several blocks of the store at which you wish to shop is becoming irksome. The next great innovation in city building will be the construction of a department store several miles out near some great artery with ample space, privately provided, for the parking of customers' cars. Office buildings to house the professions might as well be located several miles out of the central business district—one, two or three blocks off from an arterial street. Architects, engineers, lawyers, doctors, dentists, artists and musicians of established reputation now locate in the central business district because of habit, not of necessity, for their customers come to them. So for our future development we may look for a decentralization which will in itself take care of some of our traffic problems. We have long considered that the whole problem has been one of improving and increasing traffic facilities to the central district. Our thoughts should now be on ways of lessening this traffic burden by decentralization.

Traffic Studies in St. Paul furnish some interesting facts. On University Ave. traffic steadily increases from 7 a.m. to 6 p.m. when it suddenly drops. Automobile traffic is 83 per cent of the total. Light truck traffic has its peak load between 9 and 11 a.m. and from 2 to 4 p.m. Heavy trucks are only 3.2 per cent of the total traffic and are a maximum in the forenoon. Horse-drawn traffic is 1.4 per cent of the total.

On Marshall Ave. Bridge 87 per cent of the traffic is automobiles. Heavy truck traffic is negligible, and the afternoon traffic is 71 per cent greater than the forenoon traffic.

In the Central business district the afternoon traffic is 13 per cent heavier than the morning traffic, and the maximum load is from 5 to 6 p.m. Truck traffic is the heaviest between 7 and 8 a.m. and between 3 and 4 p.m.

The theoretical capacity of a 40-ft. roadway with a double car line on it is 528 vehicles per hour in each direction; that is, this is the volume of vehicular traffic which the streets can be made to carry under proper traffic regulations and *no parking*. The average present hourly traffic is 681 vehicles in four directions at Sixth and Robert St. intersection, but there are five-minute intervals when the theoretical limit it nearly reached, which would be 2,100 vehicles per hour.

A close analysis of the factors "rise in grade," "distance" and "time" and their effect on the cost of motor traffic cannot at the present state of the science be made, although elaborate studies are in progress which latter will produce definite formulas for solving these problems. It is noticeable and probably can be proven that where motor equipment can make a quick get-a-way and is uninterrupted in its travel even with bad grades and circuitous routes they will show a lower cost per ton-mile than on level grades but with continuing interruptions from traffic congestion.

Zoning, with Special Reference to Business.—A study of our economic necessities in connection with zoning develops some very interesting facts. From information put out by the Dartnel Corporation there are in Minnesota 4 drug stores, 8½ grocery stores, 1.4 dry goods stores, 6 hardware stores and 10½ general stores to each 10,000 people. Comparing this with the U. S. Census Report for the entire country, we find that Minnesota follows the average very closely for drug stores, grocery stores and general stores, half as many dry goods stores and twice as many hardware stores. There is in St. Paul one retail store in the residential area for each 20.3 families. Further, there is one salesman for nine workers in the United States; for each four factory employees there is one selling the things produced. This cost of distribution is an economic factor that must be reckoned with and it is anticipated that zoning will react favorably toward improving the situation, for combined homes and stores will not be permitted; stores cannot be built in every block but must be confined to the commercial districts. Non-conforming store buildings will gradually be eliminated for two reasons: (1) A store building in a residential district can be bought out by the surrounding property owners and the building sold and the property afterward can only be used for residential purposes. This will raise the standard of the district and appreciate property values far more than any loss that may be caused in the transaction of getting rid of the store building. (2) People will not trade at non-conforming stores after commercial districts have been thoroughly established for the reason that the store in the commercial district will be of higher class and do business at less cost.

Light industry will be confined to light industrial districts. These districts will be higher class and can do business cheaper for the following reason: Factory districts must have railroad tracks crossing streets at grade, wide pavements with heavy foundations for trucks, large water mains, numerous fire hydrants, large sewers for manufacturing wastes, high tension overhead wires for power and lighting, overhead conveyors and other things that are unnecessary and intolerable in a shopping district or residential district.

Also factories should have differential rates on gas and electricity for power, steam and hot water heat, water supply and other utilities, and this is made possible when districts rather than isolated plants, are to be served by the various utility companies.

The area required for commercial business per thousand people is now known and knowing the maximum possible density of population the area required for stores in any given district can be determined. Zoning limits traffic on local and residential streets and this determines the traffic that arteries must carry and knowing their capacity determines whether greater widths or more arteries must be provided. Furthermore, taking public improvements as a whole, we build pavements, sewers and other utilities to serve all probable needs, and these are as a rule the maximum needs. When a town is zoned these improvements are designed to fit the zone and for the service required—narrow light pavements on residential streets and heavy wide pavements in factory districts with a wearing surface to serve the needs of each. Every city now lays sewers larger and more costly than are likely to be needed because this waste is less than the waste of relaying within a few years to fit a new condition. In a zoned city the maximum requirements are known.

City Planning and Zoning Will Lessen Financial Losses—The great financial losses to which a city [without a city plan and zoning] is subject are: (1) Misspent taxes and unnecessary assessment due to a lack of continuity of purpose of succeeding city officials. (2) Depreciated property values from unregulated building, migrations and changing districts. (3) High insurance and utility rates due to mixed building, mixed districts and continued migration of residence districts. (4) Fire losses.

A city plan and a zoning ordinance will decrease these losses.

City planning is a profession in the making; it is a branch of civil engineering bearing fruit of its kind; it is a profession that has not yet standardized its method of collecting, recording and analyzing its observations; it has no standard formula; it has not yet developed its technic. This field now lies before us.

We hear much of the "City Beautiful." Beauty is a by-product of a well worked out city plan. A city that reflects its soul and preserves its traditions in good architecture is a beautiful city if its pattern or framework or setting is properly designed.

Slab Design on Hills and for Irregular Crossings

Slabs Anchored on Steep Grades—Wide Flares on Square Crossings—Triangles at Acute Intersections

By Gustave Reinberg, Jr.
New York City

In laying concrete-paved streets for real estate development, severe grades and numerous intersections of connecting streets often give rise to difficulties not commonly encountered in highway work. In work lately done for the Port Washington Development Corporation at Port Washington, N. Y., the solution of certain of these problems along sound engineering lines was attempted.

The work was done by the Roger Black Company, Inc., with J. E. Hasbrouck as field engineer and John W. Ballance as resident engineer.

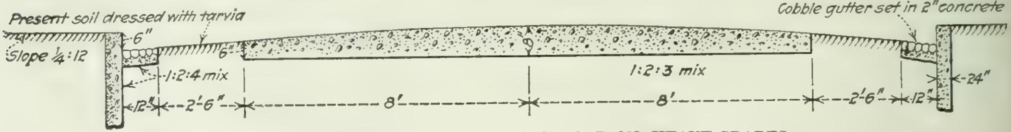

Present soil dressed with tarvia
Slope 1/4:12
6"
6"
1:2:4 mix
12"
2'-6"
8'
1:2:3 mix
8'
2'-6"
12"
24"
Cobble gutter set in 2" concrete

FIG. 1—CROSS-SECTION OF STANDARD ROAD ON HEAVY GRADES

One of the outstanding features of the work was the pouring of concrete on slopes, ranging from 8 to 15 per cent. A cross-section of the design employed is shown by Fig. 1, the concrete slab being 16 ft. wide, 8 in. thick at the center, 6 in. thick at the edges, and 30 ft. long between expansion joints, which were of asphalt ½ in. thick. The mixture employed was 1 part cement, 2 parts bank sand, and 3 parts coarse, screened bank gravel. The road was poured in a single course, screeded by hand and finished with a broom, to give it a rough, non-skid surface. The scoring was made especially heavy on steep grades to improve the tractive qualities.

On grades of 10 per cent and over some method of anchoring the slabs to avoid creeping was deemed necessary, and in the absence of authoritative precedent it was decided to experiment with two methods of anchorage under parallel conditions. The first of these consisted of a substantial toe on the lower end of each 30-ft. slab, formed by excavating a trench of the dimensions shown in Fig. 2 across the subgrade directly ahead of each joint. To take care of the shearing stress between the toe and the slab, ten ⅝-in. deformed steel bars, cut to a length of 2 ft. and bent to an obtuse angle near the center were inserted in the position shown.

The alternative method was a distributed anchor, secured by excavating nine holes, 1 ft. in diameter by 1 ft. deep, in the subgrade directly under each slab, spacing them equidistantly as shown by Fig. 3. As these holes were filled with concrete, five reinforcing bars, 2 ft. long and bent at right angles in the center, were placed in each.

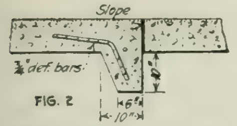


FIG. 2—METHOD OF TOE-ANCHORING SLABS ON HEAVY GRADES

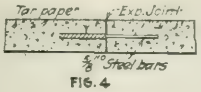


FIG. 4—EXPANSION JOINT DOWELLED WITH STEEL BARS

The surface of the slabs was distinctively marked to indicate the type of anchor used for each, so that it will be possible to determine the relative efficacy of the two systems after the road has been in service for an extended period. The distributed anchor possesses the advantage of requiring a smaller yardage of concrete, but employs several times as much steel for reinforcing as the toe anchor and is somewhat more troublesome to put in unless facilities for cutting and handling reinforcing bars are available. The advantage of this type of anchorage from an engineering standpoint is that a concentration of stresses in the lower end of the slab is avoided.

Aside from the obvious necessity of keeping the mixture as dry as possible (a good mushy consistency was used), and of especial vigilance in finishing the joints to avoid the accumulation of runnage on the upper side, no particular difficulty was experienced in laying road on grades up to 15 per cent. In order to move the mixer expeditiously, however, it is necessary to have the driving mechanism in good condition, and to plank the wheels thoroughly, preferably with heavy cleated treads. Under these conditions it was not found necessary to resort to a block and tackle to move the machine, but this is a possibility if the engine is not a powerful one.

On comparatively level streets the thickness of slab was reduced an inch, giving a 5:7:5-in. road, and a dished cobble gutter was substituted for the curb design. In laying concrete over new fill the construction shown by Fig. 4 was employed, each joint being dowelled with seven ⅝-in. round steel bars, 2 ft. long, placed through the joint material about midway up in the slab. These rods tend to prevent slippage of the slabs at the joints in the event of settlement of the subgrade, and by transferring a portion of the load from one slab to the next they should prevent excessive pressure upon either slab-end. To prevent a bond with the concrete and permit the expansion joint to function, one end of each rod was covered with tar paper. On the 15 per cent grade a similar system of dowelled joints was employed, in addition to the slab anchorage described above, to counteract the buckling effect resulting from end pressure of the slabs.

In the design of street intersections a number of interesting considerations requiring special treatment presented themselves. Each layout was studied by means of a detail drawing considerably in advance of actual pouring, to determine the radius of the connecting flares best adapted to meet the requirements of anticipated traffic and to harmonize in general appearance with the surroundings. The position of expansion joints was worked out and the pouring program arranged in accordance with a comprehensive plan of the entire project. This insured that all streets would be joined in a consistent manner, and the most advantageous layout secured in each case, after taking into consideration all the factors involved.

When approaching an intersection with the actual construction, concrete was laid only up to the point where departure from the normal 16-ft. width occurred. The flare connecting the two streets was then poured as a unit, in such a manner as to avoid all sharp corners or irregular-shaped segments of concrete between expansion joints. Flares with such thin projecting tips are frequently seen, being inevitable where a road is joined to one previously poured without making provision for the intersection. In addition to being unsightly they constitute potential weak places in intersections so made, since they receive only imperfect support from the main body of the slab, and tend to fail rapidly under traffic even when elaborately reinforced.

A diagram of a typical right-angled intersection is shown by Fig. 5. It will be noted that the flares are particularly generous, the use of too small a radius at corners being a common defect of suburban streets; 16-ft. radii were made standard at right-angle turns, while at irregular crossings, flares of 20 and 22-ft. radius were common, and in an extreme case where a straight street intersected a 46-degree curve, an arc of 47-ft. radius, was used in one flare.

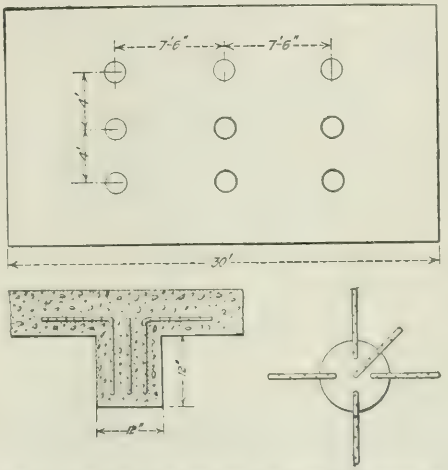


FIG. 3—SPACING OF HOLES AND DETAIL SECTION OF DISTRIBUTED ANCHORAGE

From a number of vital considerations, it was made the general policy to reinforce all intersections. The long flares presented a large surface of thin slab over which heavy traffic might be expected, and which would be very susceptible to damage at the edge, and in spite of the installation of culverts, water mains, etc., at these points as far in advance as possible, there was always the probability of unforeseen contingencies requiring in the future further excavation at or near the intersection.

In dealing with modern truck traffic heavy impact loads may always be expected, as for instance a loaded truck fitted with cross chains on the rear wheels, or a defective tire of the solid block type, where a missing block results in a concentrated hammer-blow being delivered to the slab at each revolution of the wheel. To cope with such conditions particular attention was given to the subgrade throughout, and the precaution was taken to reinforce the road with [illegible]-in. steel bars wherever local settlement might be anticipated, on the theory that a reinforced slab will act as a unit in distributing such concentrated stresses over its entire bearing surface. At intersections a network of 16-ft. ⅝-in. steel bars was used through the body of the slab, shorter bars being placed fanwise around the flares, and additional reinforcing placed over existing culverts.

The surfacing of an intersection such as that shown by Fig. 5 presents a problem in warped surfaces, which become more or less complicated with the degree of variation between the grades of the streets involved. From theoretical considerations such an intersection might be made with a level 16-ft. square at the center, having the full thickness of slab equal to the crown thickness of the road; effecting a gradual transition from this surface to the normal crown of the four roads, and sloping off the corner segments to the usual edge thickness at the form lines. Such a surface can be approximated by laying temporary wooden forms to the requisite grades, as a continuation of the form lines of each road, as indicated by the dotted lines in the drawing. These boards form a support for a straight-edged screed board used to strike off the surface, concrete being poured simultaneously on both sides of them. After screeding, the boards are pulled up and the spaces filled with fresh concrete and finished with a hand float.

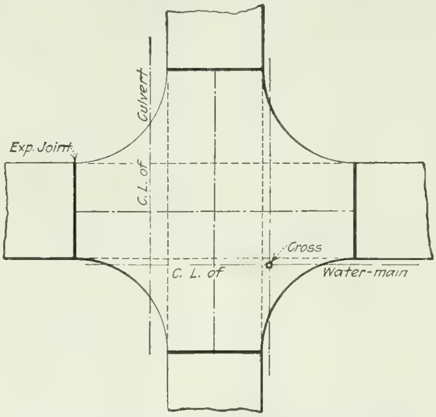


FIG. 5—TYPICAL RIGHT-ANGLED INTERSECTION
Dotted and broken lines show position of temporary screed boards.

If the grades are very dissimilar such an interesction tends to present a broken appearance, and great care must be exercised in finishing to minimize the abruptness of the transition at intersecting planes. For the majority of intersections a more satisfactory scheme was found in laying temporary forms on the center line of each road, as indicated by the dot-and-dash lines, the normal grade of the roads being carried in each case. The curved forms at the edges were lined up "by eye" to give approximately a straight grade between the edges of the two intersecting roads.

The slab was poured as a whole and screeded radially with a special half-crowned screed, care being used to avoid the formation of a peak at the center. The screed boards were then pulled exactly as in the previous instance. In reality, each intersection presents an individual problem which must be worked out in accordance with the grades existing, and the preponderance of travel to be cared for. Practical considerations will in every case adjust the theoretical to actual conditions.

The majority of these right-angled intersections, being substantially level, were poured entirely without joints, in spite of the large area of slab involved, partly for considerations of appearance and partly to avoid breaking up the slab over water pipe trenches, etc. Of course either or both of the temporary center line forms can be replaced by a permanent expansion joint, and at steep sags of grade a center joint was introduced perpendicular to the line of gravitational stress, this joint being dowelled with 4-ft. rods in the manner shown by Fig. 4. A similar construction might well be employed at sharp summits or wherever the grade of one of the streets at the intersection is excessive.

At several points, the juncture of two curved roads at a more or less acute angle necessitated a triangular layout, having a separate branch connecting the two main roads, with a decorative park in the center. Due to the close inter-relation of grades these intersections were planned as a distinct unit, a separate profile being taken and studied in conjunction with a large scale detail drawing in working out the design. In most cases it was necessary to use a comparatively short radius for at least one of the branches, and frequently a severe grade was unavoidable at the same point. Considering the requirements of traffic under such conditions, the roadway was widened from 3 to 6 ft. at these points by using a parabolic curve on the inside of the triangle. Such an intersection is shown by Fig. 6.

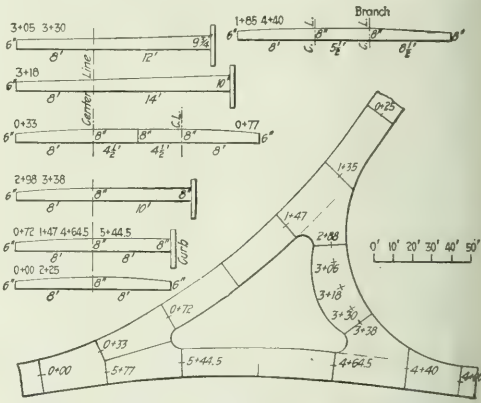


FIG. 6—LAYOUT OF TRIANGULAR INTERSECTION
Position of expansion joints and parabolic widening of roadway at sharp radius and typical cross-sections of slab for triangular intersection.

In designing the surface the problem of banking the curve is involved. While no consistent policy in this respect was followed in general, an arbitrary banking of from 4 to 8 in. was provided wherever the coincidence of a sharp curve and steep grade made this precaution seem necessary. In the case illustrated, the short branch, having approximately a 50-ft. radius and being at a sag of grade was banked 4 in. and widened 6 ft. at the center. The main roads were not banked but the crown was altered to keep drainage away from the inside edges of the triangle. Typical cross-sections of the road as finally worked out are shown (with an exaggerated vertical scale) by Fig. 6. In screeding this intersection temporary forms were laid as shown by the dot-and-dash lines. In all this work the closest co-operation of everyone concerned was necessary.

Minimum Specifications—Highway Engineering Positions

What Men Must Know—What They Must Be Able to Do—What Characteristics They Must Possess

Abstract of the Report of the American Association of Engineers to be submitted at the annual convention at Norfolk on May 7.

THE AMERICAN Association of Engineers has found it of increasing importance in its employment service to have as a guide for selection, assignment, and promotion clear definitions of the qualifications required for engineering positions. To meet the needs of this service as well as the present urgent demands in the engineering field, the association, several months ago, appointed a committee to specify the qualifications essential to successful work in various engineering positions (see *Engineering News-Record*, April 26, p. 744). This committee has confined its attention for the present to a study of the highway engineering field. An occupational study sheet was prepared and sent to 2,700 highway engineers throughout the country. The data given were compiled on large charts, and a study made of them from which were prepared the minimum requisite qualifications for each position.

This minimum specification is a statement of the things a person must be able to do, what he must know, and the personal characteristics he must possess to function in the position named. The set of specifications so prepared does not attempt to cover all the positions which occur in state, municipal, or private organizations, but it does contain specifications for typical positions from which it will be easy to develop the requirements for each individual position.

Three typical specifications are given below.

MINIMUM SPECIFICATIONS FOR CHAINMAN—RODMAN
(HIGHWAY ENGINEERING GROUP)

SKILL:

Under immediate supervision, to clear line for survey, measure distances with chain or tape, hold level or stadia rod, drive stakes for line and grade, establish bench marks, pitch and take down tent, pack and unpack equipment, make simple field sketches and field computations, index field books, and perform such other simple engineering duties as may be required of an aid or helper on survey work.

Fair command of the English language.

KNOWLEDGE:

Care of simple surveying instruments, as chain, tape, level rod, stadia rod, plumb bob, etc.

Sufficient working knowledge of arithmetic, algebra, and geometry to perform the requisite skills.

PERSONAL:

Good physique, active and alert.

Have sense of direction and location.

MINIMUM SPECIFICATIONS FOR CHIEF OF PARTY
(HIGHWAY ENGINEERING GROUP)

SKILL:

Under direction, supervise and be responsible for the work of a field party in the making of surveys for highway location, construction and maintenance.

Make the necessary computations, sketches and studies for the proper prosecution of the field work.

Make estimates and reports.

Provide for proper organization, subsistence and transportation of field party, when necessary.

Good command of the English language.

KNOWLEDGE:

Care and adjustment of all surveying tools and instruments used by field party.

Field methods of highway location, construction and maintenance.

Sufficient working knowledge of the following subjects to perform the requisite skills:

Arithmetic, algebra, geometry, trigonometry, chemistry, physics, geology, field astronomy, engineering drawing, descriptive geometry, surveying, mechanics, hydraulics, and location, construction, and maintenance of highways.

PERSONAL:

Good physical condition and endurance.

Tact, good judgment, and ability in the handling of men.

MINIMUM SPECIFICATIONS FOR MAINTENANCE ENGINEER
(HIGHWAY ENGINEERING GROUP)

SKILL:

Under direction, to supervise and direct the maintenance of highways in a district or division.

Direct, in a general way, the work of engineers, patrolmen, inspectors, clerks, and others engaged in maintenance work.

Act as advisor and arbiter on maintenance and related problems.

Make, or supervise the making of, the necessary estimates, schedules, charts, reports, etc.

Good command of the English language.

KNOWLEDGE:

Methods, systems, materials, machinery and tools used in highway maintenance.

Economics of highway operation and maintenance.

Wage rates, labor conditions, purchasing methods and material costs.

Sufficient working knowledge of the following subjects to perform the requisite skills:

Arithmetic, algebra, geometry, trigonometry, chemistry, physics, geology, engineering drawing, descriptive geometry, surveying, mechanics, hydraulics, materials of construction, electrical machinery, theory of structures, structural and concrete design, cost accounting, business law, economics, and highway construction and maintenance.

PERSONAL:

Administrative and supervisory ability.

Good physique and endurance.

Tact and good judgment in handling human and technical problems.

Ability to make or supervise the making of analytical studies such as traffic censuses, etc.

Keenness and accuracy in observation.

Firmness and fairness in decision.

Rack-Rail Traction Abandoned

Replacing rack-rail locomotive traction by heavy adhesion engines operating on grades of 6.6 per cent is a notable change reported as being made on the Halberstadt-Blankenburg Ry., in Germany, which was one of the first railways built with the Abt multiple-rack type of rack rail. Tank locomotives of the 2:10:2 type, now being introduced for adhesion working, weigh about 100 tons, with 75 tons on the driving wheels. To facilitate passage of curves of 984 ft. radius, which occur on maximum grades, the middle or main driving wheels have plain flangeless tires, while the second and fifth axles have considerable lateral play in the boxes.

Equipment Rental and Depreciation Record Cards

Financial History of Permanent Plant Easily Kept—Schedules Operate on Basis of Eight Months to Rental Year

TWO cards record the financial history of permanent equipment employed in construction operations by the Henry W. Horst Co., Rock Island, Ill., general contractors. Equipment units having a value in excess of 100 and a normal life of more than one working season are classed as permanent. All equipment consisting of numerous small pieces, as pipe or road forms, and all small tools, as picks and shovels, are charged directly to the job and the job is credited with any salvage value they have. Permanent equipment is not charged to any job but jobs on which it is used pay a rental based on the life of the unit.

Rental Schedules—Equipment generally has a life of three working seasons but there are units, as light motor trucks, which depreciate faster and other units, as hoists, which last longer. Two-, three- and four-year rental schedules are, therefore, employed as follows:

On equipment whose life is 24 months, there will be charged over a two-year period a total of $\frac{12}{10}$ of the original cost, divided as follows: First year, $\frac{8}{10}$ of the purchase price; second year, $\frac{4}{10}$ of the purchase price.

On equipment whose life is three years, there will be charged a total of $\frac{13}{10}$ of the purchase price, divided as follows: First year $\frac{6}{10}$; second year, $\frac{5}{10}$; third year, $\frac{2}{10}$.

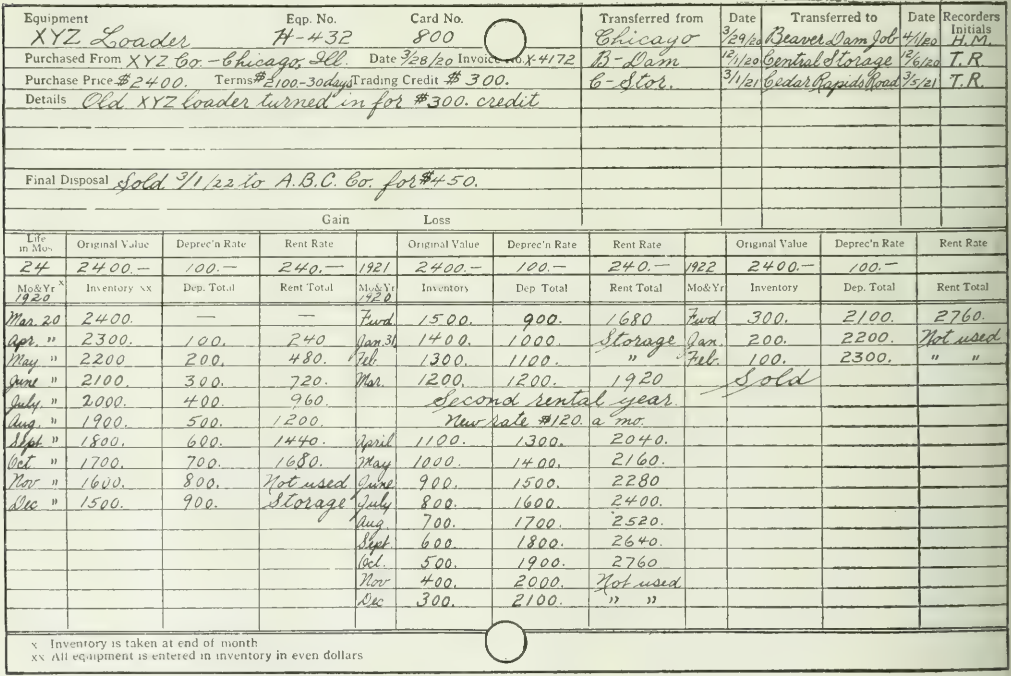
On equipment whose life is four years, there shall be charged a total of $\frac{18}{10}$ of the puchase price as follows: First year, $\frac{5}{10}$; second year, $\frac{4}{10}$; third year, $\frac{3}{10}$; fourth year, $\frac{1}{10}$.

These schedules operate on the basis of eight months to the rental year, the rental year usually differing from the calendar year in that most equipment is purchased during the spring or summer and so is not likely to be in operation for eight months in the calendar year of its purchase. The first year basis of rental continues until the piece has seen eight months of service at which time it goes into its second rental year, the change in rental rate applies, and so on. Thus a piece of equipment costing $1,600 and having a life of 2 years would pay in its first year's rental, $800 or $100 a rental month. This piece, if purchased July 1 and used through November, would earn for 5 months' service $500. If next put into service March 1 of the following calendar year and continued through the summer it would earn at the same rate through May, thus completing the eight months of service comprising its first rental year. With June, however, it would enter upon its second rental year and the rental rate would automatically change as per schedule.

Records of the equipment service and earnings are kept on one card for the job summary and another card for the equipment unit. Both cards are kept in one file.

Equipment Unit Card—An equipment unit card containing the financial history of one machine is shown by Fig. 1.

The upper part of this card is largely self-explana-



Equipment XYZ Loader Eqp. No. H-432 Card No. 800

Purchased From XYZ Co.—Chicago, Ill. Date 3/28/20 Invoice No. X-4172

Purchase Price $2400. Terms $2100.-30 days Trading Credit $300.

Details Old XYZ loader turned in for $300. credit

Final Disposal Sold 3/1/22 to A.B.C. Co. for $450.

Gain Loss

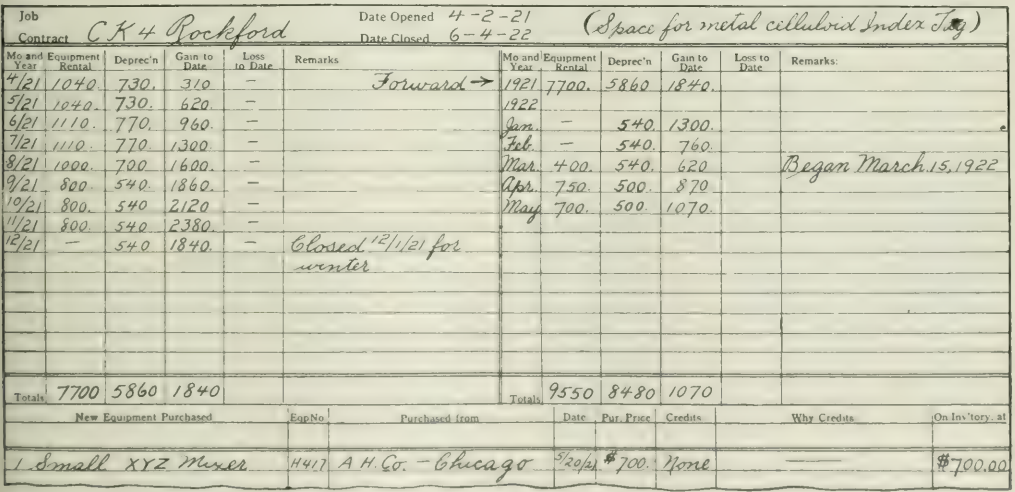
Transferred from	Date	Transferred to	Date	Recorders Initials
Chicago	3/29/20	Beaver Dam Job	4/1/20	H.M.
B-Dam	12/1/20	Central Storage	12/6/20	T.R.
C-Stor.	3/1/21	Cedar Rapids Road	3/5/21	T.R.

Life in Mos	Original Value	Deprec'n Rate	Rent Rate		Original Value	Deprec'n Rate	Rent Rate		Original Value	Deprec'n Rate	Rent Rate
24	2400.—	100.—	240.—	1921	2400.—	100.—	240.—	1922	2400.—	100.—	
Mo&Yr x 1920	Inventory xx	Dep. Total	Rent Total	Mo&Yr 1920	Inventory	Dep Total	Rent Total	Mo&Yr	Inventory	Dep. Total	Rent Total
Mar. 20	2400.	—	—	Fwd.	1500.	900.	1680	Fwd	300.	2100.	2760.
Apr. "	2300.	100.	240	Jan. 31	1400.	1000.	Storage	Jan.	200.	2200.	Not used
May "	2200	200.	480.	Feb.	1300.	1100.	"	Feb.	100.	2300.	" "
June "	2100.	300.	720.	Mar.	1200.	1200.	1920		Sold		
July "	2000.	400.	960.		Second rental year.						
Aug. "	1900.	500.	1200.		New rate $120. a mo.						
Sept "	1800.	600.	1440.	April	1100.	1300.	2040.				
Oct "	1700.	700.	1680.	May	1000.	1400.	2160.				
Nov "	1600.	800.	Not used	June	900.	1500.	2280				
Dec "	1500.	900.	Storage	July	800.	1600.	2400.				
				Aug.	700.	1700.	2520.				
				Sept.	600.	1800.	2640.				
				Oct.	500.	1900.	2760				
				Nov	400.	2000.	Not used				
				Dec	300.	2100.	" "				

x Inventory is taken at end of month
xx All equipment is entered in inventory in even dollars

FIG. 1—RENTAL AND RECORD CARD FOR EACH EQUIPMENT UNIT

tory. As indicated, the equipment is numbered and the cards are numbered. The card is kept in file under the job on which the particular piece of equipment is in use. When the equipment is transferred from this job to another job, or to the central storage, it is indicated together with the date and the initials of the recorder in the upper right hand section of the card. This means, of course, that the card is moved about from time to time and that the cards are not kept in numerical order in the filing case. However, each card number is recorded in numerical order on an equipment index sheet, which includes also after the card number, the invoice number, the name and brief description of the equipment, the number given this piece of equipment in the scrap book (in which scrap book are pasted pictures of the equipment) and, in the last column, the final disposition of the piece and date. The equipment cards are checked against this equipment index once a month in order to make sure that all cards that are not in the equipment file have been disposed of in the dead file of worthless equipment and sold equipment.



Job
Contract CK 4 Rockford
Date Opened 4-2-21
Date Closed 6-4-22
(Space for metal celluloid Index Tag)

Mo and Year	Equipment Rental	Deprec'n	Gain to Date	Loss to Date	Remarks	Mo and Year	Equipment Rental	Deprec'n	Gain to Date	Loss to Date	Remarks:
4/21	1040.	730.	310	—	Forward →	1921	7700.	5860	1840.		
5/21	1040.	730.	620.	—		1922					
6/21	1110.	770.	960.	—		Jan.	—	540.	1300.		
7/21	1110.	770.	1300.	—		Feb.	—	540.	760.		
8/21	1000.	700	1600.	—		Mar.	400.	540.	620		Began March 15, 1922
9/21	800.	540.	1860.	—		Apr.	750.	500.	870		
10/21	800.	540	2120	—		May	700.	500.	1070.		
11/21	800.	540	2380.	—							
12/21	—	540	1840.	—	Closed 12/1/21 for winter						
Totals	7700	5860	1840			Totals	9550	8480	1070		

New Equipment Purchased	EqpNo	Purchased from	Date	Pur. Price	Credits	Why Credits	On Inv'tory. at
1 Small XYZ Mixer	H417	A H. Co. - Chicago	5/20/21	$700.	None	——	$700.00

FIG. 2—RECORD CARD FOR EQUIPMENT ON EACH JOB

Should a card be lost, the loss is discovered by this check within a month's time and while it is still possible to get most of the information back on a duplicate card. Each card is divided below into three sections provided for a record of three years, and the card is a tumble card, that is, it is perforated above and below and in case the equipment is in use more than three years, the card can be turned over and the record carried on the reverse side, which is printed just as is the obverse side. One card will therefore cover a six-year period. It will seldom be necessary to use more than one card for any one particular piece of equipment. Instead of twelve lines for recording the monthly values, there are sixteen lines allowing one line for such notation as is recorded midway in the second calendar year of the accompanying card, Fig. 1, as "Second Rental Year." Note that a piece of equipment remains in its first rental year until eight months rental at a definite rate have been collected and in its second rental year until eight months rental at a different rate have been collected, et cetera. The piece of equipment recorded on the accompanying card is shown as sold for $450 when the book value stood at $100, hence a record of gain of $350. At this point the record is made in the equipment index and the card is removed from the live file to the dead file.

Colored metal tags are used on the cards: Red for general building equipment, blue for road building equipment, orange for automobiles and black for general office. Any piece of equipment not in use by the department owning it may be used by another department but the rental is credited to the earnings of the department owning the equipment.

Job Card—A filled-in job or contract card is shown by Fig. 2. This card shows the sum total of equipment rental paid each month during the life of the particular job or contract and also the depreciation on the same equipment and the "gain" or "loss" to date in equipment rental over or under depreciation. There is also shown the new equipment purchased on any job or contract with additional information sometimes needed.

These cards have the large celluloid indices under which appear the name of the job or contract and the corresponding index number. A card so indexed is then used at the head of each job and thus serves the double purpose of a job equipment summary and a job index card.

Helping to Improve the Car Situation

There are three ways in which engineers and contractors can help the American Railway Association in its program to maintain the supply of cars. Briefly they are: (1) Anticipate your requirements for bulk material and heavy equipment and place your orders early so that every ton of material that can be moved before fall will be; (2) release your cars promptly, don't wait until the free time is up; (3) when loading material or equipment plan the loading so that each car will have its full capacity and have everything ready for loading when the cars are placed.

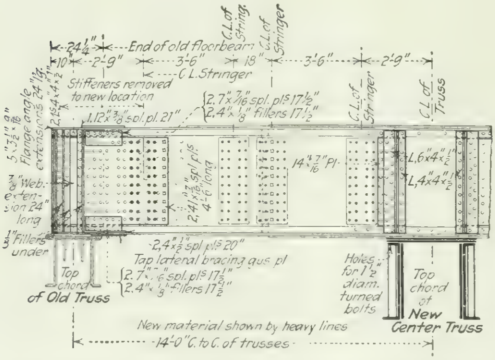
Railroad Bridge Widened and Reinforced

By G. H. Wilsey
Union Station, St. Paul, Minn.

RELOCATION of a part of the Northern Pacific Ry. line in Minneapolis has made necessary the reconstruction of the railway's bridge over the Mississippi River on a new site. The new bridge is being built for modern traffic loads, three-fourths greater than the designed capacity of the old bridge. The main spans of the old bridge are used in the new structure, however; they are being widened, a third truss is being added and the floor is being reinforced, as briefly described in the following.

The railway right-of-way passes through the center of the campus of the University of Minnesota, on the east bank of the river. Under an agreement with the regents of the university the company has relocated its line to the north of the campus, parallel to the Great Northern Ry. line, and the bridge, west of the university, has been relocated to suit.

The new bridge consists of three 90-ft. plate girder approaches on the west, two 245-ft. deck truss spans (the old ones moved to the new location and reinforced for heavier loading), and two 76-ft. plate-girder spans on the east approach. The plate-girder spans are supported on concrete piers and in order to obtain good proportion in high piers and relative short spans the piers have been made narrow, with heavy reinforcement for traction.



EXTENDED FLOORBEAM AND NEW CENTER TRUSS SUPPORT DOUBLED STRINGERS

The most interesting part of the work is the reinforcement of the old truss spans. The bridge was designed in 1891 and is a double-track structure with two 245-ft. pin-connected trusses in each span, 24 ft. apart center to center; the floorbeams rest on top of the top chord, and two stringers under each track framed into them were designed to carry 112-ton locomotives, or about E 30 loading. For a number of years traffic has been limited to freight-switching operations and low-speed passenger traffic of the Minneapolis & St. Louis Ry., a tenant line, the passenger traffic of the Northern Pacific going over the tracks of the Great Northern Ry. between St. Paul and Minneapolis.

In the new location the old trusses will be separated to 28 ft. center to center, the tracks being 14 ft. on centers. The old floorbeams will be sent to a bridge shop and extended 2 ft. on each end as shown in the drawing, the stringers of the old bridge will be doubled up under one track, and two new stringers will be placed under the other. A new riveted truss will be placed under the center of the floorbeams.

It is unusual for a pin-connected span to be reinforced by the addition of a riveted truss; but it was held that additional stiffness would be secured in this way without the addition of heavy transverse bracing, as is the custom in the Northwest. The new truss is designed for the standard Northern Pacific loading, equivalent to E 52, and is calculated to carry five-eighths of the load on both tracks. Theoretically the floorbeam reaction of this truss is greater than five-eighths, but the specifications permit of reducing the calculated load 8 per cent for two tracks and the bridge is approached by 8-deg. curves on each end, which will reduce the speed of trains to below that taken into consideration in determining the impact formula of the specifications. The new truss will be erected a small distance below the bottoms of the floorbeams and the latter will be brought to bearing by shimming after the trusses are swung, thus taking care of any permanent set that may be found in them. A new lateral system will be added.

The work has been designed and will be constructed under the direction of H. E. Stevens, chief engineer of the Northern Pacific Ry., and M. F. Clements, bridge engineer.

Friction Spark Set Off Gas Explosion at Springfield

AFTER an investigation of the purifier house explosion at the gas plant of the Springfield Gas Light Co. on Feb. 1, 1923, the Department of Public Utilities of Massachusetts has just reported that gas which leaked from one of the purifier boxes was ignited by a friction spark produced in the attempt to turn a valve which controlled the flow of gas to the boxes. This valve worked very hard, and pipe extensions were slipped over the wrench handles by which the valve was turned. Five men were trying to turn the extended handles, and were making an extra effort to turn it just at the moment the explosion took place. The spark may have occurred in the handle or under the foot of a workman; the men wore shoes with nails in the soles. Prior theories that a spark from the switches of an electric elevator set off the gas were found on investigation to be untenable. The gas leakage was due to the fact that the water seal of one of the purifier boxes was not adequate for the pressures developed under normal working conditions, and a slight increase of pressure due to refilling several retorts is considered to have caused the seal to overflow and gas to escape from the box. Among the recommendations of the department as the result of its investigation are that employees working in inclosed purifier houses be required to wear rubber-soled boots or shoes free of nails, and that all purifier units be controlled by devices which will permit the gas to be shut off easily by one man. It also recommends that where hoisting machinery or elevators are used in a purifier house, other than electric power be employed if possible.

A Logical Method of Computing Motor-Vehicle Fees

Fees in Different States Show Great Inconsistency of Present Practice—Fee Based on Impact Is Proposed

BY ROBERT C. BARNETT
Economic Engineer, Jefferson City, Mo.

A LOGICAL basis has not yet been reached for determining automobile license fees. Table I shows the present conditions or factors forming the several different bases which the different states use in arriving at their respective fees. Table II sets forth for each state in the Union the fee that is charged for a 5-passenger Ford and that for a 7-passenger Cadillac. We are groping after a result rather than proceeding by a logical analysis to arrive at a rational basis for assessing a tax.

TABLE I—BASIS OF MOTOR VEHICLE REGISTRATION FEES IN THE DIFFERENT STATES

Basis of Fee	Number of States Passenger Cars	Trucks
Gross weight	9	12
Horsepower	26	2
Horsepower plus weight	5	4
Flat rate for electrics	10	..
Cubic inches piston displacement	1	..
Value plus weight	3	2
Flat rate plus weight	1	..
Horsepower plus value	1	..
Valve only	1	..
Flat rate only	1	..
Tons capacity	..	25
Horsepower plus capacity	..	2
Total tire width	..	1
Chassis weight	..	1

Any readjustment of license fees should be made on a logical basis. Such a basis is to be found in the conception that the total of fees should bear some relation to the *annual cost* of the system and the first cost of construction. Annual cost is the sum of three items, Interest + Maintenance + Sinking Fund Payment. To meet this annual cost, there is needed a perennial source of revenue. Recourse is had to the license fees paid by the motor vehicle owners. As the total of these fees should equal all or a major portion of the annual cost of the highway system, the real problem at hand is to secure an equitable distribution of such fees among the motor owners according to the wear each produces on the roads.

The cost of maintenance depends on the destructive effect of the traffic as likewise does the sinking fund needed to replace the wearing surface.

Investigations carried on by the Bureau of Public Roads reveal the fact that impact is the most destructive agency affecting our highways today.

Impact can be decreased by keeping the road surface smooth, in short, by a thorough maintenance of the road surface. Impact is lessened by reducing the weight of the unsprung parts of the vehicle—that is the wheels, housing, differential gears, and axle. Impact is also diminished by the resiliency of the tires and of the wearing course of the pavement. It is increased by the load above the wearing course of the pavement. It is increased by the load above the springs. Impact increases with the speed of the vehicle to some extent.

Speed depends upon the horsepower of the motor and decreases as the road resistance increases, or as the load and tractive resistance increase.

Condensing these statements of relationships, we have:

1. Impact varies as

$$\frac{(\text{Load above springs})\ (\text{Weight unsprung parts})\ (\text{Speed})}{\text{Resiliency of Tires}}$$

2. Speed varies as

$$\frac{\text{Horsepower}}{(\text{Weight vehicle, loaded})\ (\text{Tractive resistance})}$$

As tractive resistance is not dependent upon the vehicle, it need not be considered here as it will later be absorbed in the general constant that will appear in the final equation. Substituting the value for speed in the above expression, we have.

3. Impact varies as

$$\frac{(\text{Load above springs})}{(\text{Weight vehicle, loaded})} \times \frac{(\text{Weight unsprung parts})\ (\text{Horsepower})}{(\text{Resiliency of tires})}$$

TAPLE II—COMPARISON OF AUTOMOBILE REGISTRATION FEES FOR THE VARIOUS STATES

State	Five-Passenger Ford	Seven Passenger Cadillac
Alabama	$11.25	$26.25
Arizona	5.00	10.00
Arkansas	9.25	15.65
California	8.80	12.40
Colorado	5.00	5.00
Connecticut	14.10	18.90
Delaware	8.40	19.60
District of Columbia	3.00	10.00
Florida	10.50	24.50
Georgia	11.25	19.60
Idaho	20.00	40.00
Illinois	8.00	12.00
Indiana	5.00	8.00
Iowa	10.00	47.60
Kansas	8.00	13.75
Kentucky	13.20	18.60
Louisiana	15.00	21.10
Maine	10.25	17.75
Maryland	13.20	18.60
Massachusetts	10.00	15.00
Michigan	10.75	18.75
Minnesota	12.00	15.00
Mississippi	11.00	15.50
Missouri	7.00	11.00
Montana	7.50	15.00
Nebraska	10.00	15.75
Nevada	7.35	17.15
New Hampshire	12.60	29.40
New Jersey	8.80	15.50
New Mexico	8.80	12.40
New York	7.10	20.35
North Carolina	12.50	30.00
North Dakota	7.20	26.85
Ohio	8.00	12.00
Oklahoma	10.00	29.90
Oregon	15.00	55.00
Pennsylvania	8.80	12.40
Rhode Island	10.75	20.00
South Carolina	6.00	10.60
South Dakota	6.00	6.00
Tennessee	11.00	15.50
Texas	7.70	10.85
Utah	10.00	15.00
Vermont	22.00	31.00
Virginia	13.20	19.60
Washington	10.00	25.15
West Virginia	12.90	24.00
Wisconsin	10.00	10.00
Wyoming	8.00	16.00
Average	10.02	18.98

In all equity, the vehicle should be penalized according to the damage that it does to the roads. In other words, the owner should pay according to his ability to produce the maximum impact with his particular car. We have here a logical basis for determining license fees by making such fees vary according to the possible impact that the specific vehicle can produce. By introducing a general constant in our expression for impact, we can put the general relation in the terse language of an equation.

License Fee —

$$\frac{(\text{Constant})\ (\text{Load above springs})}{(\text{Weight vehicle, loaded})} \times \frac{(\text{Weight unsprung parts})\ (\text{Horsepower})}{(\text{Resiliency of tires})}$$

To illustrate the application of this equation, let us assume some approximate values for the total license fees required and for the average motor vehicle, and then determine the value of the general constant and subsequently the license fees for several different cases.

Assume:

Total license fees required	$6,000,000
Weight of loaded vehicle	3,000 lb.
Weight above springs of rear axle ($\frac{7}{10}$ of total load less unsprung)	1,600 lb.
Weight of unsprung parts rear axle	500 lb.
Horsepower of motor	30
Resiliency of worn solid tire	1
Resiliency of pneumatic tire (Bureau of Pub. Roads data)	7
Total number of vehicles (10 per cent of which have solid tires)	350,000
Weighted average resiliency then becomes	6.4

Substituting these numerical values in our equation, we have

$$\frac{6{,}000{,}000}{350{,}000} = \frac{(\text{Constant}) \times 1{,}600 \times 500 \times 30}{3{,}000 \times 6.4}$$

Solving this and thereby determining the value of the general constant, we find

$$\text{Constant} = \frac{6{,}000{,}000 \times 3{,}000 \times 6.4}{350{,}000 \times 1{,}600 \times 500 \times 30} = 0.0137$$

For the assumed conditions, the equation for any specific car becomes

$$\text{License Fee} = \frac{0.0137\ (\text{Load above springs})}{(\text{Weight vehicle loaded})} \times \frac{(\text{Weight unsprung parts})\ (\text{Horsepower})}{(\text{Resiliency of tires})}$$

For the hypothetical average car as assumed, the license fee as determined by our equation is very nearly $16.

For a Ford touring car, our values would run as follows:

Weight of loaded vehicle	2,500 lb.
Weight above springs	1,450 lb.
Weight of unsprung rear axle	300 lb.
Horsepower of motor	25
Resiliency of tires	7

Using these values, our equation becomes

$$\text{License fee} = \frac{0.0137 \times 1{,}450 \times 300 \times 25}{2{,}500 \times 7} = \$8.50$$

For a 3-ton truck with pneumatics, we have as approximate values:

Weight of loaded vehicle	12,000 lb.
Weight above springs	7,200 lb.
Weight of unsprung parts	1,200 lb.
Horsepower of motor	35
Resiliency of tires	7

With these latter values, our equation now becomes

$$\text{License fee} = \frac{0.0137 \times 7{,}200 \times 1{,}200 \times 35}{12{,}000 \times 7} = \$49.30$$

If this truck were equipped with solid tires, the fee would amount to 7 × $49.30 or $345.10 unless the owner could be made to replace the solid tires before they became badly worn.

For a 5-ton truck with solid tires, we would have as approximate values:

Weight of loaded vehicle	20,000 lb.
Weight above springs	12,000 lb.
Weight of unsprung parts	2,000 lb.
Horsepower of motor	45
Resiliency of tires	1

These values substituted in the equation give a fee of $739.80.

It is thus seen that the equation gives reasonable values for cars which do small damage to the roads and that for large trucks with bad tire conditions the fee becomes a sufficient deterrent to keep them off the state roads or compel the owners to replace the worn-out tires.

An Unusual Series of Intense Rainfalls

By J. H. Lance
Consulting Engineer, Wilkes-Barre, Pa.

As DEMONSTRATING that no long period need elapse between such storms, and particularly as emphasizing the wisdom of the utmost despatch in executing repairs to inadequate structures which may have been injured by flood lest damage pile on damage, the series of severe rainfalls which occurred in the Lackawanna Valley of Pennsylvania during the summer of 1922 is of interest. These storms, the limits of which are approximately shown on the accompanying map, occurred on June 3, 11, 17 and 20, July 1, 2 and 28. None of them except that of July 28 attained its maximum intensity over a Weather Bureau station, consequently it was necessary to rely in most cases upon local observers for time-depth measurements of the rainfall.

June 3: This flood was most severe to the north of Carbondale. Wilson Creek, with a drainage area of 3.4 sq.mi., reached a maximum rate of runoff of about 300 sec.-ft. per square mile, and Fall Brook, with 11.4 sq.mi., about 146.

June 11: Most of the damage was done by wind, and the rainfall, while severe, was of short duration.

June 17: The storm reached its maximum intensity at Carbondale and directly east and west therefrom. The rainfall on Fall Brook amounted to 4.3 in. in 4.3 hr., and the resultant runoff reached a maximum rate of about 200 sec.-ft. per square mile. The same rate would have obtained on Racket Brook but for the ponding effect of the Brownell reservoir of the Consolidated Water Supply Co., which reduced the maximum flood rate at that point from about 140 sec.-ft. per square mile to about 55, and delayed it about four hours.

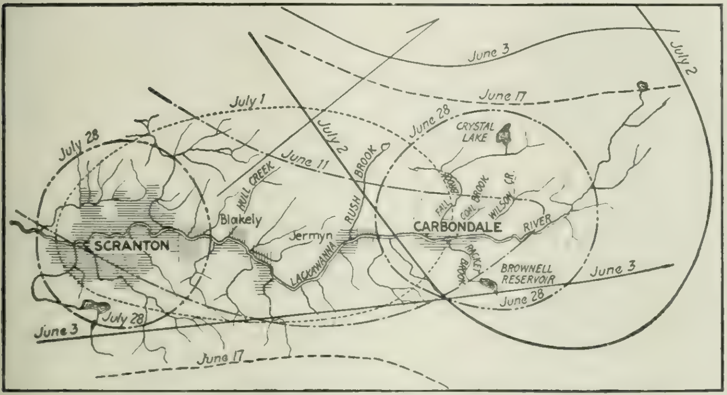
June 28: On the Fall Brook watershed, where the storm was most intense, the precipitation was 3.25 in. in 2 hr., and the resulting runoff reached a maximum rate of about 160 sec.-ft. per square mile.

July 1: This was a rainfall of short duration but great intensity. No record of the amount was found, but violent floods were caused on Hull Creek in Blakely and Rush Brook in Jermyn, and the intervening smaller streams. Hull Creek reached a maximum discharge rate of more than 120 sec.-ft. per square mile, and Rush Brook slightly less.

July 2: The whole upper drainage area of the Lackawanna River, in addition to over 100 sq.mi. of that of Tunkhannock Creek, adjacent on the west, was visited by an unusually intense rainfall. In 75 min. 2.75 in. fell on the Fall Brook drainage area, though the most intense precipitation appears to have occurred a little to the northwest. Fall Brook reached a maximum runoff rate of about 270 sec.-ft. per square mile. The maximum attained on Racket Brook was equal to that of June 17. The Lackawanna River overflowed its banks throughout Carbondale and downstream therefrom, destroying a concrete bridge in Mayfield by undercutting of the abutments and the single stream pier —which seemed to have been founded on the deposit of coal waste and sand to be found in the beds of most streams in the anthracite mining region.

July 28: This storm occurred directly over Scranton, where there is a United States Weather Bureau station. The rainfall amounted to 1.91 in. in 1 hr., which intensity is said to have been equalled only once in the twenty-two years' previous history of the Scranton station.

The Principal Lessons to be learned from a study of these storms, which caused damage amounting to about $4,000,000, are that it is unsafe to rely upon protection against any but a maximum flood, even for works of a temporary nature; and that maximum floods may occur in any year or at any interval. Thus, taking Fall Brook as a guide (because better opportunities were there afforded for accurate flow measurements), the flood of June 3 was said by observers to have been the greatest in about twenty years; yet that flood was exceeded three times in the next thirty days, the last time by about 85 per cent. In addition, there may be created a great variation in the maximum runoff rates on different streams under the same rainfall conditions, due to size and topography of the basins and relative position of the stream branches.



LOCATION OF SEVEN HEAVY PENNSYLVANIA RAINFALLS, JUNE 3-JULY 28, 1922

Loss of Head in Valves and Pipe

Summary of a pamphlet report on experiments at the University of Wisconsin by Charles Ives Corp, professor of hydraulic and sanitary engineering, and Roland O. Ruble, instructor in hydraulic engineering.

1. The loss of head due to valves and other fittings occurs in part within the valve or fitting and in part as an added loss in the pipe line downstream where normal flow has been disturbed.

2. Measurement of the loss of head where the downstream piezometer is attached too near the valve will give a loss in excess of that actually produced. From 20 to 25 pipe diameters beyond the valve will probably give the best position for the downstream piezometer opening. It is undesirable to have a greater length of pipe in the gage length than is actually needed to include all valve loss.

3. The loss of head in new clean wrought-iron pipe from ½ to 12 in. in diameter is given approximately by the formula $H = \frac{0.0319}{d\ 1.16}\ v\ 1.9$ in which H equals loss of head in feet per 100 ft. of pipe, v is the velocity of flow in the pipe in feet per second, and d is the pipe diameter in feet.

4. Globe valves offer from 15 to 40 times the resistance of gate valves for the same size. This ratio increases with the increase in the size of valves.

5. The length of straight pipe of the valve size which will produce the same loss of head varies from [illegible] to 4 ft. for fully open gate valves and from 20 to 35 ft. for fully open globe valves. In the case of globe valves the smaller valves are equivalent to the greater length of pipe measured in pipe diameters.

Points on Bridge Maintenance

In a paper urging more thorough inspection and more effective maintenance of highway bridges, read before the Minnesota Engineers and Surveyors Association last month, E. J. Miller made some suggestions for maintenance and gave valuable data on the cost of painting and floor repair. Adequate painting, if done once in five years, should be effective in protecting steel bridges from deterioration, and this will be accomplished at a cost of 20 to 25c. per lineal foot of bridge per year.

Costs derived from the repainting of 107 bridges totaling a length of 10,824 ft. show the cost of cleaning and painting, including the cost of painting and the rental of equipment, to have averaged 99c. per lineal foot of bridge. As to methods, Mr. Miller said:

On construction the bridges in Minnesota receive one shop coat of red lead and one field coat of graphite paint. These structures should receive their next coat of paint before the red lead is uncovered. However, most steel bridges in the past have been left to deteriorate until even most of the red lead has disappeared. Such cases should be either spot-coated with red lead, or, if all the original red lead has disappeared, should receive a first coat of paint. It costs in the neighborhood of $6 or $8 per gallon for labor in painting steel bridges. Therefore, it is an easy deduction that the longest-lived paint is the most economical. We have made a practice of preparing steel surfaces for painting by thorough scraping, wire brushing and cleaning. The sand-blast method has not been resorted to because it requires a bulky field equipment, is expensive, is no better for the preservation of the steel than thorough cleaning, and because, when deterioration has gone so far that more effective cleaning than scraping and wire brushing is needed, the structure is generally beyond salvage.

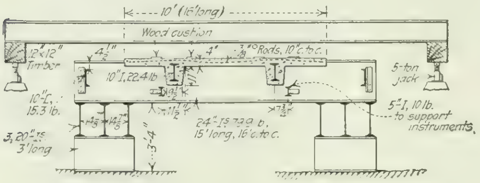
Floor Strengthening—Many bridges in Minnesota that are now inadequate can be made to give long service at moderate cost by carefully planned reinforcement, the author said. A bridge capable of carrying 10 tons safely should not be considered dangerous except on a heavily traveled trunk road, but all lighter bridges should be posted for their safe load capacity. The most common weakness is found in the bridge floor, and frequently this can be removed by substituting a smooth, stiff floor, laying additional stringers or new stringers when needed.

We have had marked success with a new 3-in. or 4-in. subfloor laid diagonally and a new 2-in. oak wearing course laid longitudinally. The life of such new floor may be increased by creosoting the subfloor and by treating the tops of the wooden stringers or nailing strips with brush coats of creosote oil mixed with tar and sanding immediately. If the main structure will carry a heavier floor, a creosoted subfloor and 3-in. creosoted block wearing floor will give excellent and economical service.

The cost of reflooring as described, based on the records of the past year, is $7.82 (including 3 x 12-in. subfloor, 4 x 6-in. wheel guards, 2 x 10-in. longitudinal oak wearing surface, and treatment of subfloor, wheel guards, and top of oak floor). This figure is based on unit prices as follows: 3-in. bridge oak, $54 per M; 3 x 12-in. fir, S1S1E, $56 per M; graphite paint, $1.65 per gallon; red lead paint, $3.60 per gallon.

Tests of Steel Floor Joists With Concrete Encasement

TESTS of two steel floor panels such as would be used in a building were recently carried out at the plant of the Dominion Bridge Co., Montreal, for the steel fabricators' section of the Canadian Manufacturers Association, to determine the effect of the concrete floor slab and beam encasement in reducing the stresses in the steel and thereby increasing the carrying capacity of the floor. The conclusion was reached that the concrete reduces the steel stress by about 36 per cent under dead- and full live-load. With a live-load 50 per cent above normal the steel stress was 20 per cent lower than under full live-load in a panel without the strengthening action of the concrete, and even twice the normal live-load resulted in a lower flange stress in the steel beams than was produced by normal live-load in the panel without concrete encasement. In these comparisons, the dead-load was the same in both cases, the load on the panels without encasement being made equal to the total dead- and live-load on the concrete-encased panels. Thus, the results indicate what proportion of the strength of the finished panel is ignored when the strength calculation is based on the resistance of the steel beams alone, as is now current practice.



CROSS-SECTION OF TEST PANEL WITH CONCRETE SLAB AND BEAM ENCASEMENT

Two identical test panels were built, each 15 x 16 ft., composed of a 24-in. I-beam 15 ft. long on each side, as floor girders, and two 10-in. by 22.4-lb. I-beam joists framed into the webs of the girders with span of 16 ft. and spacing of 5 ft. The ends of the 24-in. I-beams were connected by 10-in. by 15.3-lb. channels. Two 5-in. I-beams just below the joists provided supports for strain gages. In the first part of the tests, loads were applied direct to the steel panel, which was supported on grillages under the girders at the four corners; in the second part of the tests a 4-in. reinforced-concrete floor slab 10 x 16 ft. was constructed in the middle part of the panel, over the two joists. The slab concrete was carried down around the joists to a depth of 2 in. below the bottom flanges, with a bottom width of $9\frac{1}{2}$ in. and a top width (at under side of slab) of $11\frac{1}{2}$ in.

The slab thus represented normal construction for a width of two 5-ft. panels. The steel weight (joists only) represented $4\frac{1}{2}$ lb. per square foot of floor, and the concrete weight 71.9 lb. per square foot of floor, a total of 76.4 lb.

Before concreting, stress and deflection measurements were made under loads of about 75 lb. per square foot and 185 lb. per square foot, the latter representing a 110-lb. live-load combined with full dead-load (taking account of the weight of the concrete floor). The measured stresses in the joist flanges agreed closely with the calculated stresses of about 6,300 and 15,500 lb. per square inch respectively, showing the general reliability of the method used.

After the concrete had been poured and allowed to set for 23 days, the flange stresses in the beams were again measured, and were found to check the results on the bare panels under a load corresponding to the concrete load, when allowance was made for the extra weight of the forms. Tests were then made under superimposed live-load of 110, 165, and 220 lb. per square foot. The live-load flange stresses in the joists under these loads were found to be 2,750, 5,100, and 7,600 lb. per square inch respectively. The combined dead- and live-load stresses therefore were: For full live-load, 9,530 (as against 15,500); for $1\frac{1}{2}$ times full live-load, 11,880; and for double live-load, 14,380 lb. per square inch, which is about 1,000 lb. per square inch less than the stress with only half as great a live-load in the bare condition of the panel.

It is planned to make further tests on the two panels to see whether vibration will affect the strength of the steel-and-concrete combination.

Strength of Steel Ropes on Sheaves

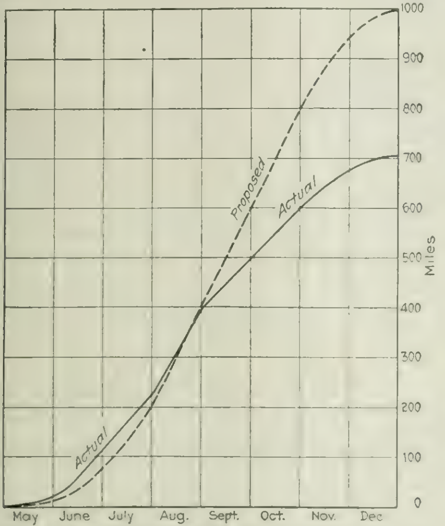
IN A SERIES of tests on plow steel wire hoisting ropes recently carried out by the Bureau of Standards and reported in "Technologic Paper" No. 229, the reduction of strength due to a rope being bent over a sheave was specially investigated. Ropes of $\frac{5}{8}$ in. to $1\frac{1}{4}$ in. diameter were tested, all of them being 6x19, with jute or manila rope cores. Pieces of straight rope 6 ft. long were tested in direct tension, while for the sheave tests 12-ft. lengths were passed over two sheaves attached to the head and their ends connected by turnbuckles attached to sockets. The test results were quite consistent. The straight rope showed fairly uniform efficiency (strength of rope divided by aggregate strength of wires) of about 85 per cent. The efficiency of the rope bent over sheaves ranging from 10 in. to 18 in. in diameter, based on the strength of the straight rope, ranged from 96 to 76 per cent, showing regular decrease as the ratio of size of sheave to size of rope decreased. Rated on the basis of the strength of the wire, the strength of the rope on sheaves ranged from 82 to 66 per cent. The wire of these ropes had a tensile strength of about 230,000 lb. per sq.in., with elongation about 2 per cent in 8 in., and reduction of area about 46 per cent. In agreement with previous test results it was found that the tensile strength of the straight rope may be expressed by the formula $83{,}000d^2$, where d is the diameter of the rope in inches.

All of the rope tests showed a bend in the load-elongation curve at about two-thirds the ultimate strength. Below this point the modulus of elasticity (based on total, not on elastic, elongation) was about $8\frac{1}{2}$ million pounds per square inch. High loads were found to have a decided effect in compressing the rope core and squeezing out of the lubricant contained in the core, and the report states "the one heavy load would squeeze out more of the lubricant from the interior of the rope than the working load applied many times. This lubricant cannot be easily replaced. Under the ordinary working load the lubricant would be squeezed out very slowly even if the load were to be repeated a great many times."

Ohio Highway Mileages in 1922

By J. Perry Shumaker
Chief Engineer, Bureau of Construction,
Ohio Department of Highways and Public Works, Columbus, O.

A SIMPLE diagram of paved road construction in Ohio in 1922 brings out clearly the effect of strikes and embargoes on progress. When the construction season opened in 1922 the Bureau of Construction found that it had 330 miles that had not been accepted during the previous year. After checking up on the amount of money that was available for 1922 it was determined that the total miles under construction would be around 1,000 miles. The total actual miles were 1,044.



ROAD CONSTRUCTION PROGRESS IN OHIO IN 1922

Before a graph was drawn it was necessary to know the status of the 330 miles carried over and how early new work could be gotten under contract. April 15 was selected as the average date of all highway awards for the year, but what actually happened was that May 15 became the average date and this retarded the actual completion.

The Department was able to keep up with the proposed mileage until Sept. 1. On July 1 the curve of proposed completion had been beaten by 30 miles, on Aug. 1 the work was 20 miles ahead and on Sept. 1 it was four miles behind.

Miller Would Improve Manhattan Traffic

Widening of some streets in the most congested areas, extension and connection of others to provide more north and south traffic lanes, pedestrian subways at points of greatest congestion and the revision of elevated structures and surface lines to provide increased ease in traffic, are essential features of a comprehensive plan for relieving traffic congestion in Manhattan, New York City, made public April 30 by Julius Miller, borough president. Specific streets together with the character of improvement contemplated, are given in the plan which Mr. Miller will soon lay before the Board of Estimate for authority to carry into effect. One of the engineering features involved is the removal to curb lines of columns supporting the "L."

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Steel Stresses and Bad Work

Sir—Accustomed to excellent editorial counsel from the *News-Record*, one feels a distinct shock at reading advice that invites disaster. It is in the last paragraph on page 653:

"The structural profession owes it to itself to place its work on a stress basis free from allowance for bad work, and then to fight hard for elimination of bad work." Let the structural profession eliminate bad work as far as may be, and *then* make such changes in their stress basis as they can justly have a right to make. **H. F. Dunham.**

New York, April 18.

Tightening a Bridge Member by Heating and Upsetting

Sir—Your issue of Mar. 22 contains an article "Tightening Tension Bars of a Bridge by Heating and Upsetting." It is no wonder to me any more why the general public refuses to recognize engineering as a profession, and classes the bridge engineer with stationary engine drivers, or plumbers, or carpenters. It seems to me that it is high time for the editorial staff of *Engineering News-Record* to apply the microscope of criticism to some of the stuff appearing in its pages.

If a mechanic or a plumber had tightened the tension member of a bridge in the manner described, it could be said with justification that he didn't know any better, but for a technical organization to countenance any such quackery goes beyond the range of patience. All the years of patient teaching, scientific research and careful preparation of specifications are thrown into the discard when such things are done—and called "ingenious." The general public and many young—old, also—engineers without experience see such things published in a publication of the standing and reputation of *Engineering News-Record* and take it for granted that there can be nothing technically wrong with the method; if there was, it wouldn't be published. Having seen, or having read about its being done in one case, on an unimportant structure, he is liable to attempt to do something of the same nature on an important structure, with disastrous results and consequent condemnation of the whole profession by the public.

If you could tighten the tension members of a bridge by any such method as that described, and get away with it, it would be just as logical, just as sensible—or just as ridiculous and absurd—to attempt to shorten the length of a compression member by heating and putting a kink in it. It wouldn't take a bridge engineer or a testing machine to tell what results to expect.

I know of one case where a so-called engineer took the plans for a 75-ft. wooden truss highway span and lengthened it out to 84 ft. in the field, and came back to the office glowing with the feeling that he had done something brilliant. When his action was condemned, he couldn't understand what was wrong, and I do not believe he understands yet what was wrong, although the structure had to be taken down and replaced at heavy expense a comparatively short time afterward. In another case, a so-called engineer in an executive position caused the erection of a structure which he called a Howe truss highway bridge of about 60-ft. span without taking measures to transfer the shear of the web diagonals to the chords. When it failed by sagging soon afterward and had to be repaired at heavy expense to the public, he couldn't understand what was wrong with it, and when told what was wrong with it, in somewhat caustic language, he said: "Well, I only took an hour to design that bridge, and maybe I did overlook something!" He was told that he had better take two hours the next time.

The question has been asked a good many times in the last few years, what is the matter with the engineering profession? The question is easily answered. It is the engineers themselves. When the time comes that engineers as a whole recognize the undeniable fact that engineering as a profession is an assembly of specialties; that no one engineer is big enough or brainy enough to be any where near proficient in them all; that it is just as criminal for an engineer to attempt to design a bridge, or to monkey with a bridge, without having had the necessary training and experience, as it is for a medical practitioner to attempt to perform an intricate surgical operation without having had the necessary arduous years of training and experience as a surgeon, then and not till then will the engineering profession get on solid ground and be recognized as such. And the whole proposition is solely up to engineers themselves. No layman is going to help them out of the morass or bog.

OLIVER A. HALL,
Designing Engineer, Alaska Road Commission.
Juneau, Alaska, April 12.

Sir—Thank you for the copy of Mr. Hall's comment on my account of the method of tightening the truss diagonals on the Millport bridge over the Muscatatuck river, or heating and upsetting, which you published in your issue of March 22. We of course recognized the possible danger from the method used and took corresponding precautions. The results justified our efforts, to the best of my knowledge and belief.

WM. J. TITUS,
Bridge Engineer, Indiana Highway Commission.
Indianapolis, April 23.

The "Mystery" of the Hot Bolt

Sir—A few days ago, when in Atlanta, I was informed that there was a mysterious thing which I ought to see, on a bridge across the railroad near Union Station. It has puzzled the people for some time, and I was told that no one seemed to have any explanation of the phenomenon. The mystery was a bolt at the head of the stairway leading from the railroad track level to the bridge, which was said to be always hot, so hot that one cannot hold the hand on it for more than a second or two.

On the cast iron newel post at the head of the stairs there is a small lug through which a bolt passes. This bolt connects the gaspipe handrailing to the newel post. The location of the greatest heat is in this lug. The bolt passing through the lug is, of course, hot. The lug is almost hot enough to light a match by mere contact. The popular explanation is that the strain on this bolt is excessive. Another is that expansion and contraction cause the heat, by friction. Before seeing the thing I had concluded that the heat was due to stray current from the street car rails on the bridge.

I purchased a combination voltmeter and ammeter and tried this, making contact with the newel post and the hot bolt. The instrument registered twenty amperes of current shunted through it. Of course the current passing through the lug was probably several times as large as this. No doubt the cause is poor bonding of the rails on the bridge and the shunting of the return current, that should go through the rails, through the steelwork of the bridge and into the ground by way of this stairway. The reason for the heat is the high resistance of the small cast-iron lug and the poor electric contact where the bolt passes through the lug.

Other bolts in the connections of the handrailing were found to be warm. The handrailing, near the foot of the steps, turns and connects to a building; possibly it has electric contact with the steelwork of the building.

The only mystery about the thing is why it should have remained an alleged mystery for more than a day. But the case offers a cogent reason for the most careful kind of bonding of trolley rails, especially in the neighborhood of a steel or reinforced-concrete bridge, for powerful effects such as this are apt to work havoc with the strength of a bridge, either by electrolysis, where moisture exists, or by the generation of heat, as in this case, if the point of resistance should be a vital connection.

EDWARD GODFREY.
Pittsburgh, April 17.

Old Concrete Road in Mississippi

Sir—The article in *Engineering News-Record,* April 5, p. 619, with regard to a section of concrete road near Mason City, Ia., laid in 1913 and still giving good service, reminds me of a section of concrete road in Lee County, Mississippi, which was laid in 1914 and is still giving good service also. This pavement was constructed 9 ft. wide with a 3-ft. gravel or crushed stone shoulder on each side. The mix was 1:2:3, and wire mesh reinforcement was used in a few places on fills.

The writer who was the engineer on the work when the road was constructed, inspected this pavement about two years ago and there were not more than half a dozen cracks in the whole 12-mile length. Transverse joints were placed at about 30 ft. intervals during construction, and I might add that I am a firm believer in transverse joints and reinforcement for any concrete road pavement.

I think this was one of the first concrete roads of any length to be constructed in the South. My recollection is that one short section had been laid near Atlanta, Ga., at an earlier date.

LANDON G. SMITH,
Bridge Engineer, Alabama State Highway Department.
Montgomery, Ala., April 13, 1923.

Engineering and Public Health

Sir—The address by M. N. Baker on "Engineering and Public Health" printed in *Engineering News-Record* for March 15 was of keen interest to sanitary engineers and especially to public health workers.

It is a forgivable since unpreventable fault of specialists in any line to over-emphasize the value of their objectives. Actual accomplishment of these objectives, such, for instance, as removing pollution from streams or cleansing water supplies, has been difficult enough in many cases to warrant some lack of perspective in order that a decently effective program might be put through. But, as Mr. Baker brings out in his suggested definition, engineering should remain engineering and should not be colored by unbalanced enthusiasm or develop into uneconomical propaganda.

Many will recall the courageous action in 1910 of Dr. Porter, then State Commissioner of Health, and Theodore Horton, engineer of the State Department of Health, in approving plans for sedimentation, only, of the sewage of Rochester in the face of protests by a large section of the press, some of the university professors and many of the citizens of that city who seemed keyed up to demand sewage treatment of the *n*th degree. The experience at Rochester since then has amply justified the sound engineering judgment of Messrs. Kuichling, Fisher and Skinner, and the city could at any time, now, if necessary, build extensions to the plant to provide almost any degree of purification with the interest and operating funds saved since the plant was constructed.

The pendulum in sewage treatment has been steadying in recent years but there appears to be some disturbances lately with the danger that several large cities may eventually find themselves unnecessarily overburdened. Such situations do not tend to insure the maximum of progress.

Rational treatment of sewage and the safeguarding of the quality of public water supplies must and will extend rapidly in the near future. The value of such improvements should not be overshadowed but I believe with Mr. Baker that a balancing of budgets to give greater prominence to city planning, proper housing conditions and conveniences for community comfort and recreation is seriously worth while.

H. BURDETT CLEVELAND.
New York City, April 20.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The Oregon Short Line R.R. Co., has applied to the I.C.C. for authorization to construct a line 27 miles long from Orchard to Perkins in Ada County, Idaho.

The Westinghouse Electric Manufacturing Co. has announced the award to it of a $15,000,000 contract for the electrification of 215 miles of the Virginian Ry. between Roanoke, Va., and Mullins, W. Va.

One Hundred and Fifty-One Miles of second track between Seligman and Needles on the Santa Fe will be opened on May 15 and 69 miles betweed Bagdad and Daggett will be ready by Sept. 1.

Legislation Exempting Engineers and surveyors who are solely officers or employees of a corporation engaged in interstate commerce from the provisions of the general business law for licensing engineers and surveyors, has been introduced into the New York State Legislature.

During the Fiscal Year Ending April 9, 1923, the St. Louis Board of Public Service awarded contracts for public improvements totaling $5,850,569.30 compared with $2,802,757.93 the previous year. During the year 35 public lettings, embracing 214 improvements, were held.

Completion of its Program for Double Tracking from Omaha to Ogden, Utah, during 1923 is planned by the Union Pacific R.R. The road will also make minor extensions, improve existing tracks and buy new equipment; the whole program to call for an expenditure of $40,000,000.

Two Hundred Miles of Double Track will be provided by an agreement which is being made between the Southern Pacific and the Western Pacific railroads. By the agreement this length of parallel single track lines in Nevada will be consolidated into a joint section of double track.

Work Will Start at Once on the elimination of grade crossings in that part of Philadelphia lying south of Christian St., between the Schuylkill and Delaware Rivers, a compact between the city of Philadelphia and the railways operating in South Philadelphia concerning such work having been completed.

A 2,000,000-Bushel Grain Elevator at St. Louis, costing about $1,100,000, is the largest single item in the approved program for improvement work on the Missouri Pacific R.R. during the present year. Next to this comes $927,000 for shops and engine terminal extensions at St. Louis, Mo.; Wichita, Kan.; Ossawatomie, Kan., and Van Buren, Ark. Other improvements involve about $1,500,000.

Secretary of War Allocates River and Harbor Fund

Definite allotment was made April 24 by the Secretary of War of funds for river and harbor improvement provided by the War Department Appropriation Act approved June 30, 1922. Total allotments are $40,463,280. There is reserved for contingencies a sum of $16,126,630. These two sums make up the total appropriation of $56,589,910 provided by the 1923 act. Following is a list of projects each of which will receive more than $500,000:

1.	Ohio River lock and dam construction	$5,000,000
2.	East River improvement, N. Y.	2,700,000
3.	Delaware River, Philadelphia to the sea	2,000,000
4.	Monongahela River, Virginia and West Virginia	1,600,000
5.	Houston Ship Channel, Texas.	1,100,000
6.	Chesapeake and Delaware Canal	1,000,000
7.	Staten Island Sound	1,000,000
8.	Mississippi River, between Missouri River and Minneapolis	900,000
9.	Coos Bay, Oregon	900,000
10.	Columbia and Lower Willamette Rivers	900,000
11.	Savannah Harbor	850,000
12.	Southwest Pass, Mississippi.	800,000
13.	Harbor at Sabine Pass and Port Arthur Canal, Texas.	800,000
14.	Mississippi River between Ohio and Missouri Rivers	800,000
15.	Waterway, Mississippi River to Bayou Teche	675,000
16.	Wilmington Harbor	600,000
17.	Jamaica Bay, N. Y.	600,000
18.	Los Angeles Harbor	575,000
19.	St. Mary's River, Mich.	550,000
20.	Baltimore Harbor and channels	520,000
21.	St. Johns River, Jacksonville, Fla.	500,000

Am. Soc. C. E. Pledges Support to Building Conference

The American Society of Civil Engineers, through its secretary, on April 20, sent the following telegram to Herbert Hoover, Secretary of Commerce:

"In view of the unusual conditions in the building trades the board of direction of the American Society of Civil Engineers has authorized me to assure you of its sincere wish to be of any service within its power in case you desire to call a conference of representatives of interested organizations which we are advised you are contemplating."

Carquinez Straits Bridge Permit Granted by War Department

The War Department has granted the Rodeo-Vallejo Ferry Co. permission to construct a cantilever bridge across Carquinez Straits between Vallejo and Valona, Calif. This is in accordance with the application noted in *Engineering News-Record* March 22, p. 557. Permission was given to construct the preferred type, a cantilever bridge which calls for a central pier and two 1,100-ft. spans. Work is to be started at once, it is announced, and the completion is expected by July 4, 1925. The cost is estimated at $4,000,000.

Illinois Opinion Divided on Good Roads Issue

Proposed Hundred Million Bond Issue Fought By Commercial Interests —Pay-As-You-Go Policy

Engineering News-Record Staff Report

Good roads advocates in Illinois, formerly working together, are now divided into two camps over the proposed $100,000,000 bond issue. It is an administration measure and as such has assumed political as well as financial and engineering aspects. In general the automobile, banking, financial and large commercial interests are aligned against the state officials, downstate politicians, farmers and residents of the smaller towns, who have become impatient because of the necessary slowness in constructing the 4,800-mile road system authorized, with the $60,000,000 bond issue, in 1918. This is an unusual situation. Commonly it has been the farmer and rural town taxpayer who this winter has been attacking extended expenditures for roads. In this instance a definite reaction against providing more funds has come from those who are usually keenest for highways—the financial and commercial interests.

PAY-AS-YOU-GO PLAN

The bankers, who are leading the opposition, have worked out a pay-as-you-go, 5-year financial program, which, including the $43,000,000 not expended of the $60,000,000, will provide $112,000,000 and build the remaining 3,000 miles yet to be constructed of the original 4,800-mile trunk line system, laid down in 1918. Further, 600 miles of paved road can be constructed annually, about the maximum, the bankers feel, which can be constructed without seriously clogging transportation facilities and material production and without interference with both farm and industrial labor. In respect to the fact that the proposed $100,000,000 issue contains $70,000,000 for additional mileage to the system, as now laid out, the bankers state that it is too early to determine whether this mileage cannot be built by the pay-as-you-go plan.

Statements of the administration, as expressed by Frank T. Sheets, superintendent of highways, indicate that the state contemplates building 1,900 miles in 1923 and 1924, exhausting the available funds aside from current revenues and still leaving 1,200 miles of the 4,800-mile system uncompleted. Current revenue, he admits, will finish the system but on such a slow program that the final mileage will not be completed before 1929. Mr. Sheets does not believe Illinois is justified in waiting so long, nor that 4,800 miles is an adequate mileage. He therefore proposed a $100,000,000 bond issue for an accelerated and enlarged program, to be completed in the same time as the 4,800 mile system would be finished. This program would embrace a system

(Concluded on p. [illegible])

Cabinet Defers Action on Girand Power Project

Immediate Action on License Application Denied—Arizona Protest Is Disregarded

Washington Correspondence

Discussion of the Girand project at Diamond Creek on the Colorado River at the cabinet meeting on April 20 resulted in a decision that no action be taken at this time on the application for license. This led the Federal Power Commission, at a meeting on April 23, to deny the plea of Mr. Girand for immediate action, as reported in these columns last week. It had been pointed out to the Cabinet officers composing the Federal Power Commission by the members of the commission's staff that all provisions in the Colorado River compact could be made conditions in any license issued for the Diamond Creek development. The action was taken with full knowledge that the Arizona legislature while in session had telegraphed the commission protesting vigorously against withholding action on the Girand application and stating that any such action on the part of the Federal Power Commission would be regarded as intolerable conduct in that it constitutes an effort of the federal government to coerce a sovereign state.

Discussion of Policy

The Federal Power Commission first took up the discussion of its Colorado River policy at a meeting April 19. At that meeting, L. Ward Bannister, an attorney representing the Governor of Colorado, told the commission that Colorado is radically opposed to the granting of the Girand license until the Colorado River compact has been ratified. He said his state's experience in the cases of Kansas vs. Colorado and Wyoming vs. Colorado had been so unfortunate that Colorado is not willing to risk any further interstate litigation if it can be avoided. He declared that the doctrine of an equitable division of water on which the compact was based is much sounder than the doctrine of prior appropriation of water and nothing should be allowed to interfere with the prompt application of the doctrine set up in the compact.

Senator Kendrick, of Wyoming, told the commission that the entire history of irrigation in the West had been one of litigation. More money, he dclared, has been spent in lawyers' fees than in project works. So as to prevent any repetition of irrigation litigation, in the development of the Colorado River, he urged that no chance be taken in granting the Girand license. Senator Cameron, of Arizona, strangely enough, also opposed the Girand project on the ground that Arizona would be more greatly benefited by the Stetson project, which provides for a 1,200-ft. dam at Boulder Canyon, which would flood out the proposed Diamond Creek dam.

In the face of the very determined opposition voiced at the April 19 meeting, and in deference to his fellow-member of the commission, Secretary Work, who strongly sympathized with Colorado's contention, Secretary Weeks, the chairman of the commission, was willing to forego his own judgment that the Girand license should be granted and suggested that the policy be threshed out at the Cabinet meeting on the following day. Members of the power commission's staff made it very clear that in their opinion the only valid argument against granting the Girand license is that the delay holds a club over Arizona. They do not share the optimistic opinion expressed in some quarters that a special session of the Arizona legislature will be called and the compact ratified promptly.

The determination of the commission not to act on the Girand license applies with equal force to other Colorado River projects. Despite the very urgent plea made by Utah interests, and by the state itself, the commission has declined to take action on the preliminary permit asked by the Utah Power and Light Co., covering its Flaming Gorge project. The permit is essential to the work of exploring foundations and to the preparation of plans. The demand for power in Utah is growing at such a rate that a delay in the development of Flaming Gorge may make necessary the erection of steam plants at Salt Lake City, an alternative which is strongly opposed both on account of the higher rates which consumers would have to pay, and because of the aggravation of the smoke problem which would follow the erection of a large power plant.

Apparently, too, the Flathead Lake power project is enmeshed in delay and uncertainty comparable with the Colorado River situation. The staff of the Federal Power Commission urged at the April 23 meeting of the Commission that the Rocky Mountain Power Co. be given a preliminary permit, abundantly safeguarded to protect the interests of the State of Washington, so that it could do the preliminary work necessary to the 270,000-hp. development planned at the outlet of Flathead Lake. The commission decided, however, to withhold action until the special commission appointed by the Secretary of the Interior, to investigate the Columbia Basin plan, should report.

Zoning Restrictions Held Invalid

A decision rendered by the Fifth Court of Appeals of Dallas, Tex., on Apr. 13, held invalid a section of the city building ordinance which prohibits the erection of business buildings in residential districts. The case was brought before the court on appeal from the decision of a district court which granted a mandatory injunction compelling the city to issue a building permit which it had refused because of the restriction mentioned. The decision followed a prior Supreme Court decision in which it was affirmed that "it is not the law of the land that a man may be deprived of the lawful use of his property because his tastes are not in accord with those of his neighbors." The city is planning to appeal the case to the State Supreme Court.

N. Y. C. Would Extend Line

The Kanawha and West Virginia R.R. and the New York Central R.R. have applied to the Interstate Commerce Commission for authority to construct an extension of the line of the Kanawha and West Virginia R.R. from its present terminus at Swiss, eastwardly up the Gauley River, to the mouth of Meadow River, a distance of twenty miles, thence southwesterly up Meadow River to a connection with the Sewel Valley R.R. near Nallen, a distance of nine miles.

Newcomen Society Officer Is Guest at Loree Luncheon

L. F. Loree, president of the Delaware & Hudson Company, gave a luncheon in New York City April 20 in recognition of H. W. Dickinson, honorary secretary and treasurer of the Newcomen Society established in England two years ago for the study of the history of engineering and technology. Besides Mr. Dickinson, the luncheon guests included some twenty-five editors and publishers of technical papers and representatives of engineering societies. Among the after-lunch speakers were H. R. Towne, past president, Am. Soc. M. E., and president of the Yale & Towne Manufacturing Co.; W. L. Saunders, past president, A.I.M.E., and chairman of the executive board of the Ingersoll-Rand Co.; David Beecroft, editor, *Automotive Industries;* and Fred Low, editor, *Power.*

The object of the Newcomen Society is to collect and distribute among its members information regarding the history of engineering and technology and to act as a channel of communication between members who are engaged in this kind of historical research; to collect and preserve technical and biographical material, including illustrations relating to engineering work and industrial processes; and to form by collaboration among its members a card index of published information on the history of engineering and technology.

Membership in the society is open to all persons interested. The membership fee is £1 a year. Further details may be obtained from Mr. Dickinson, whose address is The Science Museum, London, S.W. 7, England.

Progress on American Falls River Project

The American Falls Reservoir district in Idaho on the Snake River will vote May 12 on a proposal for $2,700,000 bonds to finance the district's share in the construction of the dam. The storage required by the district will be 300,000 acre-ft. With the subscription of the district a reservoir of 900,000 acre-ft. is assured. An appropriation by Congress of $1,000,000 for expenditure by the U. S. Reclamation Service is available if expended before July 1. In consequence the district is making an effort to complete the election and confirmation of bonds in time to permit the $1,000,000 to be spent. This money will be used largely for right-of-way.

Los Angeles Union Depot Case in U. S. Supreme Court

The California Railroad Commission has filed a petition with the U. S. Supreme Court for a writ of review in the Los Angeles Union Terminal and grade crossing elimination case. The California Supreme Court ruled that the Railroad Commission had no jurisdiction to order the construction of a union terminal in Los Angeles for the three interstate railroads entering that city. The Commission contends that it has jurisdiction and is appealing to the United States Supreme Court to set aside the decision of the California Supreme Court. The case was noted in *Engineering News-Record* Dec. 22, 1921, p. 1039.

Antioch Water Case Revived in New Form

Another action to adjudicate the rights of the delta and upriver water users on the Sacramento and San Joaquin Rivers has been started by the filing of a suit by the Holland Land Co. and more than a hundred other plaintiffs against the Williams Irrigation District and some five hundred other users of Sacramento and San Joaquin river waters. The suit is similar to the Antioch suit noted in *Engineering News-Record* March 24, 1921, p. 513, and Oct. 5, 1922, p. 579 but in the new case the opposing interests are the rights of irrigators on the deltas and lower reaches of the river against irrigators farther upstream.

More than 400,000 acres are affected by the suit, all important tributaries of both the Sacramento and San Joaquin rivers are involved and the action specifically includes practically all important users of water in the upper river district.

This suit was instituted after it had become apparent that no success would attend the original Antioch case in which the plaintiff alleged that heavy diversions of water upstream caused salt water from the bay to pollute the Antioch municipal water supply. Antioch lost the fight in the State Supreme Court when that court reaffirmed a previous decision denying the city an injunction to restrain the Williams Irrigation District and other defendants from diverting water. A new move was then instituted by intervenors and delta land owners, in an application for permission to include 6,000 new defendants in the action, but this move lost when the Superior Court of Alameda County denied the motion.

Grade Separation Is Ordered at St. Louis

The Missouri State Public Service Commission on April 9 ordered the elimination of the grade crossing of the Wabash R.R. at Delmar Ave. in St. Louis. The separation will be made by track depression rather than by track elevation as proposed by the railroad. The cost, estimated to be $538,000, will be borne 40 per cent by the city and 60 per cent by the Wabash R.R. Co. This is the first step in a more comprehensive plan for doing away with five important grade crossings on the Wabash in St. Louis, and is the result of nearly twelve years of discussion.

Minnesota Road Program Held Up

Minnesota's highway program has received a setback due to the failure of the recently-adjourned legislature to provide for a $10,000,000 bond issue this year and for a like issue next year for trunk highway improvement. The highway department will now have only the proceeds of the motor vehicle tax for construction and maintenance. This year the sum expected is about $6,700,000. Of this only $1,000,000 will be usable for new construction, but an equal amount will be obtained from the federal government. Of this $2,000,000, three-fourths will be applied on contracts let last winter.

Defeat of the $20,000,000 bond proposal will necessitate a reduction in the highway department's force at its St. Paul headquarters and in the field.

Columbia Basin Project Field Work to Be Begun

Definite steps are to be taken during the coming week in the investigation of the Columbia River Basin reclamation project in Washington. Assistant Secretary of the Interior Goodwin, a member of the commission named by the Secretary of the Interior to conduct the investigation, will leave for Spokane, Wash., within the next few days where he will meet Director A. P. Davis, of the Reclamation Service, for the purpose of outlining plans for the field work. Four field investigators have been named to meet with the two commissioners in the field. Following this conference the field investigation will be started and will be continued until all necessary data have been compiled for the proposed irrigation of the Columbia River Basin. These field investigators are Homer J. Gault, engineer in charge of the Reclamation Service; Kirk Bryan, geologist of the Geological Survey; Glenn L. Parker, hydraulic engineer of the Geological Survey, and A. T. Strahorn, soil expert of the Department of Agriculture.

South Carolina Reorganizes Highway Engineering Force

The engineering forces of the South Carolina State Highway Department were generally reorganized at a meeting of the State Highway Commission here, the changes made by the highway engineer, Charles H. Moorefield, being confirmed by that body. The changes were made possible by the appropriation of more money by the general assembly for the department.

The new organization will be as follows: N. S. Anderson, chief of construction; Ambrose Harwell, chief of maintenance; W. C. Cathey, E. D. Sloan, J. M. Martin and W. K. Beckham, division engineers, having charge of the four districts into which the state is divided; Robert King, equipment engineer and J. C. Perrin, resident engineer.

Wilson Dam Construction Work Keeps Up with Estimate

Washington Correspondence

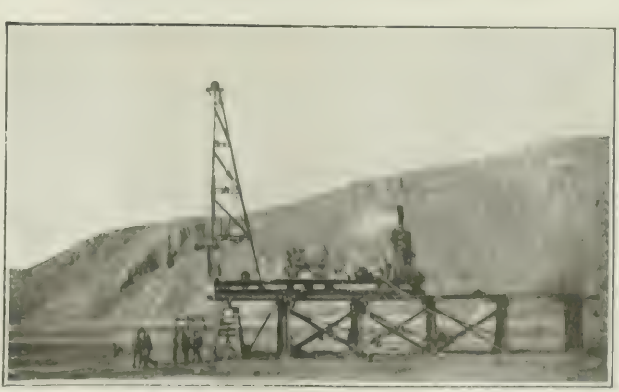
Work on the Wilson Dam at Muscle Shoals is 40 per cent complete. Progress is closely following the preliminary estimate. In March 34,586 cu.yd. of concrete were put in, of which 17,293 cu.yd. went into the dam, 17,000 into the power house, and the remainder into the lock.

Working conditions have been particularly favorable. There have been few days with rainfall enough to interfere with work, and no high water. Labor turnover has been small and the productivity of labor is much higher than two years ago. There has been no trouble in getting materials, since sand and aggregate are being secured locally by the regular working force and there has been no difficulty in maintaining an ample reserve of cement, the only material shipped in.

Wisconsin Societies to Co-operate

A recent conference of the presidents of the Engineering Society of Wisconsin, the Madison Technical Club, the Engineers Society of Milwaukee and the Milwaukee chapter of the American Association of Engineers resulted in recommending the organization of a joint committee consisting of one member from each of the the various engineering societies in the state, which committee will work on matters concerning the engineering profession in general. It has been recommended that the Wisconsin society appoint its representative, inform the other societies of its action, and take the initiative in calling together the various representatives. The president has appointed Jerry Donahue, Sheboygan, Wis., as this society's member of the joint committee. The Engineers Society of Milwaukee has also taken action and has appointed J. C. Pinney, dean of the college of engineering at Marquette University, Milwaukee, Wis.

Railroad Construction in the Bolivian Andes



CONSIDERABLE construction work is being done in South America by engineers and contracting organizations from the United States. Among New York firms engaged in South American work is the Ulen Contracting Corp. The view herewith shows a pile trestle being built in the Bolivian Andes on the Villazón Atocha Ry. When completed this line will make rail travel possible from Buenos Aires to Peru. J. B. Cameron, of the Ulen company, who furnished the picture reproduced above, is chief engineer of construction on this line.

Court Upholds Federal Assessment on Arizona Project

The assessment of $75 an acre on land within the Yuma Irrigation Project, in Arizona, which was declared by the Secretary of the Interior in 1917, was clearly in accordance with the law and the contract, according to a decision rendered by the United States Supreme Court April 30, in the case of the Yuma County Water Users Association against officials of the Reclamation Service.

The project was started in 1904. Unofficial estimates placed the cost of a dam across the Colorado River and other works at a figure which would bring an assessment of approximately $35 an acre. Great difficulties were encountered in the construction works, and the contractor abandoned the contract, which was completed by the Federal government at a cost more than double the unofficial estimates. When the Secretary issued his order assessing $75 an acre, the landowners, through their association, brought suit, claiming that $35.28 an acre was the contract assessment. The lower courts, and the Supreme Court, held that the preliminary estimates of cost were unofficial and not part of a contract.

Illinois Opinion Divided on Good Roads Issue

(Continued from p. 803)

of 7,300 or 7,800 miles, harmonizing with the 7 per cent provision in the federal aid law. Due to the increased number of motor cars over the number estimated when the former issue was put through, there is sufficient revenue to pay interest and sinking funds to amortize both old and new issues. The new bonds, like the old ones, would be 20-year serials. All the arguments developed in the eight years' campaign for the $60,000,000 issue hold for the new issue, says Mr. Sheets. The new program will establish a definite business policy for the next few years and thereby greatly reduce the overhead. Should the legislature pass the bill the people must still vote on it, the earliest opportunity being the fall of 1924, thus not making the money available before the 1925 season.

With an additional $100,000,000 for roads the bonded indebtedness of the state is greatly increased. There are now in addition to the $60,000,000 road bond issue, a $20,000,000 obligation for water-way bonds and $55,000,000 for a soldiers' bonus. While the road bonds are paid from the automobile license fees, nevertheless it is the state's credit and taxing ability which are behind the bonds. Taxes have doubled in the last 5 or 6 years. The average voter is much more responsive to demands for economy in the conduct of government than he was a few years ago. He remembers all too vividly his doubled tax.

The plan in dispute is one to submit to these voters the decision whether a debt of $100,000,000 shall be assumed not merely to complete the planned system of 4,200 miles but to increase this system by an additional 2,000 to 3,000 miles. Leaving consideration of whether a larger system is needed until another time, it seems plain that the logical action is for the legislature to put the present question before the people, who possess the right to decide and not the bankers, administration or legislature.

San Francisco Bay Bridge Contract Is Let

The Webb San Francisco Bay Bridge Co., which holds the franchise for a six-mile bridge across the south end of San Francisco Bay from San Mateo, on April 27 awarded the contract for building the bridge to the Coast Construction Co. for $10,000,000. This includes seven miles of approach roadway. The company has filed a $1,000,000 bond to guarantee faithful performance of the work which is to start immediately and is to be completed in three years. For a distance of one mile the water is 40 ft. deep and this will be bridged by a 200-ft. lift span and arches of 250-ft. span. Shorter concrete arches will be used for two half mile approaches and the remaining four miles will consist of trestle or fill. The roadway is to be 60 ft. wide.

Prof. Whipple to Retire from the Massachusetts Health Council

George C. Whipple, professor of sanitary engineering at Harvard University, has informed the Governor of Massachusetts that on the expiration of his present term of membership, May 1, on the Massachusetts Public Health Council of the State Department of Health he wishes to retire from the service. This action has been taken in order that Prof. Whipple may have more opportunity to devote to professional work on one hand and to teaching on the other.

Prof. Whipple informs *Engineering News-Record* that he has considered it inappropriate to accept any professional engagement in Massachusetts during the nine years he has been a member of the Public Health Council. Hereafter he expects to do more private work, but in so far as possible, he states, this will be done in association with other engineers rather than in competition with them, as it seems to Prof. Whipple that "this should be the true attitude of a college professor toward his engineering colleagues."

Boulevard Slide in Pittsburgh to Be Taken Into Court

Announcement by the Pennsylvania R.R. last week stated that the company will bring suit against Pittsburgh for damage and expenses caused by the Jones Hollow slide along Bigelow Boulevard two years ago. As reported in *Engineering News-Record* Nov. 25, 1920, p. 1058, the railroad temporarily lost the use of half a dozen or more tracks and was put to large expense in the emergency work necessary to keep pace with the progress of the slide and ultimately remove the material that flowed out on the tracks. After the slide was stopped, the railroad company filed a claim with the city for about $1,000,000 damages, but the city authorities tabled the claim. Subsequent conferences on the claim came to nothing, and it is now planned to settle the question of liability in the courts. The city regarded the slide as an Act of God, and considered itself absolved from liability by this fact.

Testing Materials Society Announces Program

The program for the annual meeting of the American Society for Testing Materials has just been announced. It will last from Monday, June 25, through Friday, June 29. The morning and afternoon of Monday will be devoted to committee meetings, and the first session Monday evening is on non-ferrous metals and alloys. On Tuesday there will be three sessions; in the morning, on corrosion, fatigue of metals and magnetic analysis; in the afternoon, on wrought and cast iron, coal and coke, and heat treatment, the early part of the evening being devoted to the presidential address and the latter part to an informal dance and smoker.

On Wednesday, the morning session is on steel and methods of testing and the evening session on a symposium of consistency and testing of glue. There will be no afternoon meeting. On Thursday, the morning meeting is on road materials, waterproofing and thermometers; the afternoon meeting on timber, rubber and textiles, and in the evening there will be simultaneous sessions—one on preservative coatings and the other on cement, lime, gypsum and ceramics, and nomenclature. On Friday there will be two morning sessions—one on petroleum products, electrical insulating materials, and slate, and the other on concrete. The afternoon will be devoted to a golf and tennis tournament, and the evening a final meeting at which there will be discussed a symposium: What properties of and methods of making concrete require further investigation?

Important papers to be presented include "Endurance Properties of Steel: Their Relation to Other Physical Properties and to Chemical Composition," by D. J. McAdam, Jr.; "A New Method of Magnetic Inspection," by A. V. de Forest; a topical discussion "Is It Desirable to Include Chemical Requirements in Cast-Iron Specifications?"; and studies on the use of calcium chloride in concrete.

The nominating committee has announced the regular nominations for officers as follows: President, Guilliaem Aertsen, Midvale Steel & Ordnance Co., Chicago; vice-president, W. H. Fulweiler, chief chemist, United Gas Improvement Co., Philadelphia; for members of the executive committee, J. B. Chubb, Universal Portland Cement Co., Chicago; T. G. Delbridge, Atlantic Refining Co., Philadelphia; H. L. Scott, Henry L. Scott & Co., Providence, R. I.; P. H. Walker, U. S. Bureau of Standards, Washington, D. C.

Contractor Liable for Extra Cost on Galveston Causeway

The decision of the District Court and of the Court of Appeals that the Galveston Causeway Construction Co. (formerly Larkin & Sangster, Inc.) and its surety, the United States Fidelity & Guaranty Co., must pay the Galveston, Harrisburg & San Antonio Ry. Co. and other railroads $652,626 for excess cost of the causeway connecting Galveston Island with the mainland of Texas will stand, the U. S. Supreme Court having denied a petition for a writ of certiorari April 30.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

NATIONAL FIRE PROTECTION ASSOCIATION; Boston; Annual Meeting, Chicago, May 8-10.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION, New York; Annual Meeting, New York, May 10.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Meeting, New York, May 15.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; Annual Convention, Ithaca, N. Y., June 20-23.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Detroit, Mich., May 21-25.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29.

The Société des Ingenieurs Civils de France, Section Americaine, will hold a joint meeting with the four founder societies on May 4 at the Engineering Societies Building, New York City. The occasion is the 75th anniversary of the founding of the French society.

The Utah Society of Engineers, at its regular meeting, April 18, had as its principal speaker Brig. Gen. U. G. McAlexander, U. S. Army, who spoke on the engineering features of the second battle of the Marne. Brig. Gen. McAlexander, at the opening of the war a colonel, commanded the 38th Infantry which held a pivot position at Chateau-Thierry.

The Colorado Society of Engineers at its recent discussion of municipal affairs had as its principal speaker Professor E. H. Gardner, marketing and advertising expert of the University of Wisconsin.

Personal Notes

E. P. Lamb, formerly with the Jahncke Dry Dock Co., of New Orleans, La., has been appointed district manager of the Trans-Continental Engineering Company's New Orleans office.

Charles A. Patterson, formerly town and city engineer of Torrington, Conn., has recently opened an office in the Chamber of Commerce Building, that city, to engage in the practice of engineering and architecture.

John M. Belknap, for the past seven years connected with the engineering department of the Lord Construction Co., New York City, has resigned to accept a position as resident engineer for the Terry & Tench Co. on the construction of the Bear Mountain-Hudson River bridge and highway approaches at Peekskill, N. Y.

Arthur J. Benline has reopened consulting offices at 1910 Webster Ave., New York City, where he will again practice architectural and structural engineering.

Walter Clemens Gernt, formerly with the H. J. Clemens Co., of Detroit, Michigan, has become associated with J. French Paddock and associates, Detroit, civil, architectural and landscape engineers. Mr. Gernt will act as general manager and will specialize in design and installation of waterworks, and hydraulic equipment.

Carl G. Yarling has been appointed assistant engineer of Kokomo, Ind., under Charles L. Sellers, as city civil engineer, appointment to become effective May 1. **Fred Davenport**, who was employed by the city as special engineer for the construction of the large Washington street sewer in 1921, was appointed surpervising engineer to assist Mr. Yarling in carrying through the heavy street building program already begun this year.

Col. William B. Greeley, chief forester, U. S. Forest Service, has been awarded a Distinguished Service Medal by the War Department. Col. Greeley supervised the operations of all forestry troops in France and was awarded the Legion of Honor by the French Government and the Distinguished Service Order by Great Britain.

M. C. Noble, recently appointed, chief, bureau of roads and bridges, Nebraska Department of Public Works, has been in road work in the Middle West for a number of years. He was graduated from Iowa State College, from which institution he secured a civil engineering degree, and after graduation spent a year on land drainage in Minnesota and Iowa. During the next three years he engaged in road, bridge, drainage and land surveying work in Iowa. During the war he was a first lieutenant in the Coast Artillery Corps, spending fourteen months overseas. Upon his return he was made project engineer with the Nebraska Department of Public Works and later became assistant division engineer. Previous to his appointment as chief of the bureau of roads and bridges he was division engineer with the Nebraska Department of Public Works.

Paul E. Green, consulting engineer, Chicago, has been appointed by the finance committee of the Chicago City Council to investigate and report on all street pavements laid in 1922. An appropriation of $40,000 is available for the work.

Colonel Charles Keller, whose resignation as Engineer Commissioner of the District of Columbia was noted in these columns recently, has become associated with the Byllesby Engineering & Management Corp. He is now on the ground as business manager of the El Dorado hydro-electric project, under construction by the Western States Gas & Electric Co. in the Sierras near Placerville, Calif.

H. A. Van Norman, assistant engineer in the bureau of water-works and supply of the Los Angeles, Calif., board of public works, has been appointed special consulting engineer to advise the board on sewer construction work under a recently voted bond issue of $12,000,000. Mr. Van Norman was division engineer on the construction of the Los Angeles aqueduct and later was in charge of the Owens Valley and part of the Mojave divisions where the large steel siphons were constructed.

C. N. Phillips, formerly office engineer for the Miami Conservancy District, Dayton, Ohio, has accepted a position with the Electric Bond and Share Co. of New York. Mr. Phillips was associated with the flood-prevention work for six and one-half years as field engineer in charge of preliminary surveys, and, during the construction period, as office engineer, acting as personal assistant to the chief engineer, Arthur E. Morgan, and Charles H. Paul, his successor.

Obituary

John G. Rodgers, vice-president of the Pennsylvania R.R., in charge of the northwestern region and located at Chicago, died April 11 at Camden, S. C. He was born in Philadelphia, Pa., in 1865. In 1882 he entered the service of the Pennsylvania R.R. as rodman and became an assistant engineer, but later went into the operating department.

Henry A. Young, of the consulting engineering firm of Young & Hyde, Inc., New York City, died at his home in Maplewood, N. J., April 23. Mr. Young had been engaged in the design and construction of fortifications in the United States Engineering Department, and later as engineer in the United States Reclamation Service. He was identified with the construction of the Huntley Irrigation Unit, at Huntley, Montana. In 1906 he took charge of the design and construction of a water supply system for the City of Camaguey, Cuba, and shortly after his return to New York in 1909 formed the firm of Young & Hyde, Inc.

Max Gary, the well-known German cement expert and professor, died in Berlin on April 9 in his sixty-fourth year. Prof. Gary was connected with the government testing laboratory at Dahlem, Berlin, for many years. His investigations into cement are among the best known of the German studies. He was in this country in 1912 attending the last meeting of the International Association for Testing Materials.

Dr. S. S. Wheeler, one of the founders of the United Engineering Society and former president of the American Institute of Electrical Engineers, died at his home in New York, April 20, aged 64 years. Dr. Wheeler, educated at Columbia College, New York City, was given an honorary degree of Doctor of Science by Hobart College and Master of Science by Columbia University. He was one of the early associates of Thomas A. Edison, being the designer and manufacturer of one of the first successful small motors made. At the time of his death he was at the head of the Crocker-Wheeler Co., Ampere, N. J., large manufacturers of electrical machinery.

W. J. Murphy, builder of the Arizona canal, which irrigates half of the acreage of the Salt River valley, and for years connected with railroad construction in the southwest, died at Phoenix, Ariz., April 17, at the age of 84. He was born in New Hartford, N. Y.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Asphalt Producers Confer on Fewer Varieties

Meeting at Department of Commerce Lays Foundation for Waste Elimination Program

IN LINE with Secretary of Commerce Hoover's program for the elimination of waste in industry producers of asphalt for paving work, representing a large percentage of the country's yearly output, met in a preliminary conference with the Division of Simplified Practice of the Department of Commerce in Washington April 24, endorsed the general principle of reducing excess varieties of their product, fixed May 28 as the date of a general conference of producers and users of asphalt, the latter to be represented by delegates from the principle engineering societies and specification-making bodies in the road and paving field, and recommended as a basis for discussion at the forthcoming meeting the penetration limits for asphalt embodied in the tentative specifications of the American Society for Testing Materials. The producers also agreed unanimously to submit to the Department of Commerce before the next meeting figures, in percentages of shipments during 1922, indicating the range of varieties of asphalt for road work they were called upon to produce. Last week's meeting, arranged between the Asphalt Association of New York and the Department of Commerce, followed a presentation of the case for fewer grades of asphalt and a subsequent discussion both by users and producers published recently in *Engineering News-Record.*

Needless Waste in Present Practice

The preliminary conference was attended by representatives of the leading producing companies and was opened by William A. Durgin, chief of the Commerce Department's Division of Simplified Practice, who explained the general features of Mr. Hoover's program of waste elimination in industry. R. M. Hudson, Mr. Durgin's assistant, presided at the session. J. R. Draney, U. S. Asphalt Refining Co., New York, outlined the history of attempts at reducing the number of grades of asphalt called for in road and paving specifications, emphasizing the point that in different sections of the country different penetration limits were demanded for material under identical conditions of traffic and temperature. Present practice, he stated, results in a needless waste of labor at the refineries, requires excessive storage and increases capital costs.

Supplementing Mr. Draney's remarks, Prevost Hubbard of the Asphalt Association referred to the work on simplification of grades done by the U. S. Bureau of Public Roads. the Asphalt Association, and the American Society for Testing Materials. The latter organization now has tentative specifications which confine the grades, as determined by penetration, to eight. About one-half of the country's asphalt tonnage, Mr. Hubbard pointed out, goes into paving work and the remainder into roofing and manufactured products.

Col. Compton Presents Data

As a basis for discussion, Col. R. Keith Compton, chairman, Paving Commission, Baltimore, presented the results of a questionnaire sent out in November and December, 1922, to cities and state highway departments asking for a statement of penetration limits specified for various types of asphalt pavement, including asphalt macadam, asphaltic concrete (coarse aggregate), asphaltic concrete (fine aggregate), and sheet asphalt. For asphalt macadam 33 different sets of penetration limits were reported; for asphaltic concrete (coarse aggregate), 25; for asphaltic concrete (fine aggregate) 27; and for sheet asphalt, 49. Col. Compton's figures were regarded as convincing evidence of an opportunity for simplification.

What the present demand for varieties means in the way of added expense at the refineries was explained by Herbert Spencer, of the Standard Oil Co. of New Jersey, who referred to such items as additional pumps and pipe lines, storage facilities, land and general overhead expense. The state highway departments, it was pointed out, call for a greater variety of asphalt grades than do other consumers.

Speaking for the Texas Co., William H. Kershaw told how his organization had met demands for large tonnages during 1922 with 5 standard consistencies based on a penetration scale of 40-50; 50-60; 60-70; 90-100; 115-130. In addition, another grade for paving block filler was produced. Mr. Kershaw endorsed the 8 ranges of penetration embodied in the tentative specifications of the American Society for Testing Materials.

C. N. Forrest, of the Barber Asphalt Co., Maurer, N. J., stated that the limit of accuracy of the penetration test is 4 to 5 points, so that specified ranges involving differences of one or two points are a needless refinement. R. S. Townsend, of the Atlantic Refining Co., Philadelphia, believed that six or seven asphalt grades for paving and road work, with an additional grade for block filler, would meet all reasonable requirements. L. M. Law, of the New Orleans Refining Co., told that during 1922 his organization had been able to fill 52 per cent of its orders with 5 grades of material; the remaining 48 per cent had required 20 different penetration ranges.

Engineers at Second Conference

On motion by Mr. Kershaw, it was decided to limit the scope of the proposed program for eliminating varieties to asphalt for paving, excluding road oils and surfacing materials and asphalt used for roofing. A motion also was passed putting the industry, as represented at the meeting, on record as desiring to reduce varieties of asphalt used for paving purposes.

After further discussion the meeting unanimously adopted a resolution recommending as the basis for discussion at the May 28 meeting the scale of 8 penetration limits for paving asphalt included in the tentative specifications of the American Society for Testing Materials. The penetration scale referred to is as follows: 25-30; 30-40; 40-50; 50-60; 60-70; 70-90; 90-120; 120-150; or a total of eight grades. (The first two limits have been recommended by Committee D-4 but not yet adopted as tentative.)

At the forthcoming meeting on May 28, the following organizations, in addition to the producing companies, will be invited to send representatives: American Society for Testing Materials; American Society of Municipal Improvements; American Association of State Highway Officials; American Society of Civil Engineers. In addition, it is planned to have representation from the U. S. Bureau of Public Roads, the United States Chamber of Commerce, and the engineering press.

Those who attended the April 24 meeting were: William A. Durgin and R. M. Hudson, Division of Simplified Practice, Department of Commerce; Herbert Spencer, Standard Oil Co. of New Jersey; J. R. Draney, U. S. Asphalt Refining Co.; C. N. Forrest, Barber Asphalt Co.; Prevost Hubbard and J. E. Pennybacker, the Asphalt Association; Irvin K. Giles and R. S. Townsend, Atlantic Refining Co.; Benton L. Boye, Standard Oil Co. of New York; W. H. Kershaw, the Texas Co.; L. M. Law, New Orleans Refining Co.; E. W. McCullough, U. S. Chamber of Commerce; Col. R. Keith Compton, Baltimore Paving Commission; and R. K. Tomlin, Jr., associate editor, *Engineering News-Record.*

To Sell Universal Cement by Bag Instead of Barrel

Beginning June 1, Universal portland cement will be sold and invoiced by the sack instead of by the barrel. This change, the company announces, is made only after sending an inquiry to thousands of cement buyers, including dealers, contractors, architects and engineers, large industrial concerns and others. The replies were overwhelmingly in favor of the change.

To Simplify Sewer Pipe

Washington Correspondence

A survey of types and varieties of sewer pipe, drain tile and specials, flue linings and specials and wall copings and specials looking toward elimination of excess types is to be undertaken by the Eastern Clay Products Association and the Clay Products Association. A meeting of all interests concerned will be held Oct. 22 to consider the results of the surveys. This is the result of a preliminary conference on the subject held April 23 with the Division of Simplified Practice of the Department of Commerce.

The conference decided to have the two associations make a survey of the field in the materials mentioned, using the data each now has and filling in as is required, and to submit the results to a final conference Oct. 22.

Argue Trade Data Exchange Case Before Supreme Court

Issues of Price Agreements and Trade Association Activities Involved in Government Appeal

Washington Correspondence

Arguments were presented April 25 and 26 before the United States Supreme Court in the case of the government against the American Linseed Oil Co. and others, involving the right of business to exchange trade information through associations or through private bureaus acting as clearing houses for such data. The case is considered to be the most important to trade associations since the hardwood lumber case, but it involves different questions than the latter.

The Federal government alleged that by exchanging various forms of information which were distributed as statistics by the Armstrong Bureau of Related Industries the defendant linseed oil companies created a condition tending to prevent competition in prices of their product. The United States District Court for Northern Illinois, where the suit originally was instituted in 1921, held for the defendants and ordered the suit dismissed, the government appealing.

In arguing before the Supreme Court, Special Assistant Attorney General James A. Fowler declared that daily and instantaneous price reports were sent the bureau by the linseed oil members, and relayed back to the members by the bureau, and charged that each day each member knew the prices quoted by his competitors.

Lakewood Wins Appeal on Carr Finishing Machine Patents

In an opinion just rendered by Judge Page, the U. S. Circuit Court of Appeals for the Seventh Circuit has upheld the validity of the Carr strike-off and tamper patents for concrete-road finishing machines, manufactured by the Lakewood Engineering Co., Cleveland, and has declared the Maxon finishing machine an infringement. The decision just rendered reverses the ruling of the lower court which dismissed the Lakewood Company's claims. The principals in the case were Edward G. Carr and the Lakewood Engineering Co., against Glenway Maxon, Jr. The opinion of the Court of Appeals concludes with this statement: "The claims of both Carr patents are valid and infringed, and the decree is reversed with the direction to enter a decree for an injunction and accounting."

In discussing the rival claims the Court said: "In 1920, appellee, [Maxon] a former employee of Carr, made the machine complained of and put it into use. Appellee's description of his machine shows clearly that there is no substantial difference between it and appellants' [Lakewood's] machine. The chief claim of difference is that, whereas appellants' tamper has a quick up-and-down motion, the tamper in appellee's machine drops until it comes in contact with the road, and, as the piston comes up in the cylinder, the pressure is built up and forces down the tamper until it reaches the limit of its stroke, which is the top of the form. By this alleged operation, it is urged that appellee escapes infringement of the vibratory element in appellants' claims. . . . As the whole movement [of the Maxon tamper] is made by the regular uninterrupted motion of the engine, transmitted through its crank-shaft and the piston attached thereto, the movement of the tamper must have the same regularity and cannot go down slowly and come up quickly as claimed. There is no difference between the operation of the tampers in the two machines, and we are of opinion that infringement is clearly shown."

Space for Water-Works Exhibit at Detroit Over-Subscribed

Water-works manufacturers have over-subscribed the space available for exhibits in connection with the annual convention, in Detroit, of the American Water Works Association, May 21-25. In order to take care of all applications the exhibit committee, of which George McKay, Jr., is chairman, has been compelled to reduce the amount of space desired by exhibitors wanting more than two booths.

Business Notes

Service Motors, Inc., a Delaware corporation, has taken over the business of the Service Motor Truck Co., Wabash, Ind., and will continue to build motor trucks and railroad motor coaches. This is a result of the reorganization plans started last November and is said to assure adequate capital to meet all needs for manufacturing and further expansion. Paul Moore is president and general manager of the organization.

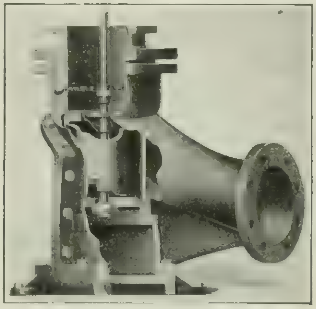
Bucyrus Co., South Milwaukee, Wis., announces the appointment of W. M. Myers as works manager, effective last month. Mr. Myers is a native of Richmond, Va., and has served with the American Locomotive Co., the Baldwin Locomotive Works and the Lima Locomotive Works. He resigned from the last named company to accept a commission as officer in the Ordnance Department of the Army in 1917. At the close of the war he was commissioned in the Ordnance Department of the regular Army and was stationed at the Watertown Arsenal.

Floyd C. Furlow, president, the Otis Elevator Co., died April 26 in New York. He was 46 years old and had been connected with the Otis company for 18 years; he was made president five years ago. He was educated at Georgia Institute of Technology and at Worcester Polytechnic Institute. For several years he pursued the profession of consulting engineer at Atlanta and at the same time was a lecturer in experimental engineering at Georgia Tech. In 1902 he was made chief engineer of the Plunger Elevator Co. of Worcester, Mass., and two years later became vice-president of that company. Mr. Furlow became chief engineer for the Otis Elevator Co. in 1906, and [illegible] after was made vice-president and then president.

Equipment and Materials

Valve for Water Columns

Absence of cup packing, direct flow of water and reduced number of parts are the main advantages of a new valve for railway water columns which has been introduced by the T. W. Snow Construction Co., Chicago. With the valve in closed position, as shown, the bottom chamber is filled with water which leaks in around the lower part of the plunger or main valve. The first downward movement of the valve rod opens the pilot valve in the bottom of the main valve thus allowing the water to escape upward but to act as a cushion as the main valve descends into the chamber. In this open position there is almost unobstructed flow from the main to the water column, as the water does not flow through or around the valve and there are no ports or by-passes to clog or freeze up. The long sweep of the curved connection is also claimed to reduce materially the friction of the water. As the valve is raised, its bottom flange tends to pocket water above it, the only escape being the tapered clearance space. In this way the valve forms its own dashpot to prevent sudden closing and consequent water hammer. A large bolted door on the water chamber enables the entire valve to be removed after disconnecting one attachment to the valve rod. The vertical pipe of the water column is seated on a ball bearing.



Welded-Flange Pipe Coupling

To prevent corrosion at exposed threads of pipe having screw flanges or couplings the National Boiler Washing Co., Chicago, has developed a joint formed by drop-forged steel flanges welded to the pipe, thus eliminating threads. In installing a boiler-washing plant for a railway roundhouse the piping is located on the plans, lengths and angles being determined accurately. Pipe is cut to length at the shop and then fitted with the drop-forged flanges, which are bored to the proper angle, heated, shrunk in place and finally welded. The faces of the flanges are ground at the proper angle to give a smooth surface for the gaskets. It is stated that with the piping thus completed at the shop there is material reduction in the time and cost of installation as compared with work where the piping is cut, bent and threaded in the field.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Average Weekly Value of April Contracts Let Over 59 Per Cent Heavier Than in 1922

Total of 794 Awards During April, Average Value $250,629 Compared With 912 in March, Averaging $263,000

Contracts awarded in the four issues of *Engineering News-Record* during April, totaled $198,665,000 as compared with $240,349,000 in the five issues of March. This represents an average weekly value of $49,750,000 for April, against $48,000,000 during the preceding month.

The number of awards totaled 794 during April, with an average value of $250,629 as compared with 912 in March, averaging $263,000 per contract.

The April weekly average, $49,750,000, represents an increase in money value of 14 per cent above the weekly average of $43,313,000, for the corresponding period in 1920. Weekly average for April, 1921 was $26,417,000.

Minimum costs observed in Constructions News on each class of construction are as follows: Water-works, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings, $150,000.

Engineering News-Record Construction Cost Index Number

May, 1923	216.70
April, 1923	213.50
May, 1922	164.62
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number advanced 3.2 points since last month, due to higher lumber and steel prices and stiffening in labor rates. Yellow pine rose $2 per M. ft. in month. Steel contract prices higher; demanding of premiums for quick deliveries, less frequent. The average rate for common labor is now 51c. Thus, general construction cost is 31 per cent higher than one year ago and 20 per cent under the peak; it is 116 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly		
April, 1923	(*4 issues of E. N.-R.*)	160
March, 1923	(*5 issues of E. N.-R.*)	195
April, 1922	(*4 issues of E. N.-R.*)	150
1913		100
Yearly		
1922 (entire year)		130
1921 (entire year)		88
1920 (entire year)		91
1913		100

Engineering News-Record's Construction Volume Index Number is 160 for the month of April, and 130 for the whole of 1922, as against 100 for 1913. This means that the actual volume of construction in 1922 (not the mere money-value of the contracts let that year) is 30 per cent above the volume of construction for 1913. Our monthly volume number, 160 for April, 1923, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

Building Interests Plan Check on Rising Costs

New York Contractors, Architects, Bankers and Others Appoint Committee of Fifteen to Act

TO DEVELOP a plan for relieving the acute situation in New York building construction caused by rapidly rising costs of labor and materials, a conference was held April 30 at the Engineering Societies' Building, at which were present more than 100 contractors, architects, bankers, real estate men, merchants and representatives of insurance companies. After a general discussion an advisory committee of fifteen was appointed to seek a remedy for conditions which threaten to halt the present construction program in the metropolitan district. With bricklayers demanding $12 to $14 a day and common labor on construction work from $7 to $8 a day, according to testimony brought out at the meeting, wages are undergoing what was characterized as a "snow-balling" process, constantly rolling up into larger sums. Cass Gilbert, architect, said that he had advised clients against building projects amounting in the aggregate to $5,000,000. A policy of discouraging new building ventures under present condi-

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING APRIL, 1923

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Canada	Total
Water-works	$152,000	$5,063,000	$1,207,000	$987,000	$934,000	$151,000	$50,000	$8,544,000
Sewers	116,000	1,672,000	251,000	2,830,000	370,000	258,000		5,497,000
Bridges	25,000	503,000	420,000	714,000	1,163,000	104,000	381,000	3,310,000
Excavation, drainage and irrigation		50,000	29,000	1,101,000	1,135,000	72,000	119,000	2,506,000
Streets and roads	451,000	4,200,000	5,548,000	6,734,000	7,712,000	2,315,000	2,681,000	29,641,000
Industrial works	4,562,000	13,490,000	673,000	7,367,000	11,605,000	5,334,000	2,750,000	45,781,000
Buildings	6,650,000	27,263,000	9,094,000	15,177,000	12,195,000	7,371,000	1,649,000	79,399,000
Federal government	46,000	1,051,000	439,000	2,276,000	314,000	1,152,000		5,278,000
Miscellaneous	1,625,000	4,857,000	275,000	2,755,000	957,000	3,978,000	4,262,000	18,709,000
Total	$13,627,000	$58,149,000	$17,936,000	$39,941,000	$36,385,000	$20,735,000	$11,892,000	$198,665,000

Cement Consumption Increases

Portland cement consumption in the Eastern states of the country between 1918 and 1922 increased 64 per cent, or from 22,963,000 to 37,688,000 bbl., according to a study just made by the Cement Information Service. The greatest increase in the use of portland cement during this period occurred in the State of New York, where shipments grew from 6,335,000 bbl. in 1918 to 13,212,000 bbl. in 1922, or an increase of 109 per cent.

The largest per capita consumption of cement throughout the Eastern states in 1922 occurred in Delaware where 1.60 bbl. per person were used; in New York the consumption per capita in 1922 was 1.23 bbl.; in New Jersey 1.50 bbl., and in Pennsylvania 1.15 bbl. Over 11 per cent of all the Portland cement consumed in the country in 1922 was used in New York State.

There were 13,055,000 bbl. of cement available at mills throughout the entire country, Apr. 1, 1923.

tions was also announced by R. H. Shreve of the firm of Carrere & Hastings, architects.

Instances of ever increasing demands on the part of labor were cited by representatives of the Fred T. Ley Co., the Thompson-Starrett Co., and George A. Fuller Co., Marc Eidlitz & Sons, and the Barney-Ahlers Co. W. J. Barney, head of the organization just named, brought out the further point that labor was only one of the present difficulties. Material prices have undergone great increases, he said, and it is difficult and often impossible to secure deliveries without payment of premiums. Many contractors, he predicted, may be forced to shut down work rather than assume the ever-mounting costs.

The need for drawing up immediately a program of action was stressed by many of the speakers. This will be one of the duties of the committee of fifteen above referred to, including in its membership three representatives from each of the following interests: Builders, architects, bankers, owners, and general industry. As representatives of the construction interests the following were named members of the committee: Otto M. Eidlitz, of Marc Eidlitz & Sons; W. S.. Faddis, of Caldwell Wingate Co.; and Louis J. .Horowitz, president, Thompson-Starrett Co. This week's meeting, it is understood, is the outcome of the recent letter from Secretary Hoover, reprinted elsewhere on this page, suggesting that the federal government would gladly co-operate in relieving the building situation provided the construction industry took preliminary action by drawing up some sort of definite program on which to act.

Railway Statistics Issued

In its annual bulletin, recently issued, the Car Service Division of the American Railway Association presents a statistical digest of related economic and transportation factors applied to the movement of the country's production during the year 1922. Cars of revenue freight loaded totalled 43,713,519, as compared with 39,323,158 in 1921; 45,118,472 in 1920; and 41,836,910 in 1919. The total car loadings (23,465,127) for the second six months of 1922, the period including the shopmen's strike and the two coal strikes, were only 0.8 per cent less than for the corresponding six months of 1920, which was the record loading in the history of American railway operation.

CARS AND LOMOTIVES AWAITING REPAIRS

1922	Cars	Locomotives
July 1	324,583	14,412
July 15	342,079	15,764
August 1	345,013	18,078
August 15	335,575	18,963
September 1	321,674	19,841
September 15	304,548	20,157
October 1	291,654	19,727
October 15	270.045	19,231
November 1	249,960	18,366
November 15	235,660	18,356
December 1	226,288	18,009
December 15	213,837	17,883
1923		
January 1	216,011	15,549
January 15	217,200	16,073
February 1	209,471	15,412
February 15	206,585	15,581

The railroads are making progress in restoring the condition of equipment impaired during the shopmen's strike. The figures above from July 1, 1922, to Feb. 15, 1923, show the number of cars and locomotives awaiting repairs.

Cement Production Reaches Record Figures

Production and shipments of portland cement for March and for the first quarter of this year are greater than for any similar period in the history of the industry.

In order to meet the demand, the industry is now producing at an unprecedented rate. The production of 9,880,000 bbl. in March shows a gain of 47 per cent over that month in 1922, while production during the first three months amounted to 25,669,000 bbl., or a gain of 68 per cent over last year.

Stocks of finished portland cement in the warehouses of the various producers amounted to 13,055,000 bbl. at the end of March. With a yearly capacity of all producers ranging between 140,000,000 and 150.000,000 bbl., there will be no cement shortage this year, according to the Atlas Co., provided there is no railroad embargo and that purchasers do not concentrate their orders during the peak months.

Western Pine Manufacturers Sued

By direction of Attorney General Daugherty a suit in equity against the Western Pine Manufacturers' Association, comprising approximately 50 corporations, and 86 individuals, officers of the companies and others, was filed April 30 by Lafayette French, Jr., U. S. Attorney for the district of Minnesota, in the U. S. District Court, at St. Paul, praying that an injunction issue against the association and the individuals named, as constituting "a combination and conspiracy in restraint of interstate trade and commerce in lumber."

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Market quiet; all business remains at $27 base, Birmingham, as of month ago. Eastern Pa. No. 2X, dropped $1.12 per ton in month. Basic iron rose 50c. in Philadelphia and $1 in Cincinnati; No. 2 foundry, $1 in Pittsburgh and Chicago and gray forge, 50c. per ton in Philadelphia, since last month.

Railway Supplies—Rail buying continues fairly active, particularly in West. Minimum on light rails now $45, against $43 last month, at Pittsburgh mills. Standard rails remain at $43 per ton f.o.b. mill. Track supplies and red oak ties higher in St. Louis; spikes, bolts a d angle bars also advanced at Birmingham.

Pipe—Black and galvanized wrought-steel pipe discounts dropped two points on Pittsburgh basing card of Apr. 19, change reflected in New York warehouse discounts. Birmingham mill base now $49 on 6-in., class "B," cast-iron pipe, against $48 per ton, one month ago. Rise reflected in New York, Chicago and St. Louis warehouses. Sewer pipe and clay drain tile cheaper in St. Louis; slight advances in sewer pipe in Baltimore and Boston.

Road Oils and Asphalt—Advance of ½c. per gal. in road oils, f.o.b. New York; slight declines in St. Louis. Scarcity of Mexican oil has manifested itself during last thirty days. Asphalt advanced in Boston, St. Louis, Baltimore, Montreal and Philadelphia.

Paving Materials—Granite blocks down 50c. per M. in Philadelphia; advanced slightly in Kansas City and Boston. Wood blocks up 15c. in Boston and 35c. per sq.yd. in New Orleans due to upward tendency in price of oil. Crosswalks, 6 x 24-in., and 5 x 16-in. bluestone curbing higher in New York.

Sand, Gravel and Crushed Stone—Sand, $1.25 in New York, against $1 per cu.yd. one month ago. Advances also reported in St. Louis, Dallas, Boston, Los Angeles, Baltimore and Birmingham, due mostly to higher labor costs. Sand down slightly in New Orleans. Gravel higher in St. Louis and Boston. Crushed stone up in St. Louis, Boston, Los Angeles and Baltimore.

Lime and Cement—Hydrated lime up in New York, Boston, Baltimore and Atlanta; down in St. Louis. Common lump lime cheaper in Boston and Atlanta. Lump finishing, lower in Boston but advanced slightly in Atlanta. Cement prices fairly stable; advances, however, reported in Boston, Atlanta, Los Angeles and Baltimore.

Structural Steel — Steel contract prices advancing. Premiums, however, previously demanded for quick deliveries, are disappearing from the market due to falling off in demand and consequent increase in promptness of shipments. Shapes and plates now $2.50@$2.75, bars $2.40@$2.75 per 100 lb., f.o.b. Pittsburgh. Less pressure in demand for plates. Mills reluctant to take on additional orders while deliveries are still behind on tonnages already booked.

Brick and Hollow Tile—Brick prices unchanged in New York since first of the year. Common brick up $1 in Atlanta, $1.50 in Dallas, $2 in Boston and $3.80 per M. in Baltimore; down $1 in Kansas City and slightly lower in Detroit. Hollow tile higher in New York, Chicago, St. Louis, Baltimore and Boston; no declines.

Lumber—Yellow pine timbers up $2 per M. ft. in New York, since month ago. Pine lumber also advanced in Minneapolis, Atlanta, Birmingham, Detroit and St. Louis and declined in Boston and Chicago. Douglas fir timbers rose in San Francisco, Boston, Seattle, Denver, Minneapolis and Detroit; no declines reported. Hemlock advanced in Denver; no changes elsewhere either in hemlock or spruce.

Explosives—Dynamite, 40 per cent gelatin, advanced ½c. per lb. in New York, Apr. 2. Similar advances occurred in both 40 and 60 per cent, in Minneapolis, St. Louis, Denver, Baltimore and New Orleans.

Scrap—Prices unchanged in New York; slightly higher in St. Louis despite fact that scrap is more plentiful.

Linseed Oil—Raw oil advanced 3c. in New York and 10c. per gal in Chicago, during month. Recent advance also reported in Dallas with declines in San Francisco and Montreal.

Hoover Wants Program Before Calling Conference

Secretary of Commerce Hoover will withhold action, for the present at least on the plan for calling a conference of the building and construction industries with a view to stabilizing construction. The following letter from Mr. Hoover, made public by the National Lumber Manufacturers Association, suggests that the trades themselves should formulate some sort of program as a preliminary to any conference that might be called:

"I have received several score of requests that a conference be called in Washington of the building and construction material industries with a view to evolving some sort of plan for orderly construction. I have felt, however, that it would be very difficult for such a conference to arrive at concrete results which did not in some stage appear to be unwarranted restraint on freedom of action in the building trades.

"This department is alive to the necessities of larger construction due to the deficiencies accumulated over many years and I would deplore official action which might have unexpected results. It is vital for the country that our construction industries should proceed in an orderly manner without inflation in prices or costs, as such inflation would inevitably bring about a buyers' strike. I have felt that the Government could contribute something to the situation by withholding its own building programs as far as possible, thus giving a clearer field to private construction. Government construction could be speeded up at such times as there is relaxation in private demand.

"I am at all times only too willing and anxious to cooperate with the trades in these great questions, but before assembling a conference, I feel we should have before us from the trades themselves some sort of program as to what might be accomplished by such a conference. I would be greatly obliged if you could make any suggestions along this line. I have a perfectly open mind in the matter, as indicated above, but I see a great many dangers that might come out of it."

Next Week—See first page of Construction News.

Labor Rates and Conditions Throughout the Country

Production of construction materials and manufactured products is going forward at an unprecedented rate. The heavy demand, which continues, comes not only from the construction industry, but from railroads as well.

With respect to the generally acknowledged labor shortage, the preliminary results of a survey conducted by the National Industrial Conference Board indicated that this is only about 2½ per cent of the total number employed in industry on Mar. 15. Small as this percentage is, its effect has been considerable, and there is the danger of a greater labor shortage.

The common labor rate for the nation as applied to pick and shovel men in construction operations, is placed at 51c. per hr. as against 50c. for the preceding month, according to *Engineering News-Record's* figures. Local building conditions are as follows:

Atlanta—Building brisk; wage schedules unchanged.

Baltimore—Scarcity of bricklayers, carpenters, hodcarriers, structural iron workers and common laborers.

Birmingham—Wage rates unchanged except common labor, which advanced slightly.

Boston—Scarcity of pile drivers, plenty of other trades. Wage schedule advanced.

Chicago — Landis Award Board granted carpenters, caisson workers and common laborers wage advance, effective June 1.

Dallas—Bricklayers and carpenters practically 100 per cent employed. Bricklayers union scale advanced $1 per day, effective May 15. Small surplus of hoisting engineers, hodcarriers, piledrivers and structural ironworkers. Common labor situation improving.

Denver—Shortage of bricklayers; surplus of carpenters. General advance in wage schedules.

Detroit—No change in building employers' scales for any trade. Tendency to pay bonuses. No scarcity reported but men in all trades in good demand.

Kansas City—Bonuses of $2 per day offered bricklayers. Scarcity of carpenters and hodcarriers.

New York—Employers in building trades disposed to grant increases of $1 to $2 per day to various crafts in form of bonuses, thereby averting threatened strike of May 1. Most serious problem involves interjurisdictional dispute between several unions of Building Trades Council over right to cut concrete for piping and wiring. About 2,700 stone workers struck for $2 per day increase, Apr. 20. Plasterers union on trial charged with restraint of trade and commerce.

Philadelphia—Fair supply of hoisting engineers and piledrivers; no surplus in any other trade.

St. Louis—Shortage of bricklayers; paying as high as $13@$15 per day. Carpenters advanced from $1.10 to $1.25 per hr., effective May 1. Hoisting engineers and piledrivers get increases of 12½c. and 25c. per hr., respectively, effective May 1. Bonus of $1 per day granted structural ironworkers.

Seattle—Carpenters, structural ironworkers, piledrivers and hoisting engineers granted increases of $1 per day. House painters and glaziers receive advance of 50c. per day.

CURRENT BUILDING TRADES WAGE RATES PER HOUR

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.70	$0.70	$0.30	......	$0.65	$0.30@.35
Baltimore	+1.50	+1.00	.80@1.00	.87½	$0.65	.80@1.00	+.30@.50
Birmingham	1.00	.75	.50@1.00	.15@.25	......	1.00	+.20@.30
Boston	1.25	+1.12½	+1.00@1.25	+.82½	1.00	+1.12½	+.60@.70
Cincinnati	1.25	1.00	1.00	.77½	1.00	1.00	.40@.60
Chicago	1.10	+1.15	1.10	......	1.10	1.05	.72½
Cleveland	1.40	1.25	1.25	.87½	1.00	1.25	.87½
Dallas	+1.37½@1.50	1.00	1.00	.40	.87½	1.00	.30@.50
Denver	+1.37½@1.50	+1.12½	+1.12½@1.18¾	.75@.81¼	1.00	+1.15⅝	.35@.55
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.12½	1.00	1.00@1.25	+.75	1.00	1.00	.35@.50
Los Angeles	1.25	1.00	1.00	+.62½	......	+1.00	.50
Minneapolis	1.00	.80	.80	.65	......	.80	.35@.50
Montreal	.90	.65	.50	30	.50	.65	.25
New Orleans	1.00	.85	.90	.65	.80	1.00	35@.40
New York	+1.50	1.12½	+1.25@1.50	+1.00	1.00	1.12½	+.50@.75
Pittsburgh	1.30	1.20	1.12½	.90	......	1.00	.50
St. Louis	1.50	+1.25	+1.25@1.37½	1.00	+1.25	1.25	+.45@.90
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.56¼
Seattle	1.12½	+1.00	1.00	93¾	1.00	+1.12½	+.50@.62½
Philadelphia	1.37½	1.12½	1.00	.75@1.00	1.10	1.10	.50@.65

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	May 3	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$31.55	$20.50
Northern Basic	**32.27**	20.78
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	33.27	20.50
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	34.44	26.16
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	27.00	16.50
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	*32.64*	22.34
Virginia No. 2 (silicon 2.25 @ 2.75)	34.17	28.24
Basic	**31.50**	20.25
Gray Forge	**31.50**	21.00
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	**33.00**	20.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	33.01	16.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	**32.00**	21.96
Basic	31.00	21.46
Bessemer	31.00	21.96

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh May 3	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$40.00		$43.00	$43.00
Standard openhearth rails	43.00	40.00	$43.00	43.00	43.00
Light rails, 8 to 10 lb.	**45.00**	30.00	2.00*	43.00	43@**45**
Light rails, 12 to 14 lb.	**45.00**	30.00	2.00*	43.00	43@**45**
Light rails, 25 to 45 lb.	**45.00**	30.00	2.00*	43.00	43@**45**
Rerolled Rails	**45.00**	28.00	..	....	......

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.50	$1.65
Chicago, Hardwood and Red Oak	1.25	1.40
Chicago....Empty Cell Creosoting (add'l)	.45	50
San Francisco ..... Green Douglas Fir	.84	1.14
San Francisco, Empty Cell Creosoted, Douglas Fir	1.70	2.25
St. Louis, White Oak	1.30	1.55
St. Louis (creosoted) (zinc treated)	1.70	2.05
St. Louis, Red Oak, plain	**1.20**	**1.45**
St. Louis, Sap pine-cypress	1.05	1.30

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named

	Pittsburgh May 3	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, $\frac{9}{16}$-in and larger	$3.15	$2.15@2.25	$3.00	**$4.15**	$4.85	**$3.60**
Track bolts	4.00@4.50	3.00@3.50	4.00	**5.15**	5.85	**4.60**
Standard section angle bars	2.75	2.40	2.75	**4.00**	4.10	**3.00**

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	**62**	**50½**	¾ to 1½	[illegible]	13

LAP WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
2	**55**	**43½**	2	23	7
2½ to 6	**59**	**47½**	2½ to 4	[illegible]	11
7 to 8	**56**	**43½**	4½ to 6	[illegible]	11
9 to 12	**54**	**41½**	7 to 12	[illegible]	11

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	**60**	**49½**	¾ to 1½	30	14
2 to 3	**61**	**50½**			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	**53**	**42½**	2	23	9
2½ to 4	**57**	**46½**	2½ to 4	29	15
4½ to 6	**56**	**45½**	4½ to 6	28	14
7 to 8	**52**	**39½**	7 to 8	21	7
9 and 10	**45**	**32½**	6 to 12	16	2
11 and 12	**44**	**31½**			

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	**52%**	62½%	52%
2½ to 6 in. lap welded	**49%**	59½%	49%

	Galvanized New York	Galvanized Chicago	Galvanized St. Louis
1 to 3 in. butt welded	**39%**	48½%	39%
2½ to 6 in. lap welded	**36%**	45½%	36%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus **10%**. Cast iron, standard sizes, **21**½% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York May 3	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	**$53.00**	**$63.00**	$50.80@51.80	**$62.20**	**$61.60**	$64.00
6 in. and over	**49.00**	**58.50**	46.80@47.80	**58.20**	**57.50**	60.00

Gas pipe and Class "A," $5 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York May 3	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$40.00	*$40.00*	$62.50	......	$73.00
4	55.00	50.00	*40.00*	75.00	$76.50	83.00
5	80.00	80.00	.	100.00	97.75	108.00
6	105.00	100.00	*75.00*	175.00	127.50	133.00
8	170.00	150.00	*185.00*	187.50	212.50	199.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.	$0.114	. .	..	$0.15	$0.12	......
4		.114	$0.10	*$0.10*	.15	.15	$0.12
5	.	.171	.125	.	.23	.18	.16
‡6	$0.24	.171	.150	*.14*	.23	.21	.1855
8	.38	.266	.25	*.225*	.35	.30	.30
10	.57	.399	.325	*.315*	.53	.42	.441
12	.72	.513	.425	*.405*	.68	.54	.567
15	1.13†	.684	.625	*.675*†	.90	.90	.819
18	1.65†	.95	.85	*.945*†	1.25	1.32	1.071
20	1.98†	1.14	1.125	...	1.50	......	....
22	2.64†	1.52	1.375	*1.26*†	2.00	....	1.44
24	2.97†	1.71	1.625	*1.62*†	2.25	2.16	1.89
27	4.81†	2.99	....	*2.65*†	4.69†	3.00	3.34
‡30	5.33†	3.312	.	*3.25*†	5.94†	3.60	4.06
33	6.93†	4.41	.	*3.95*†	6.88†	.....	4.99
36	7.91†	5.0225	...	*4.50*†	7.50†	....	5.42

	3	5	8	12	24	36
Boston	**$0.127**	**$0.195**	**$0.308**	**$0.595**	**$1.975**	†**$5.90**†
Minneapolis	....	....	40	72	2.55	5.66†
Denver	.135*	18*	.27	47	1.70	...
Seattle	.13	.....	36	72†	2.60†	.....
Los Angeles	.11	.165	275	495	1.65	.....
New Orleans	.112*	.168*	.28	476	1.182	...
Cincinnati	.14	.215	.34	66	2.25	4.92†
Atlanta	.112*	.168*	.28	.476	1.82	.....
Montreal, *delivered*	68‡	.45†	70	1.35	4.50†	
Detroit	.117	1755	.273	.5265	2.34†	6.15†
Baltimore	**126**	**.189**	**.294**	**567**	**1.89**	**5.4375**
Kansas City, Mo.	.135*	.19*	.30*	52	2.09	3.95
Philadelphia	.124	1871	.286	545	1.89†	4.37†

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3 in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

		May 3	One Year Ago
New York, 45% asphalt	(at terminal)	$0.0525	$0.05
New York, 65% asphalt	(at terminal)	.0525	.045
New York, binder	(at terminal)	.06	.055
New York, flux	(at terminal)	.0575	.05
New York, liquid asphalt	(at terminal)	.06	.06
St. Louis, 50-60% asphalt		[illegible]	.05
St. Louis, 40-50% asphalt		[illegible]	
Chicago, 40-50% asphalt		.0525	.05
Chicago, 60-70% asphalt		.055	.0525
Dallas, 45% asphalt		.04	10
Dallas, 55% asphalt		.048	11
Dallas, binder		.053	15
San Francisco, binder, per ton		9.50*	13.00*

* F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Mexican*)	$19 00	$15.00
Boston (*Mexican*)	21 00	17 00
Chicago (*Stanolind*)	22.25	16 00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	17.00*	11.00*
Dallas, (*Texas*)	23.00	15.00
Seattle, "*D*" *grade* (*California*)	24 75	20.50†
Denver (*California*)	24 00	
Minneapolis *f.o.b. Twin Cities* (*Stanolind*)	25.45	19 10
St. Louis (*Mexican*)	30 00	25 00
Baltimore (*Standard Oil*)	21 00	15.00
Montreal (*Imperial*)	28 00	21 00
Atlanta (*Mexican*)	26 00	23 50
Detroit (*Mexican*)	22 47	18.40
Cincinnati (*Kentucky Rock*)	22.50	19.50
Maurer, N. J. (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	21.50	18.50
Philadelphia (*Mexican*)	21.00	18.00
Kansas City (*Texas*)	27.50	25.50
Los Angeles "*D*" *grade* (*California*)	19.15	11.00‡

*Freight to San Francisco, 80c. per ton.
†F.o.b. Richmond, Cal.
‡F.o.b. El Segundo refinery.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade 1)	5-in. granite, 30 blocks per sq.yd.	$134.50 per M.
Chicago	About 4x8x4 dressed About 4x8x4 common	3 50 per sq.yd. 3 10 per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M
Boston	5-in. granite 28 blocks per sq.yd.	$130.00 per M.
Atlanta	Granite	2.66 per sq.yd.
Detroit	5-in. Granite 4-in. Granite	3.00 per sq.yd. 3.25 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	100.00 per M
New Orleans	Granite, 4 x 8 x 4	3.25 per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	4x8x4 dressed 4x8x4 common	3 10 per sq.yd. 2 90 per sq.yd.
Kansas City	Granite	3.25 per sq.yd.
Philadelphia	Granite	*134 50* per M.

FLAGGING—

New York	Bronx, 4 ft wide Manhattan, 4 ft. wide Queens, 5 ft wide 6x24-in. cross-walk	$0.22 per sq.ft. .22 per sq.ft. .24 per sq.ft 1.10 per lin.ft.
Chicago	18 in. wide	.... per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 80c; 5 x 20 in, Queens, 85c *St Louis*: Class "A" straight, delivered, 5 x 16 in. $1.40 per lin.ft. *Chicago*: 5 x 8 in., $1.65; 6 x 8 in., $1.95 per lin.ft. delivered.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq Yd.
New York (*Delivered*)	3	16	$2 63
New York (*delivered*)	3½	16	3 19
Boston	3½	16	2 50
Chicago	4	16	3.00@3 25
Chicago	3½	16	2 50
St Louis	3½	16	2.75
St. Louis	4	16	3 10
Seattle	4	16	Off market
Minneapolis	3½	16	2 62
Atlanta	3½	16	2 00
New Orleans	3	16	2 45
New Orleans	3½	16	2 65
New Orleans	4	16	2 95
Dallas	4	18	3 90
Baltimore	3½	16	none used
Montreal	4	16	4 50
Detroit	3	16	2 84
Detroit	4	16	3.00
Cincinnati	4	16	2.38
Kansas City	4	16	3 65
Philadelphia	3½	16	2 60

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel				Sand	
	1½ In.		¾ In.			
	May 3	One Year Ago	May 3	One Year Ago	May 3	One Year Ago
New York	$2 25	$1.75	$2 25	$1 75	$1 75	$1 00
Denver	1.90	2.50	1.90	2.50	1 10	1 10
Chicago	2.00	1.80	2.00	1.80	2.00	1 80
St. Louis	2.35†	1.25†	2 45	1.30†	2 10†	1 10†
Seattle	1.25	1.50	1 25	1.50	1 25	1 50
Dallas	2.25	2.25	2.25	2.25	1 90	2.25
Minneapolis	1.75*	1.50	1 75*	1.50	1 00	1 00*
Cincinnati	1.50†	1.87½	1 50†	1.87½	1 25†	1 43
San Francisco	2 15	2.25	2 15	2.25	1 50	1 50
Boston	1.50†	2.40	1.50†	2.40	1.20†	1.65
New Orleans	2 85	2.08½	2 85	2.08½	1.25	1.35
Los Angeles	0 75*	1.50†	0 85*	1 50†	1 10†	1.35†
Atlanta	1 90†	1 85†	1 90†	1 85†	1 24†	1.15†
Detroit	2 25	2.00	2 25	2 00	2 00	2 00
Baltimore	1 86	1.40	2 06	1 60	0 80†	2.00
Montreal	1 25†	1.25†	1 50†	1 50†	1 25†	1.25†
Birmingham (Crushed slag used instead of gravel)					1.45†	1.25†
Philadelphia	1 85	1.50	1 95	1.55	1 90	1.60
Kansas City	1 60	2.00	1 60	2.00	0 66*	1.20

New York—Grit, $1.75 per cu. yd.; ready mixed, $2.25
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit.
† Per ton.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In.		¾ In.	
	May 3	One Year Ago	May 3	One Year Ago
New York	$1 65	$1 65	$1 75	$1.75
Chicago	2.00	1 60	2 00	1.60
St. Louis *delivered*	2 10	1 65	2.30	1.65
Dallas	2 50	2 73	2 50	2.73
San Francisco	2 15	2.25	2 15	2.25
Boston, *delivered*	1.75*	3.00*	1 75*	3.00*
Minneapolis, *at plant*	2 00	2 00	2.25	2.25
Kansas City	1.50	2.10	1.50	2.10
Denver	3.50	3.50	3.50	3.50
Seattle *delivered*	3 00	3.00	3.00	3.00
Atlanta	2.00*	1 90*	2 00*	1 90*
Cincinnati	1 75*	1.75	2.25*	1.75
Los Angeles	1.60	1.75*	1 60	1.85*
Detroit	1.60@1.90*	1.90*	1.60@1.90*	1.90*
Baltimore	2.50	1.75*	2.55	1.65*
Montreal	1.80*	2.00*	1.90*	2.00*
Birmingham *delivered*	3.20	3 20	3.10	3.10
Phildelphia	1 80*	1.70*	1 65*	1.55*
Pittsburgh	2.85	2 85	2.85	2.85
Cleveland	3.25*	3.25*	3.25*	3.25*

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1 30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1 40
East Canaan, Conn.	1.25	1.35	4.00	1.00
Easton, Catasaqua, Pa	1.00	1.00	2.00	0 90
Birmingham, Ala.	1.00	1.00	1.00	1 00
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1 25
Cleveland, Ohio	1.20	1.20	....	1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2.00	1 20
Western Pennsylvania	1 25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$18 60	$13 10	$3.75*	$3.00@3.25*
Chicago	20.00	20.60	1.50†	1.50†
St. Louis	23 00	19 00	....	.....
Boston	22.00	15.00	1.00*	2.25*
Dallas	22 50	....	....	2.50†
Cincinnati	16.80	13.30	....	10.75‡
San Francisco	22.00	16.00	....	1.75†
Minneapolis	25.50	21.00 (white)	1.60†	1.25†
Denver	24.00	.....	....	2.70†
Detroit	19.50	17.50	....	18.25‡
Seattle *paper sacks*	24.00	.....	2.80†	.....
Los Angeles	.....	....	....	3.00*
Baltimore	24.25	17.25	2.55	.....
Montreal	21.00	21.00	....	11.00‡
Atlanta	23.50	15.00	2.35†	1.50†
New Orleans	.....	....	2.40†	
Philadelphia	16.00	15.00	13 50‡	12 50‡
Kansas City	25.60	24 00	.....	2 40*

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.70, Sheboygan $1.60. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	May 3	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.50	1.60
Atlanta (Magnolia)	11.00 per ton	11.00 per ton
Cincinnati (Utica)	1.72	1.77
Boston (Rosendale)	2.60	0.80 per bag
St. Louis (Carney)	1.75	2.10

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	May 3	One Month Ago	One Year Ago
New York, del. by truck	$2.70@2.80	$2 70@2.80	$2.40
New York, alongside dock to dealers	2.30	2.30	2.00
Jersey City	2.48	2.48	2.12
Boston	2.80	2.75	2.50
Chicago	2.20	2.20	1.97
Pittsburgh	2.24	2.24	2.02
Cleveland	2.46	2.46	2.26
Detroit	2.47	2.47	2.17
Indianapolis	2.41	2.41	2.21
Toledo	2.48	2.48	2.20
Milwaukee	2.37	2.37	2.18
Duluth	2.14	2.14	1.94
Peoria	2 41	2.41	2.08
Cedar Rapids	2.48	2.48	2.21
Davenport	2.43	2.43	2.16
St. Louis	2.35	2 35	2 20
San Francisco	2.71	2.71	2.73
New Orleans	3.30	3.30	3.00
Minneapolis	2.39	2.39	2.24
Denver	2.85	2.85	2.90
Seattle	2.90	2.90	2.94
Dallas	2.25	2.25	2.25
Atlanta	3.50	2.90	2.39
Cincinnati	2.54	2.54	2.35
Los Angeles	3.80	3 40	3.30
Baltimore	3.05	2.61	2.50
Birmingham	2.50	2.50	2.27
Kansas City	2 42	2.42	2.40
Montreal (*delivered*)	2.68	2.88	2.50
Philadelphia	2.41	2.41	2.21
St. Paul	2.39	2 39	2.24

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind.	$1.95	La Salle, Ill.	$2.10
Universal, Pa.	2 00	Hudson, N. Y.	2.20
Steelton, Minn.	1.95	Leeds, Ala.	2.20
Fordwick, Va.	2 20	Hannibal, Mo.	2.10
Mitchell, Ind.	2 10	Lehigh Valley District	2.10
Iola, Kan.	2.10	Wyandotte, Mich.	2.30
Mason City, Ia.	2.10	Alpena, Mich	2.10

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago Mill	Warehouse New York	Warehouse St. Louis	Warehouse Dallas	Warehouse San Francisco
032	22	**$0 92**	$0 99	$1 24	**$1 02**	$1 09	**$1 12**
049	28	**1 18**	1 28	1 58	**1 30**	1 33	**1 45**
068	35	**1 44**	1.56	1 94	**1 59**	1 61	**1 77**
093	45	**1 85**	2.00	2 50	**2 04**	1 935	**2 28**
126	57	**2 28**	2 47	3 09	**2 53**	2 451	**2 81**
153	68	**2 72**	2.95	3 60	**3 01**	3 05	....
180	78	**3 12**	3.39	4.22	**3 46**	3 351	....
245	103	**4 12**	4 47	5.60	**4 56**	4 427	....
287	119	**4.76**	5 16	6.44	**5 27**	5 115	**5 68**
336	138	**5 52**	5.99	7 39	**6 11**	5 934	....
395	160	**6 40**	6.94	8.67	**7 09**	6 88	....
			PAVING				
036P	17	**$0 71**	$0 77	$0.95	**$0 78**	$0 731	....
053P	24	**1 00**	1 08	1.35	**1 10**	1 032	....
072P	31	**1 26**	1 37	1 71	**1 39**	1 333	....
097P	40	**1.62**	1 76	2 20	**1.79**	1 84	....
049R	24	.	1.08	....	**1.10**	1 032	....
067R	31		1.37	....	**1.39**	1 333	.
089R	40	....	1.76	....	**1.79**	1 84	...

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27Dia.	2.3	$22 00	**$21 25**	$20 72	$21 43	$25 50
26 "	2.5	22 00	**22 50**	22 39	20 78	27 58
25 "	3.0	22 00	**25 25**	24 93		30 71
24 "	3.4	24 00	**27 25**	27 10	24 28	33 16
22 "	4.33	27 00	**31 75**	32 27	.	35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut New York	Warehouse, Uncut Chicago	Warehouse, Uncut St. Louis	Warehouse, Uncut Dallas	Warehouse, Uncut San Francisco
¾ and larger..	**$2 40@2 75**	**$2 65**	$3 34	**$3 32½**	**$3 35**	$3 15	$3 40
⅝	**2 45@2 80**	**2 75**	3 39	**3 37½**	**3 40**	3 20	3 45
½	**2 50@2 85**	**2 85**	3 44	**3 42½**	**3 45**	3 25	3 50
⅜	**2 65@3 00**	**2 90**	3 49	**3 57½**	**3 60**	3 40	3 65
¼........	**2 90@3 35**	**2 95**	3 84	**3 82½**	**3 80**	3 65	3.90

Includes 15c charge for cutting to lengths of 2 ft. and over

Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¾ and larger	*$2 30*	**$3.05**	$2 85	⅜....	$2 75	**$3 30**	$3 10
⅝ in.	*2 35*	**3 10**	2 90	¼....	2 80	**3 50**	3 35
½	*2.40*	**3.15**	2 95	... .		... ..	....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common May 3	Common One Month Ago	Common One Year Ago	Paving Block 3-inch*	Paving Block 4-inch*
New York (del.). .	$23 50	$23.50	$20 40	$46 50	$54 00
New York (at dock)...	20.00	20.00	17 00		.
Chicago..............	11 00	11 00	11 00	34 00	42 00
St. Louis, salmon.	15@17	**15@17**	14 00	*36* 50@38 50	40@**42.85**
Denver, salmon.......	12 00	12 00	12 00		......
Dallas	**13 10**	11 60	11 15	33 00	
San Francisco	15 00	15 00	15 00		
Los Angeles (del.)...	15 00	15 00	15 00	(not used)	
Boston..............	**22 00**	20 00	16 00	48 25	56 00
Minneapolis (del.).....	17@19	17@19	15 00	. ..	
Kansas City	*15.50*	16 50	14 50		. ...
Seattle .	13 00	13 00	14 00	50 00	
Cincinnati	18 00	18 00	15 00	43 00	43.00
Montreal	16 50	16 50	16 00	100.00‡	68 00
Detroit (del.) ..	*17* 50@**20.00**	20.00	16 50	38.50	41.50
Baltimore (del.)....	**23.00**	19.20	20 00	40 00	45.00
Atlanta ..	**14 00**	13 00	9 00	**42.00**	
New Orleans......	17 25	17 25	12 50		
Birmingham .. .	12 50	12 50	9 50		
Philadelphia	19@25	19@25	16.00	40 00	48.00
Pittsburgh (del.)	16 00	16.00	17 50	......	......
Cleveland	16 00	16.00	......		

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡ Imported

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York May 3 on Trucks*	New York One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12	**$0 1573**	$0 1112	**$0 1032**	$0 125	$0 09	$0 108	
6x12x12	**2097**	1667	**1496**		**12**	156	
8x12x12 ..	**2621**	.2084	**1754**	19	**165**	244	**$0 2691**
10x12x12		.	**2190**		**.190**	...	**3505**
12x12x12		.	**2846**		**236**		**4206**

* 5 per cent off for cash

	4x12x12	8x12x12	12x12x12
Boston..................	**$0.115**	**$0 22**	
Minneapolis (f.o.b. cars)..	736	12125	$0 214
Minneapolis (delivered)...	0836	1369	239
Cincinnati	0859	1611	
Kansas City	083	1455	
Denver	065	123	188
Seattle (delivered)	11	[illegible]	[illegible]
Los Angeles factory .	10	175	
New Orleans	12	23	
Detroit (delivered)	101	1995	27
Montreal . .	115	215	30
Baltimore .	**125**	**27**	
Atlanta . .	0893	1674	
Dallas . .	115		
Birmingham	11	18	
Pittsburgh (delivered) .	068	[illegible]	179
Cleveland	09	[illegible]	

San Francisco, Philadelphia, Atlanta and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh Mill	Birmingham Mill	Warehouse New York	Warehouse Dallas	Warehouse St Louis	Warehouse Chicago	Warehouse San Francisco
Beams, 3 to 15 in	**$2 50**@2 75	**$2 75**	$3 44	$4 50	**$3 45**	**$3 40**	**$3 85**
Channels, 3 to 15 in.. .	**2.50**@**2.75**	**2 75**	3 44	4 50	**3 45**	**3 40**	**3 85**
Angles, 3 to 16 in., ¼ in. thick...............	**2.50**@2.75	**2.75**	3.44	4 50	**3 45**	**3 40**	**3 85**
Tees, 3 in. and larger...	**2.50**@2.75	**2.75**	3 44	4 50	**3 45**	**3.40**	**3 85**
Plates, ¼ in. thick and heavier	**2 50**@2 75	**2 75**	3 44	4.60	**3.45**	**3.40**	**3 85**

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse New York May 3	Warehouse New York One Yr. Ago	Warehouse Chicago	Warehouse St. Louis	Warehouse San Francisco	Warehouse Dallas
¾ in. and larger	$3 25@3 50	$4 00	$3.50	$3 75	**$4 15**	**$5 00**	$4.95
			CONE-HEAD BOILER				
¾ in. and larger.	$3.35@3.60	$4.10	$3 60	$3.85	**$4.25**	**$5.10**	*$5.05*
⅝ and 11/16. .	3 50@3 75	4.26	3 76	4 00	**4 40**	**5 25**	*5 20*
½ and 9/16	3 75@4 00	4 50	4 00	4 25	**4 50**	**5 50**	*5.45*

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.....	**$2.90@3 10**	$3 45	$4 20	$4.25	**$3.34**	$4 95
Cut		5 50	5.80	5 75	**3.74**	5 00

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.50 per roll in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.75 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., **$6.35**.

ROOFING MATERIALS—Prices f.o.b. New York, in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton....................	$67 50
Tar pitch (in 400-lb. bbl.), per 100 lb	1 62½
Asphalt roofing (in barrels), per ton, f.o.b. plant*....................	38.75
Asphalt felt (light), per ton, f.o.b. plant*..............................	75.00
Asphalt felt (heavy), per ton, f.o.b. plant*..............................	75.00

* Delivered in Metropolitan Dist., $3.00 additional.

WINDOW GLASS—Double strength, box list, united inches, 34, "AA", "A" and "B" grades, all at discount of 84 per cent from standard lists, f.o.b. New York.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10..............	$2.65@3.25	$4.25	$4 15	**$4.85**	$4.34
No. 12................	2.75@3.35	4.30	4.20	**4.90**	4.39
No. 14................	2.85@3 45	4.35	4 25	**4.95**	4 44
No. 16................	3.05@3.65	4.45	4.35	**5 00**	4 54
Black					
*No. 18 and 20	3 35@**3 85**	4 80	4 85	**5 95**	4 70
*No. 22 and 24	3 40@**3 90**	4 85	4 85	**6 00**	4 75
*No. 26	3 45@**3 95**	4 90	4 90	**6 05**	4 80
*No. 28	3 50@**4 00**	5 00	5 00	**6 15**	4 90
Galvanized					
No. 10	4 00@**4 50**	**5 10**	**5 10**	**6 00**	4 90
No. 12	4 10@**4 60**	**5 20**	**5 20**	**6 10**	5 00
No. 14	4 10@**4 60**	**5 20**	**5 20**	**6 10**	5 10
No. 17 to 21	4 40@**4 90**	**5 50**		**6 40**	5 30
No. 22 and 24	4 55@**5 05**	**5 65**	**5 65**	**6 55**	5 45
No. 25 and 26	4 70@**5 20**	**5 80**	**5 80**	**6 70**	5 60
*No. 28	5 00@**5 50**	**6 10**	**6 10**	**7 00**	5 90

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gage; for galvanized corrugated sheets add 15c. all gages.

LINSEED OIL—These prices are per gallon:

	New York May 3	New York One Year Ago	Chicago May 3	Chicago One Year Ago
Raw in barrels (5 bbl. lots)	$1 16	$0 91	$1 25	$0 90

WHITE AND RED LEAD—Base price in cents per pound:

	Red				White	
	May 3		1 Year Ago		May 3	Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	14.50	16 00	12 25	13.75	14 50	12.25
25 and 50-lb. kegs	14 75	16 25	12 50	14.00	14 75	12 50
12½-lb. keg	15 00	16 50	12 75	14 25	15 00	12.75
5-lb. cans	17 50	19 00	15 25	16 75	17 50	15.25
1-lb. cans	19 50	21.00	17.25	18.75	19.50	17.25

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards To contractors, $2 per M ft. additional.

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$40 00	$41 00	$42 00	$45 00
3x6 and 8	40.00	41 00	42 00	45 00
4x4-6 and 8	40.00	41.00	42 00	45 00
3x10 and 12	40.00	41.00	42 00	45 00
3x14	42 00	42 00	44 00	46 00
4x10 and 12	40 00	41.00	42 00	45.00
4x14	42 00	42.00	44 00	46.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$42 00	$44.00	$46.00
6x14	47.00	49.00	51 00
8x10	42 00	44.00	46.00
8x14	47 00	49.00	51.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22–24 Ft.	20 Ft. and Under	22-24 Ft.
3x 4 to 8x8	$52 00	$53 00	$54 00	$56.00
3x10 to 10x10	56 00	57.00	57 00	59.00
3x12 to 12x12	60 00	61 00	60.00	62.00
3x14 to 14x14	67.00	68 00	65.00	67.00
3x16 to 16x16	72 00	73 00	70.00	72 00
3x18 to 18x18	86 00	87 00	82.00	83 00
4x20 to 20x20	96.00	97.00	93.00	95.00

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under.

Other Cities

	8 x 8-In. x 20 Ft. and Under				12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$65.00	$130.00	$65.00	$65.00	$85.00	$150.00
Seattle	...	31 00	......	......	......	31 00
New Orleans	35.00		......	..	40.00	......
Baltimore	35.00	53.00	53 00	60.00	50.00	53.00
Cincinnati	45 00	51.50	51.50	51.50	45.00	53.50
Montreal	50.00		.	...	......	90.00
Los Angeles	.....	53.00	.	......	......	54 00
Denver	.....	43 00	43 00	43 00	.....	44 00
Minneapolis	46.50	45.75	41 50	.....	50.00	46 75
Atlanta	38 00	.....	.....	.....	42.00	.....
Dallas	48 00	.....	.....	.....	53 00	.....
Kansas City	45 75	44.75	44 75	.....	58.75	48.75
Birmingham	38.00	.....	.....	.....	45.00	.....
Philadelphia	47 00	41.50	40.00	45.00	58 00	42 00
Detroit	48.75	53 25	.....	.....	61 75	53.25
St. Louis	46.00	.....	.....	.....	53 00	. .

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	$50.00	$90 00	$50 00	$57.00	$105 00
Seattle	......	28 00	.. .	.....	30 00
New Orleans, at mill	80.00	.....	.....	39.00	.. .
Baltimore	65.00	44.00	44 00	37.00	50.00
Cincinnati	60.00	82 00	82 00	35.00	78 00
Montreal	.....	50.00	37.00	45.00	45.00
Los Angeles	.....	48 00	.....	.....	.....
Denver	.....	...	38 25	38 25	37 25
Minneapolis	47 50	43.25	39.50	43 75	41 25
Atlanta	22 00	.....	.....	32 00	.. ..
Dallas	48.00	.....	.....	51 50	.. ..
Kansas City	81 00	.....	.....	69 00	
Birmingham	32.00	.....	.....	42 00	..
Philadelphia	37.00	43.00	40.00	57.00	41.50
Detroit	55 25	42.00	..	48.50	43 00
St. Louis	47.50	.....	.	37 00	.

Birmingham—Quotes carload lots, f.o.b. sidings. $1 50 additional per M. ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractors on large projects.

St. Louis—Wholesale price to contractors, f.o b. cars, $3 per M. ft. additional.

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M. ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.29
Birmingham	.69	Kansas City	.735
Boston	.365	New Orleans	.515
Buffalo	.26	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.50†
Cincinnati	.29	Philadelphia	.32
Cleveland	.21	St. Louis	.43
Denver	1.27*	St. Paul	.60

* Minimum carload, 40,000 lb.

† Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

May 3	One Month Ago	One Year Ago
$2.60@2.75	$2.30@2.70	$2.00

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	22½%
Patent flattened strand, special and cast steel	22½%
Patent flattened strand, iron rope	7½%
Plow steel round strand rope	37½%
Special steel round strand rope	32½%
Cast steel round strand rope	25%
Round strand iron and iron tiller	7½%
Galvanized steel rigging and guy rope	10%
Galvanized iron rigging and guy rope	+10%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ⅝-in., 8 ft., ¾-in., 6; ⅞-in., 4½; 1-in., 3½; 1⅛-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.16¼	New Orleans	$0.18½
New York	.18½	Los Angeles	....
Chicago	.18	Seattle	.18
Minneapolis	.20½	St. Louis	.19½
San Francisco	.18	Montreal	.30
Atlanta	.22	Detroit	.19
Denver	.22	Baltimore	.18
Cincinnati	.20	Kansas City	.20½
Dallas	.129	Birmingham	20½
Philadelphia	.18		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin	
	40%	60%
New York	$0.275	$0.30
Boston	.23	.25
Kansas City	.2225	.2525
Seattle	.165	.195
Chicago	.22	.25
Minneapolis	.1967	.2173
St. Louis	.2275	.2525
Denver	.2075	.2325
Dallas	.29	.375
Los Angeles	....	...
Atlanta	.23	.26
Baltimore	.22	.23
Cincinnati	.22	.25
Montreal	.1957	.235
Birmingham, *delivered*	.16	.17
New Orleans	.252	.285
San Francisco	.1625	.1925
Philadelphia	.2625	.295

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.13	$0.17½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.17½	0.22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.19½	0.24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.25	0.34
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$21.00	$11.50	$17 25
Stove plate	17.00	12.00	17.00
No. 1 machinery cast	21.00	16.50	21.25
Machine shop turnings	14.00	4.00	13.00
Cast borings	15.00	5.50	14.00
Railroad malleable cast	20.00	12.50	22.50
Re-rolling rails	21.00	13.00	21.75
Relaying rails	28.50	30.00	29.25@33.50
Heavy melting steel	18.50@19.00	.....	......

SHIP SPIKES—Current prices per 100 lb.:

	San Francisco		Seattle
In.	Galv.	Black	Black
¼	$8.25	$6.25	$8.00
⅜	7.30	5.80	7.75
½	7.15	5.65	7.70

Pittsburgh base in lots of 200 kegs or more, $3.50@3.75.

A Consolidation of Engineering News and Engineering Record
McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren, *Editor*
Frank C. Wight, *Managing Editor*

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NEW YORK, MAY 10, 1923
Number 19

Times Have Changed

From Engineering News, Oct. 7, 1909, p. 391

MR. WILBUR WRIGHT made a notable flight of some 20 miles from the military reservation at Governor's Island, in New York Harbor, on Oct. 4. After rising above the island he proceeded up the Hudson River to about 125th St., passing over all sorts of river craft and over the warships of England, France, Germany, Italy and the United States, assembled for the Hudson-Fulton celebration. The return was made over the same course and he landed at the starting point. The total time of the flight was about 33 minutes. The height at which the machine flew varied from 30 to 300 ft.

Special to The New York Times

SAN DIEGO, Cal., May 3, 1923—The great army monoplane T-2, piloted by Lieutenant Oakley G. Kelly and Lieutenant John A. Macready, landed here today at 12: 26: 56 p.m., Pacific time [3: 26: 56 p.m., Eastern standard time] 26 hours and 50 minutes from the time it left Hempstead, L. I., yesterday afternoon. The distance covered is estimated at more than 2,700 miles.

Able Hands at the Helm

IN THE twenty years or more since the government established its great scientific and technical study laboratory at Washington, the Bureau of Standards, the ideals of science have been the guiding star by which the institution's course was charted. There have been those who believed they saw scientific and technical aims in conflict at the Bureau, and not a little of the passive opposition which the Bureau at times encountered may be traced to such belief. But all the engineering investigation conducted there, however practical, has manifestly been vitalized by the scientific spirit; and we believe that any impartial survey of the Bureau's development will show no conflict, or even rivalry, between the two. Some months ago, when the sure hand of Dr. Stratton relinquished the helm, there was justified apprehension that other purposes might come into control—that his successor might lay a course by another star. The choice of George K. Burgess quiets these apprehensions. It gives assurance that scientific ideals and inspirations will continue in control, supported by a thorough understanding of technical needs. Engineers who have come into direct contact with Dr. Burgess' work at the Bureau feel a distinct satisfaction, moreover, that the future guidance will have the inestimable advantage of ripened experience in the peculiar problems of the great public laboratory no less than in scientific and technological research.

A Novel Dam

EUROPEAN conditions as to labor and material are so different from ours that it is not possible to make comparisons between standards of structural practice. For that reason an American engineer can say of the remarkable Tirso dam now approaching completion in Sardinia only that it would never prove economical in this country. It is, however, a most interesting structure not only because it is by far the highest multiple-arch dam in the world (nearly 70 ft. higher than the Lake Hodges dam, the highest in the United States) but because of the use of stone masonry for buttresses and concrete for the arch face. With masonry costing what it does in the United States such buttresses would probably be prohibitive and even were they possible it is doubtful if their superiority over concrete would be admitted. But the Europeans are more partial to composite structures and doubtless have some good arguments why the masonry buttresses were used.

Over-Ordering Abuses

THE abuse of over-ordering emphasized recently in these pages is not peculiar to the construction industry. It is, to some extent, found in every industry whose nature is such that contracts are placed for future delivery. The Committee of the Department of Commerce on Business Cycles, headed by Owen D. Young, chairman of the board of the General Electric Co., has, in its report of March 1, this year, characterized over-ordering as one of the bad features of inflation periods and recommends forms of contracts that provide financial penalties for cancellation. The committee put it this way: "Contracts for purchase of materials should contain definite and substantial financial penalties for cancellation. It is clearly undesirable that contracts should be considered subject to cancellations except under conditions specified in advance, with such penalties as may be fair to both parties. Insistence on this principle and the inclusion in contracts of substantial penalties for cancellation will tend to prevent duplication of orders, to lessen the tendency to place orders far ahead of immediate requirements, and to prevent speculative buying by men who when they order have no intention of completing the purchase if prices drop."

More Light on Activated Sludge

THAT sewage sludge can be activated without compressed air aëration is the belief of a number of operators of working-scale plants in England which depend wholly upon mechanical agitation and is a growing belief or hope in America. The findings of Dr. Buswell on another page tend to confirm this belief. Some new light is thrown on the old subject of metabolism. It is well known to biologists that protozoa and sphaerotilus organisms thrive with very little oxygen. On finding these organisms dominant in activated sludge the question is naturally raised, does the process really need so much air? Most advances come about by re-examination of previous experiments for possible errors of technique or conclusion. Dr. Buswell disagreed with the Nordell conclusions against mechanical agitation and by analyzing closely the process of changing organic to inorganic matter has come to the conclusion that sewage will in any reasonable treatment get enough oxygen to take care of the "wet burning" process whereby the dead, but fresh, organic material in sludge is ingested and digested into the living stage again, at which point it is "ripe" and ready to be "harvested." Since it is a short step it requires a minimum of oxygen. Further treatment simply reduces the fertilizer value. Probably the most satisfying outcome of Dr. Buswell's tests are his conclusions that activated sludge treatment differs from the tank-and-filter treatment only in degree of progress toward complete mineralization rather than in kind. From the practical standpoint Dr. Buswell is quite emphatic in stating that the laboratory apparatus used was for experimental purposes to determine factors by isolation or by making certain of them constant rather than to point the way of future plant design.

Special and Universal Standardization

NEWS of the formation of a body to deal with marine standardization, as just reported, makes an interesting addition to the story of the development of standardization methods, and recalls various doubts and misgivings that have existed. Technical standardization until recent years was parceled out into many small specialty fields, apparently each unrelated to any other. Then followed the successful attempt to bring all the work under central control, wiping out the boundary lines between fields, by the establishment of the American Engineering Standards Committee. It was a swing from an extreme to the opposite—from narrowest limitation to vague, formless universalism. Now comes the first sign of a return to an intermediate position, with specialization again claiming its place. Both of the extremes have weaknesses that are more or less obvious. With intensive specialization, the narrowness of objective is (or was) frequently accompanied by narrowness of view, leading to disregard of essential considerations and therefore yielding unsound results. With the wiping out of specialization came loss of aim and vital impulse, so that the results produced were apt to be bloodless. Somewhere between, in some intermediate conditions, there must be a minimum of faults and a maximum of efficiency. It may be that the reestablishment of independent specialty standardization in the marine field will help in bringing us nearer this ultimately desirable adjustment.

Women Engineers in England

WHILE this country can boast a few women engineers, it certainly has not reached the stage of England where, we note from a recent copy of the Manchester *Guardian*, there has been an annual meeting —the first of its kind—of the Women's Engineering Society. They came together at Birmingham University in April with some forty delegates. According to the account, there was a paper by a Miss Partridge, B.Sc., on her practical experience in electrical contracting; another on some considerations of electrical design by a lady who is an associate member of the Institute of Electrical Engineers; and a lecture, with lantern slides, on the development of the woman engineer in France by Madame Laurent, a director of the École Technique Feminin de Paris, which would indicate that in France, too, women are going into engineering work. Mrs. Frank B. Gilbreth, the well-known wife and coworker of the equally well-known American efficiency engineer, was to have spoken but was kept away from the meeting by illness. While we adhere to the feminist view that women are people and that therefore sex is a curious basis for technical society segregation it is obviously our duty to record this latest development.

Charging for Highway Service to Foreign Trucks

ROAD traffic counts in Connecticut indicate that 40 per cent of the net tonnage is carried by foreign trucks. These trucks pay no fee for operating on Connecticut highways. Assuming that the damage to roads is proportional to tonnage carried, the condition is considered to require action. In any event, action has been inaugurated by introducing into the State Legislature a bill imposing a tax on trucks from other states which operate in Connecticut more than a certain few days a year.

There is prophecy in this action of a contingency which confronts all state highway departments. Although few states have now so dense a traffic of foreign trucks as has the state named, it is only a question of time when it will exist in many states. What then is to be the solution? May we assume that there will be an equal interchange of road service which balances all charges of road damages by foreign trucks. Such a complete mutuality of road service between states seems unlikely although we have no sufficient traffic records to furnish proof one way or the other. Are truck operators to pay a tax or license fee in every state of the group in which they operate? There are already several groups of states in which truck haulage is an interstate operation. New York, Connecticut, Massachusetts, and Rhode Island form one group. Another is New York, Pennsylvania, and New Jersey with Maryland and Delaware possible future units. Or instead of control and regulation by separate states, will there be interstate regulation by a federal bureau?

These questions have more than speculative interest. In a very few years they are certain to press hard for an answer. How well prepared are engineers to answer them? It is true perhaps that most state highway officials have estimated the facts, but these estimates are hardly more than educated guesses. There must be a more solid basis of known traffic facts to establish sound policies and practices. To possess this knowledge traffic surveys must be undertaken in enough detail and for a long enough period to disclose information which at present only one or two state highway departments have. The state highway administration of Connecticut aided by the Bureau of Public Roads has taken an admirable lead in determining highway traffic facts. It should be an encouraging example to others.

City and Regional Planning

THE elemental parts of city planning rather than the comprehensive city plan were dominant at the Baltimore Conference on City Planning last week. This was in part due to the many papers relating to Baltimore on the program but it is in keeping with the history of city planning. That is, it has been and largely still is such elements as streets, water supply, sewers, paving, parks and transportation, each as a rule singly and independent of the other, that are planned and not these and other elements of the city planning in relation to each other and the whole. Perhaps this, combined with the inherent difficulties of planning—or replanning—existing city areas is one reason why so much attention has of late been given to regional planning. Experience has shown that even in the unbuilt areas of a city it is difficult to plan comprehensively, at least with much hope of carrying the plans beyond the paper stage, on account of what might be termed the ossification of the plan of built-up area and lack of co-ordination between the inner and outer area of the city on the one hand and the outlying districts on the other.

This and other things have directed increasing attention to regional planning in the last few years, in the hopes of working in more nearly virgin territory and fixing at least the main trunk and limbs of the skeleton of a plan covering city, suburbs and satellite cities before lines are so fixed as to make co-ordinated regional planning difficult and costly if not prohibitive. Naturally enough, studies of regional planning did not go far before it was seen that some degree of zoning is almost as essential throughout a whole region as within a single municipality. As soon as regional zoning was given detailed consideration it became evident that it presents serious difficulties not found in city zoning due to a multiplicity of local administrative units in place of the single governing body of a city, town or village. These difficulties should not prove insurmountable, but they call for a large and broad-minded co-operation between municipalities, with perhaps county or inter-county and even state direction, as well as for able leadership and competent technical advice.

Counteracting Boom Psychology

WITH the air of one who finds the misfortune of his friends not altogether displeasing, the New York correspondent of the London *Times* reports to his paper that the United States is riding to a financial fall. "The simple truth is," he says, "that what has been described as 'boom psychology' has seized the public. A continually rising stock market, a runaway market in building, in steel and in motor cars, humming factories, labor fully employed at very high wages, the newspapers full of company reports showing enormously increased production in the basic industries, easy money, extravagant expenditure everywhere—these are influences toward excitement which few human beings can resist. All of these are present now in the United States. . . . The last phase of the business cycle has begun. Nobody can tell how long it will continue, because no one can know whether caution will intervene to check a forward movement already too rapid in its pace or whether the recovery presently will bolt, with the bit between its teeth. Of the two alternatives the latter seems the more probable, if only because excessive optimism is the American national vice."

One lone correspondent's view of the business situation would not be very important were it not for the fact that that view is commonly held by a number of people, who do not see that the very prevalence of the view is the protection against the catastrophe they anticipate. If we can only get enough people to have the same worry the contingency they worry about will by that fact be apt not to occur.

It is true that this country is enjoying remarkable prosperity. Every statistical figure for the current year shows unprecedented production, rising wages, increasing sales and import taxes and lowering unemployment. These indices of prosperity are, to be sure, accompanied by rising prices, but so far, at least, this rise has not kept pace with the production and consumption averages, the excess of which over price averages is a fair measure of prosperity. Judging by the history of such booms the curve will go on and up until a sudden and unlooked-for break carries it far below a normal level. It is just such progress that the *Times* correspondent predicts.

This year, however, the business men of this country are better prepared to prevent such an occurrence than ever before. The fall of 1920 is still a horrible memory. That summer, too, all the indices of prosperity were rising, and in the optimism following the depression of war almost every one lost a sense of values and plunged on and on in an orgy of production and price elevation. The inevitable happened—a "buyers' strike," with consequent cancellations, overstocking and a depression which took nearly three years to outlive. Ever since, the lesson of unwisdom has been hammered home. With that lesson in mind, optimism—at least excessive optimism—should have ceased to be an American vice.

There are signs already that those who control affairs are taking heed of the lesson of 1920. Undue expansion is being checked in every business organization, unnecessary building is not encouraged, financiers are opposing the large bond issues for public improvements, the federal government has announced a policy of decreased public works, architects and engineers are advising against projects which can well be withheld. Prices and wages, even, are going up with a slowness indicative of economic necessity rather than with the eager rapidity of 1920. Certainly, the business world is going into the summer with full recognition of the signs in the road. To foresee trouble is the surest way to avoid it.

Nor does there seem to be any reason for those in the construction field to be fearful that a too widespread warning against expansion will result in a too sudden shutting down of construction. There is small danger of that now. Already the prospective work for the coming year is great enough to engage all the men and material that are available. Much more than the normal flow of business for the next few months would swamp the productive capacity of the industry, and cause just the trouble we are trying to avoid. The time has now arrived for the longer view; for an appreciation of the fact that tomorrow's job is nowhere near as important as next year's job and that in the long run it avails nothing to profit greatly for a while if such profiting means losing much more over a long period.

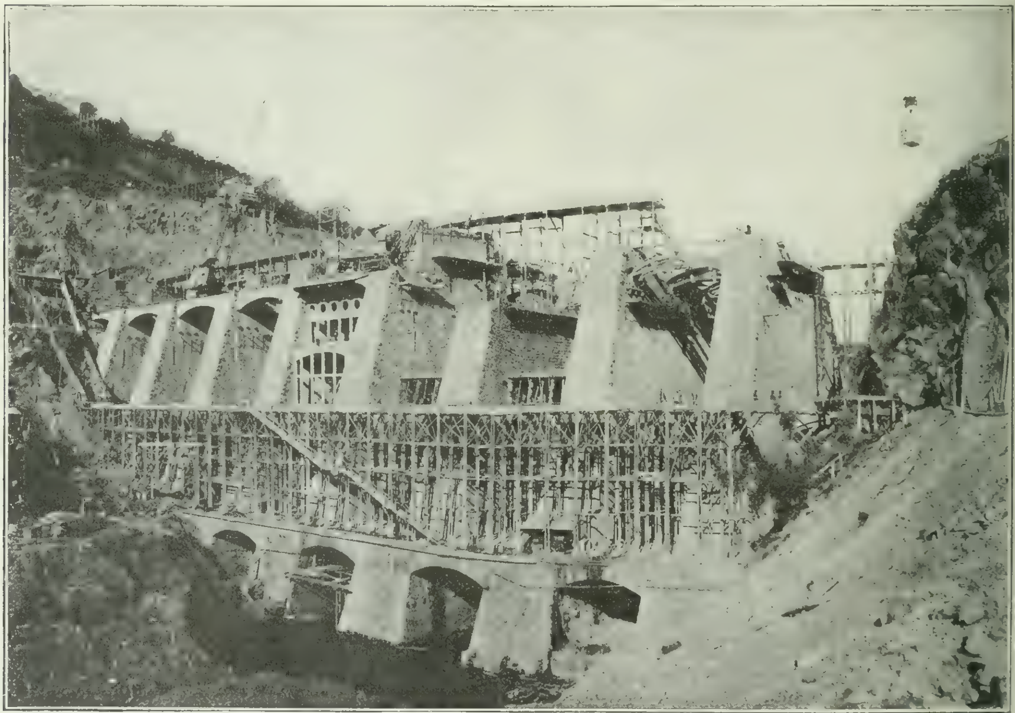
The time has come, too, for the personal application of the general advice against overexpansion and undue prices. The individual counts for much in the control of the business cycle. In all of the suggestions of the Hoover committee, governmental or group action plays a minor part. The burden of smoothing out the curve rests on the collection of individuals. This may seem impractical and idealistic but in reality it is the most practical and materialistic advice in the world. Each individual either in person or in a corporation must act now as though his action would control the mass. A material man who raises prices for undue profit; a labor leader who blackmails a higher wage out of a driven contractor; an engineer who advises or starts an unnecessary piece of construction; each will be responsible for the break that will surely follow their combined performances. For each to consider himself the controller of the situation will hold the curve of progress within normal bounds and by so doing each will help to prove our English prophet without honor even in a country not his own.

Record Height Multiple-Arch Dam Under Way in Italy

Tirso Dam for Power and Irrigation on Island of Sardinia Is 200 Ft. High and Has Seventeen Reinforced-Concrete Arches on Stone Masonry Buttresses

By I. Gutmann
With the Hydraulic Division of the Electric Bond & Share Co., New York City

THERE is now nearing completion in western Sardinia, Italy, a multiple-arch dam 200 ft. high—the record for that type of dam—which is of novel design in that the reinforced-concrete arches of the deck are supported on cut-stone masonry buttresses. It is known locally as the Santa Chiara di Ula dam, but it is across the Tirso River, and has also been called the Tirso Dam. The dam is the main structure of a power and irrigation project, generating some 30,000 hp. peak capacity and irrigating about 75,000 acres.



DOWNSTREAM FACE OF WORLD'S HIGHEST MULTIPLE-ARCH DAM UNDER CONSTRUCTION
The Tirso dam in Sardinia is 200 ft. high and has seventeen 49.2-ft. span reinforced-concrete arches on stone masonry buttresses.

The Tirso is the principal river on the island. Its drainage area above the dam site is about 800 square miles. The region of the watershed is semi-arid, not unlike the coastal ranges of California in its character. Naturally, the discharge of the river varies greatly, viz., from nearly zero, in the middle of summer, to 35,000 sec.-ft. after heavy rainstorms, in winter. According to an estimate based on stream flow studies, the average available discharge of the river is about 700 cu.ft. per second.

The reservoir formed by this dam will have a surface area of some 8.5 square miles and will store some 330,000 acre-ft. of water; in other words it has about 85 per cent of the capacity of the Ashokan reservoir, but not quite one-fourth of the Roosevelt reservoir. The reservoir will irrigate ultimately some 75,000 acres of land. Of these some 12,000 acres are covered with malarial swamps, which are being drained while the dam is built.

The power station will be of 10,000 hp. normal capacity and 30,000 hp. peak capacity. It is worth while noting here that the power station is being built within the body of the dam, in its five central panels. From this station energy will be supplied to all points on the island, particularly to the zinc and lead mines.

The reservoir will also prevent the floods which used to ravage the lowlands of the Tirso basin.

Description of the Dam—According to the designers the multiple-arch type was adopted not so much on account of its being more economical than a gravity dam (the saving in this case is said to amount to 20,000,000 lire) as on account of its being deemed safer as to temperature cracks, a consideration especially important for dams in arid and semi-arid regions where the lowest temperatures occur at the time of highest water.

The dam will be 200 ft. high (61 m.), counting that height as the distance between the continuous crown of the arches (110.0 m.) and the average foundation (49.0 m.). High reservoir level is El. 109.0 m. and low tailwater is El. 52.6 m. The foundations of some of the buttresses are, however, many meters below the 49-m. level. The foundation rock is trachyte. Tests have shown that its crushing strength is about 11,800 lb. per square inch.

There will be altogether seventeen arches of 15-m. (49.2-ft.) span. The buttresses are trapezoidal in shape. Their upstream slope is 57 deg. to the horizontal and the downstream slope is 70 deg. 40 min. to the horizontal. The top of the buttresses is 5 m. (16.4 ft.) long. Their length increases downward in accordance with the formula: Length = (distance from top) + 5 meters. At El. 49 m. (base of dam) the buttresses are 66 m. (216.5 ft.) long. At El. 61 m. the buttresses are prolonged to carry on arches a road to serve the power station. The thickness of the buttresses varies parabolically from 2.50 m. (8.2 ft.), at the top, to 7 m. (23 ft.) at El. 52 m. Below this level a uniform thickness of 10 m. (32.8 ft.) is maintained. The buttresses are built of rough pointed trachyte stone and are faced with ashlar. The courses are horizontal, except within the zone of the most intense pressures, i.e., within the triangle at the downstream toe, where the courses are inclined normally to the resultant pressures. To every three square meters of buttress wall there is a steel tie-rod, hooked at the ends, which binds the masonry laterally. The ends of the tie-rods will support the brackets of a movable inspection foot-bridge.

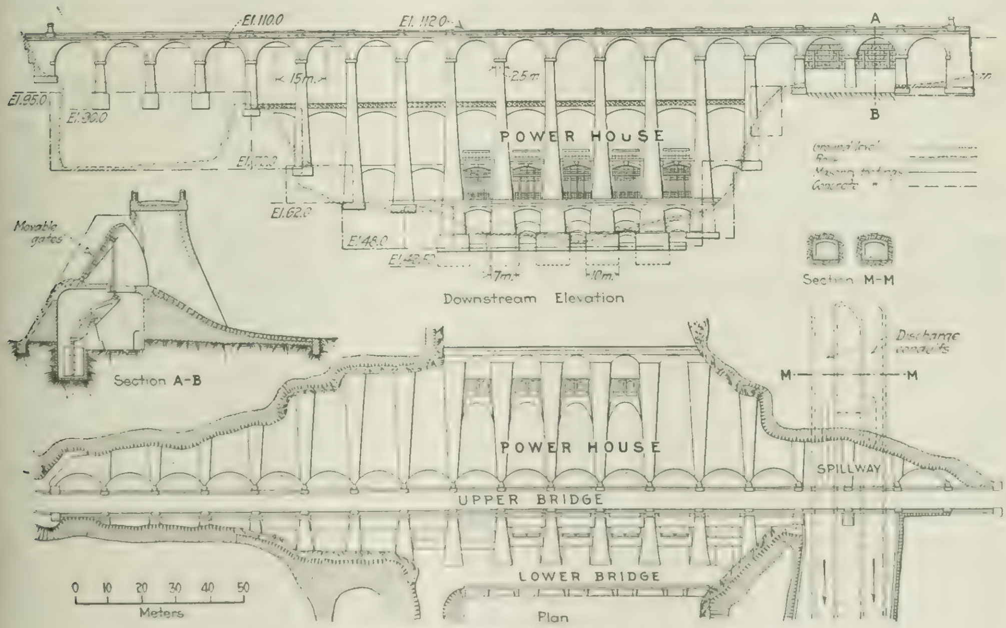
The maximum compression in the buttresses has been calculated not to exceed 191 lb. per square inch.

Pressure Measurement—It is proposed to measure the actual pressures within the masonry of the buttresses by means of carbon sticks fitted into stone blocks embedded in various levels of the buttresses. It is well known that the electrical resistance of carbon varies quite regularly with mechanical pressure exerted upon it. Holes will be drilled through the stone blocks, carbon sticks a trifle smaller in diameter will nearly fill the holes and the remaining free space will be paraffined. The sticks will be connected with an electric bridge and calibrated for pressure. Later these blocks and carbons, provided with insulated wires, will be embedded in the masonry and their resistance observed. The pressures will be calculated from the observed resistances.

The buttresses are strut-tied by means of four series of arch bridges. Besides the bridge carrying the power station roadway, mentioned before, there is also a series of four bridges, 3 m. wide, at El. 70 m.; and a series of three bridges, 2.50 m. wide, at El. 90 m. The buttresses are further braced at the top where they are crowned with a massive series of semi-circular vaults, 12.50 m. in diameter, carrying the provincial highway. The highway is protected with a solid parapet of gray-azure granite. The gray azure on top of the reddish trachyte will make a very pleasing color scheme.

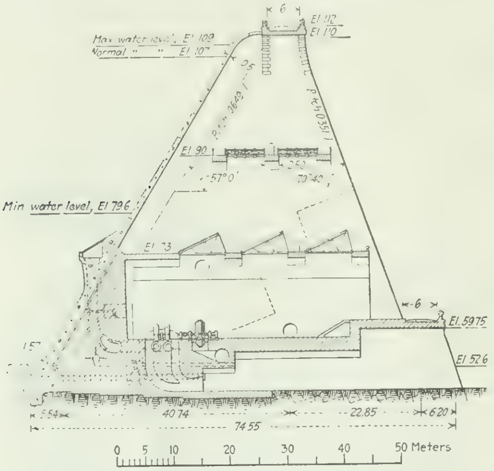
Communication between the bridges strut-tying the buttresses is made possible by foot-walks clinging to the buttress-walls and by means of openings made in the buttresses. There is only one opening to a buttress for each series of bridges.

Deck Design.—Upon the stepped upstream slopes of the buttresses rest the inclined reinforced-concrete



PLAN AND DOWNSTREAM ELEVATION OF THE 200-FT. MULTIPLE-ARCH TIRSO DAM arches forming the face of the dam. The arched decks rise from a concrete escarpment built along the floor of the valley and penetrating the rock to a depth of some two meters. The arch rings, which are 15 m. in span, have been designed on the principle: rise equals one-third of span. This implies a constant angle of 133½ deg. The arch rings vary in thickness from 50 cm. (19.7 in.) at the top of the dam to 1.67 m. (5 ft. 6 in.) at the bottom of the central panels.

Within the uppermost 10 m., the arch rings are reinforced both at the extrados and at the intrados, carrying 8.12 kg. of steel per square meter; below this section only the extrados are reinforced with 3.64 kg. of steel per square meter. The reinforcement consists of longitudinal double bars 10 mm. in diameter, spaced 20 cm. apart; transverse bars towards the extrados, 4 mm. diameter, 25 cm. apart; and expanded metal 1.10 kg. per square meter.



SECTION THROUGH DAM SHOWING POWER HOUSE AND BUTTRESS

The upstream surface of the arched deck is covered with asphalt below the penstock inlets and with gunite and waterproofing mixtures above that level.

The arch spandrels are partly filled by means of a heavy concrete slab reinforced as the arch and anchored in the buttress with steel rods. The top of the arched decks is provided with a heavy cope to shed the water off the arches.

The decks are true arches only for a height of 37 m. (121.4 ft.) from El. 73 m. to El. 110 m. Below El. 73 m. the arches have a permanent centering of masonry and back of it a heavy mass of stonework, in which the power station is housed. This great mass of masonry has been provided in order to dampen the vibrations produced by the power station machinery, also in order to compensate for the penstock holes in the arches and in the buttresses. Vertical drains run along the upstream face of this mass of stonework, intercepting seepage through the decks and discharging it into a main drain running along the base of the dam. About El. 63 m. another egg-shaped main drain, which is also an inspection gallery, runs through the center of the masonry mass. Blind adits radiate from this gallery upwards as well as laterally. These adits are numbered in order to facilitate reporting seepage conditions within the dam. Water from these adits and gallery is discharged into the tailrace of the turbines by means of a pipe 60 cm. (nearly 2 ft.) in diameter.

Power Station—The power station occupies the five central panels of the dam. Four panels house the turbines and motors, while the fifth holds the transformers and other appurtenances. There are four pairs of reinforced-concrete penstocks corresponding to four pairs of turbines, one pair to a panel. A pair of penstocks originating in one panel feed a pair of turbines located in an adjacent panel, east of the first, the penstocks going through the buttress separating the two panels. The penstocks were skewed in this fashion in order to avoid sharp curvature in them. The penstocks are sufficiently reinforced to withstand full maximum pressure on their outside, at a state of vacuum inside of them. They are protected with strong grizzlies and have a double control consisting of a plug in the grizzly chamber and a sluice gate located just back of the arched deck. There is in addition also the gate control of the turbines.

The power station is equipped with: two double horizontal turbines of 6,000 hp., total 24,000 hp.; two double horizontal turbines of 9,000 hp., total 36,000 hp.; and one auxiliary turbine of 60 hp.

Four three-phase alternating-current dynamos of 5,000 v. are coupled to the turbines. The current will be transformed from 5,000 v. to 75,000 v. The transformers are housed in a separate panel which is divided into seven floors and is provided with an elevator running in a shaft 40 m. high. Communication between the five panels is effected by means of openings, 2.50 m. in diameter, made in the separating buttresses. Four traveling cranes may be run through these passages.

The power station will be roofed with trussed sheds and its walls will be faced with majolica and polished stucco. Its front will consist largely of huge windows, 8 by 11 m. (26.25x36 ft.) each.

The floor of the power station is at El. 58.1 m. The axes of the turbines are at El. 59 m., the normal level of the tailrace will be at El. 52.60 m., giving a suction of 6.40 m. (21 ft.) in the draft tube. At very high water the level of the tailrace may reach El. 59.75, and then the power house will be flooded. The draft tubes discharge into a channel 5 m. wide which also carries the discharge from the galleries draining the dam as well as the discharge from two valve-controlled scouring pipes, 0.95 m. (3 ft.) in diameter, laid at El. 52 m

Reservoir Outlets—The reservoir has no open crest overflow spillway. High floods are to be taken care of by gate-controlled outlets, near the eastern abutment of the dam, of a total capacity of 800 cu.m. per sec. (28,250 sec.-ft.). The gates are of a cylindrical type. They can be worked by man power and can also be adjusted to become automatic in action for any desirable level within a certain range.

There are also two tunnel outlets, near the eastern abutment, 37 m. (121.4 ft.) below the top of the dam. These outlets are controlled by means of four sluice gates and will discharge 800 cu.m. per sec. (28,250 sec.-ft.) when operated at full head.

With simultaneous operation of all the outlet means, including the penstocks and the scouring pipes, a discharge of some 2,000 cu.m. per sec. or 70,000 sec.-ft.

can be taken care of, which is about 87 sec.-ft. runoff per square mile of watershed. The outlet provisions can by no means be considered excessive. They are likely to be inadequate inasmuch as there is no simple overflow spillway and as the operation of all the outlets depends upon human factors and fairly intricate machinery, which may fail at the critical moment. Recent Californian practice is to provide open overflow spillway capacity at the rate of 200 sec.-ft., or more, per square mile of watershed.

Foundations—In the bottom of the valley, under a covering of very hard rock, there was discovered a thin layer of sand overlying a dark tufaceous rock, readily soluble in water. The porous tufa was excavated and masonry was substituted in its stead. A deep pocket of similar tufa was found also under three buttress-sites at the western abutment. The footings of these buttresses were enlarged and a concrete diaphragm was built down to El. 72 m. which is well within firm rock. A concrete diaphragm of varying depth is built all along the dam profile.

Construction Details—The construction of the dam was commenced in 1917 during the worst period of the war, about the time of the Caporetto disaster. The island was blockaded and all the able-bodied men were at the front. Labor, necessary supplies and transportation means were hardly available.

The dam site is situated in a very unhealthy, malarial region. In spite of the fact that all the men were taking quinine regularly and that some drainage work was promptly executed, many lives were lost and the efficiency of the men was greatly reduced. During the war the force consisted of 400 Austrian war prisoners. After the armistice, with the return of the Sardinians from the front, things picked up, going at a very satisfactory rate ever since. By now about two thirds of the work has been done.

The stone and sand come from nearby sources. The mortar used is made of equal volumes of sand and crushed basalt and about 507 lb. of cement to the cubic yard. At the age of 28 days it averages 1,900 lb. per sq.in. in compression, and 220 lb. per sq.in. in tension, at 180 days 3,980 lb. per sq.in. in compression and 497 in tension.

The buttresses and arches have been built at the same time. No great floods have occurred and the sluices under the center of the dam have been adequate so far.

Power is produced in a fuel electric plant of 411 hp. maximum capacity. Power costs about 40,000 lire per month. The construction plant consists of the following main items: Aerial cableway, 220 m. (722 ft.) long, 70 mm. (2¾ in.) cable diameter, 7 tons capacity; towers, one stationary and one oscillating, 22 m. (72 ft.) high; traveler, 8-m. (26.24-ft.) span, 4 tons capacity; two electric cranes with 29-m. (95-ft.) struts, of 20-m. (66-ft.) working radius, 2 tons capacity; two steam cranes, three four-ton derricks, two winches on towers 20 m. (66 ft.) high, eight motor winches, etc. four air compressors, one cement gun, one grout injector, two half-yard concrete mixers; rock-crushing plant; power drilling rig capable of drilling to a depth of 400 m. (1,312 ft.); one hand-drilling rig; seven large pumps, one working against a head of 680 ft. and making 4,000 r.p.m., the belt running 124 miles an hour; two steam trucks; five 35-hp. tractors with four five-ton trailers to each; a thirty-ton trolley car, etc.

The laborers' camp can accommodate 1,300 men. It is provided with a flour mill and bakery. There is also a steam laundry equipped with a drying chamber, electric ironing machine, etc. There is a large public bath with showers and dressing rooms. There is a hospital with twenty beds, an operating room fully equipped for major operations, a bacteriological laboratory, X-ray cabinet, etc.

The concession for the Tirso development is held by an Italian company, Imprese Idrauliche ed Elettriche di Tirso. The dam was designed by Luigi Kambo, who also superintended its construction during the early stages. The project has been described in the *Annali del Consiglio delle Acque Pubbliche*, published by the Ministry of Public Works of Italy.

Precast Concrete Slabs Replace Wood-Block Bridge Floor

A PLANK and wood-block floor has been replaced by a floor of precast concrete slabs on the easterly half of the Connecticut River bridge connecting Holyoke and South Hadley, Mass. The change was made to reduce maintenance costs, which were high. Eight years' wear of the old floor, consisting of creosoted wood block on 4-in. chestnut planks, produced so uneven a surface that a new floor was necessary, and it was decided to pave with concrete. As traffic had to be maintained, precast slab construction was chosen.

The slabs were cast in a yard near the bridge. To assure a good fit of the slabs the floor of the bridge, which is slightly skewed, was laid out in the yard, and steel members were set in the same position as the stringers and floorbeams and to the proper heights, determined by accurate levels. The bottom of the mold between these members was formed of sand, except that wooden forms were used to shape arched recesses in the bottom of the slabs. The slabs are about 8 x 20 ft. in size, 13 in. thick at the ends and 6 in. thick at the arched crown, and weigh 8½ tons each. They fit excellently when placed in position. The car-track strip, on one side of the bridge floor, served to carry traffic around the working point on the floor.

According to a brief description of the work by H. W. Woodill, in the Portland Cement Association's *Concrete Highway Magazine* of February, the trusses of the bridge, 160 ft. in span and of double-intersection web type, were strong enough to carry the added weight of the concrete floor, but the stringers and floorbeams were not adequate. The floor system was therefore reinforced by putting in additional floorbeams, midway between the old floorbeams, spaced 16 ft., and suspending the new floorbeams by hangers from the intersections of the web members.

The concrete slabs were molded early in the fall of 1921 and placed on the bridge last summer.

Minutes, Not Feet

In "Four Problems in Surveying," an article by L. F. Hammond in the April 26 issue of *Engineering News-Record*, the fourth line from the end of the article read: "If 'a' is under 10 ft., . . ." whereas it should have read: "If 'a' is under 10 min., . . ."

New Water Purification Plant at Norfolk, Virginia

Aerator Weirs—False-Bottom Underdrains, Coagulant Basin Superimposed on Clear Well—Flume Type of Wash-Water Tank

SEVEN-DROP weir aerators, concrete false-bottom underdrains, a flat concrete wash-water tank over the filter operating gallery and a clear-water basin under the coagulation basin are features in the new filtration plant at Norfolk, Va., put into operation late in 1922. The plant is one portion of the improvements and extensions that have been under way since 1920 when a providential rain saved the city from a water famine. So low had the supply dropped that steps had been taken to pump salt water into the mains for fire protection and sanitation and to supply drinking water to the 120,000 inhabitants from tank cars, motor sprinklers and wagons. The new system comprises the Lake Prince 4-billion-gallon storage dam, 20 miles west of the city, connected to the distribution system by 18½ miles of 30 and 36-in. cast-iron, wood-stave and concrete pipe. A pumping station below the dam, housing three 15-m.g.d. motor-driven centrifugal pumps forces water through these mains to the filtration plant located a half mile from the Elizabeth River crossing in the western part of the city; designed for a normal capacity of 24 m.g.d. only one-half has been installed. The following notes on the plant are taken from a paper by Walter H. Taylor, III, city engineer, presented recently before a convention of engineering societies at Richmond:

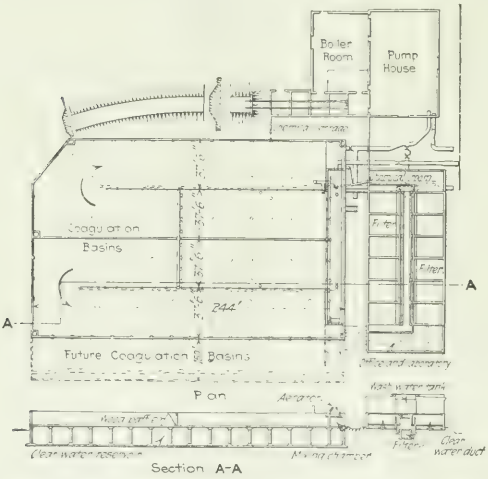


FIG. 1—GENERAL PLAN NORFOLK FILTRATION PLANT

On reaching the filtration plant (see plan, Fig. 1), the raw water is dosed from alum tanks located on the ground floor of the chemical house in the western part of the filter building. For convenient charging from the second floor, the chemicals in carload lots are received on the second floor and stored on both floors. Orifice tanks control the rate of dosage and hydraulic ejectors force the solution into the main. This arrangement made unnecessary an elevated "head house."

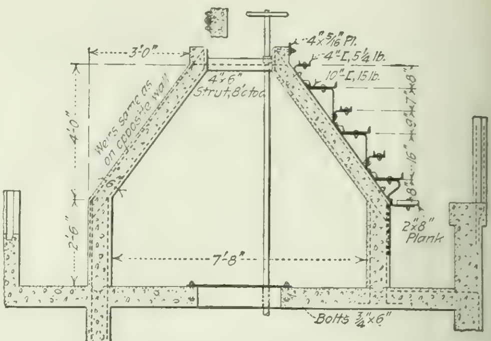


FIG. 2—CROSS-SECTION OF WEIR AERATORS

Mixer—A few feet beyond the point where the alum solution enters the main, the water passes into a baffled mixing chamber, where the velocity is 0.8 ft. per second and the detention period seven minutes when operating at the rate of 12 m.g.d.

Aeration—Immediately above the mixing chamber is the aerator (Figs. 2 and 4). The water falls successively over four weirs each side, and between weirs it is broken into a spray by splash plates. This arrangement of aeration of water after passage through the mixing chamber was adopted not only to remove tastes and odors but also for the double purpose of giving a final mixing of the water and alum solution and to release carbon dioxide formed by the chemical reactions.

Coagulant Basins—From the aerator the water passes to the two coagulating basins, designed for a detention period of five hours. Each basin, midway of the first passage, has a baffle or skimmer, made of wood to permit of change of location if desired. In front of this baffle is a row of mud valves connected to the cast-iron sewer. By an occasional opening of these valves it is believed that large quantities of the precipitated matter, mostly of a vegetable nature, will be removed, and thereby greatly lengthen the period between dewaterings of the basins for thorough cleansing. Both basins are connected to the influent duct to the filters. In leaving the basins the water must pass over a submerged weir wall, which is designed as a further precaution against passage of sediment to the filters.

Clear Water Storage—Beneath the coagulating basins, and occupying the same area, is the clear-water reservoir

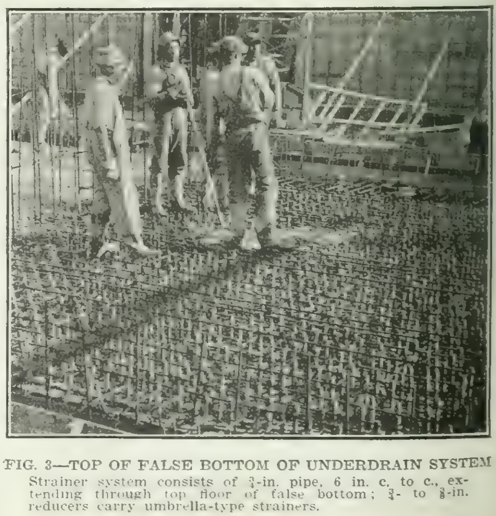


FIG. 3—TOP OF FALSE BOTTOM OF UNDERDRAIN SYSTEM
Strainer system consists of ¾-in. pipe, 6 in. c. to c., extending through top floor of false bottom; ¾- to ⅜-in. reducers carry umbrella-type strainers.

of 3,500,000-gal. capacity. The floor of the coagulating basins forms the roof of the clear-water reservoir and is a 10-in. flat slab with 4-in. drop panel supported on 20-in. columns spaced 15½ ft. each way. The columns rest on the floor of the reservoir, which is of similar design, a flat slab, but inverted, to spread the load evenly over the soft underlying sand. The bottom slab is extended outward, forming footings for the side walls. As the excavation was 11½ ft. deep the added pressure on the subsoil amounts to less than 1,000-lb. per square foot.

The concrete work of the reservoir and basin was carried forward in a manner to produce a minimum number of construction joints. Slab sections 31 ft. wide by 150 ft. long were poured in one continuous operation. Each construction joint had a 6-in. copper strip carefully imbedded 3 in. in the concrete each side of the joint. Two per cent of fine clay was added to the cement for making the concrete for the floor of the coagulating basin. No "chuting" of concrete was allowed, each batch of concrete being hauled in cars from the mixer to its location in the slab. No leakage has occurred through the slab from the 10 ft. of water standing in the coagulating basin.

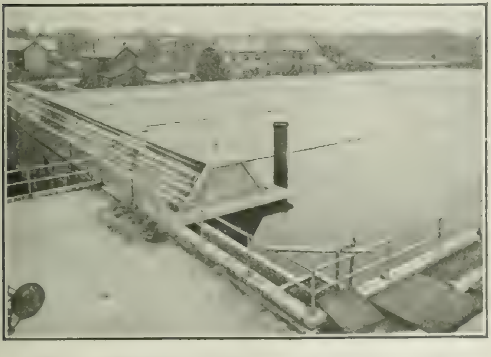


FIG. 4—AERATOR AT END OF COAGULATING BASIN
Two round-the-end baffled basins of 4-hour detention period are preceded by 7-fall weir aerator to remove tastes and odors.

The manner of superimposing the coagulating basins upon the clear-water reservoir resulted in great economy of funds and saving in land. The unusual purity of the raw water in this instance made it a safe procedure.

Filters—The twelve filter tanks have a normal capacity of 1 m.g.d. each. Instead of the usual system of manifolds and laterals of pipe, these filters have a "false bottom" 2 ft. deep formed by an 8-in. flat slab of concrete supported by the side walls and six short columns. Set vertically in this slab on 6-in. centers are ¾-in. galvanized pipes (Fig. 3) with ¾-in. brass reducers threaded to the upper ends. These reducers are placed flush with the upper surface of the slab and into them are screwed, Fig. 3 shows, the umbrella-type strainers. Sixteen inches of graded gravel and 30 in. of sand complete the filter beds.

Wash-Water Tank—Wash water is supplied either from a motor-driven centrifugal pump, controlled from the operating floor, or from a wash-water tank. The concrete tank is located under the roof of the building above the operating floor and is 14 x 101 ft., by 3 ft. deep. With this arrangement a uniform head is obtained for the washing of the filters and the unsightliness of an elevated structure eliminated. The tank was poured as a monolith and has been full of water for more than six months without the slightest evidence of leakage on the operating floor.

Col. Dabney H. Maury of Chicago has been acting in a consultant capacity on this work since April, 1920. The project has been under consideration by the department since 1912, under the writer. Norman Z. [illegible] was assistant engineer of design, and also had charge of the erection of the filtration plant. The Stanford & Brooks Co., of Baltimore and Norfolk, were the general contractors.

Los Angeles Engineers Approve Concrete Sewer Pipe in Sea Water

A REPORT of the Board of Public Works of Los Angeles summarizes the information gathered on a trip it made for the purpose of ascertaining from practical engineers their ideas on the value of reinforced-concrete sewer pipe when used in sea water. The reason for the trip was the desire, on the part of the board and the city council, to save approximately $250,000 on the cost of the permanent outfall sewer at Hyperion by substituting 7-ft. precast reinforced-concrete pipe for cast-iron pipe. The places visited on the trip included several cities on the Pacific coast and the Mare Island Navy Yard. At Oakland, Calif., they inspected 1,200 ft. of 36-in. reinforced-concrete sewer pipe, laid in 1907, which is entirely submerged at high tide; and 750 ft. of 5½-ft. reinforced-concrete pipe, laid in 1908, which is two-thirds submerged in salt water. Both pipes were found to be in as good condition as when laid fifteen years ago. W. W. Harmon, city engineer, stated that he considers concrete pipe as durable as cast-iron.

At Alameda, Calif., George Sperbeck, the assistant city engineer, showed the board their concrete sewers and expressed an opinion similar to that of Mr. Harmon.

At San Francisco the chief assistant engineer, Mr. Healy, reported that they had lined a 7 x 9-ft. tunnel with concrete, and that they had also laid reinforced-concrete sewers ranging in diameter from 6 ft. to 11 ft. in which a 1:2:4 mix had been used; that these sewers were subject to ebb and flow tide and were in first-class condition.

Mr. Earl, the supervising engineer of the Public Works Department of the Mare Island Navy Yard, stated that the navy had had so much success with concrete exposed to sea water that it has approved plans for extensive works at the navy yard in which concrete will be used. Mr. Earl stated further that in his experience he had never found any deterioration in concrete when properly made and if submerged at all times. In his opinion 1½ in. of concrete over the reinforcing was sufficient for submerged pipe. The government is specifying in some of its work that wax tailings be used to spray pipe that is to be only partly submerged. It is at present constructing a cooling system at the Mare Island power plant in which sea water will be used. The pipes here will be of precast reinforced concrete.

In view of the foregoing evidence the board recommended that precast reinforced-concrete pipe, of a minimum thickness of 9 in., be used for the mile ocean outlet at Hyperion.

Economy in Engineering

"To accomplish a given result for the least cost is the aim and purpose of engineering. Our architectural friends may find it hard to reconcile this definition with their profession; but I understand that they concede that that which is structurally correct, symmetrically proportioned and harmoniously colored must be good in architecture, and that needless embellishment injures, rather than improves, an architectural design and is therefore WASTE. WASTE the engineer must shun as he would a dread disease. Waste is a disease of our social order. Extravagance in any form of engineering or architecture comes back upon the ultimate consumer." —Walter H. Wheeler, in a recent presidential address to the Engineers' Club of Minneapolis.

Operating Local Gravel Pits for Concrete Road Work

Locating and Testing Deposits—Planning the Pit Equipment—Installing Washers—Analyzing Job Costs

By H. J. Kuelling
Construction Engineer, Wisconsin Highway Commission

Abstract of paper read before the annual meeting of the American Road Builders' Association.

During 1922 in Wisconsin there were constructed 355 miles of concrete road. Of this mileage there were 187 miles on which the fine aggregates were shipped on a railway; 84 miles on which they were trucked or otherwise hauled directly from commercial plants; and 84 miles on which they were produced in local operations. In percentages these ran 52.8 per cent shipped; 23.6 per cent trucked from commercial plants, and 23.6 per cent from local production. In respect to coarse aggregate the corresponding figures were: 153 miles, 119 miles and 83 miles and the percentages were 43.1 per cent; 33.5 per cent and 23.4 per cent. On a basis of two parts coarse to one part fine aggregate, 54 per cent of the tonnage on these 355 miles of paving never saw a railway. This means cheaper concrete roads; a saving in freight; easing up on the burden of the railways; a saving in bond cost, and an easing up for the contractor in the all-important matter of financing his job.

Location Surveys—The location of gravel deposits is the duty of a geologist; all material parties are in charge of a geologist, just as they would be if deposits of lead or iron were being sought. His knowledge of geology shows him where to seek the best supplies. The duty of the engineer, who accompanies the geologist in locating, is to study the deposit from the physical viewpoint of whether or not it can be successfully operated.

Each party is equipped with a Ford ambulance of the type used in the World War. It is also fully equipped with shovels, picks, scales, containers, screens, glacial and soil maps, and any other tools necessary efficiently to conduct the work. Some of the parties carry along small cooking outfits while practically all of them sleep in their cars at night. They are paid salaries and have to maintain themselves but they turn in an expense account for the car. Each party is given a number of proposed projects to cover.

The methods vary with the kind of material being sought. Those parties whose task it is to locate concrete aggregates have to spend more time and take more care in the results than do those parties who are locating surfacing materials.

A party locating aggregate must first try to locate a satisfactory deposit as near as possible to the center of the project. If this is impossible they must widen out in their search, always keeping in mind the disadvantages of long hauls and poor setups. They must also locate in each case the nearest water supply. They usually do some test-pitting, especially on undeveloped deposits, to determine the amount of stripping and otherwise prove their conclusions. In general, a field test is made of the material in the nature of a silt, colorimetric and screen test. Their notes are kept on loose-leaf forms provided by the Highway Commission. The deposits are spotted by section, town and range, and the owners' names are obtained wherever possible. Each deposit is given a location number, these numbers starting at one and running upward consecutively in each county.

Such surveys cost the state in the neighborhood of $40 or $50 per mile of project. After the surveys are made and the field information properly analyzed it is the duty of the materials department and the district office to see that the most promising locations are properly test-pitted.

Testing the Deposits.—The test pitting is exceedingly important. It must be done extensively and thoroughly. If several miles of concrete road are to be built out of a proposed pit, it is necessary very thoroughly to test-pit the site, especially if it is an undeveloped deposit. Enough holes should be dug to determine the extent of the deposit and they should be dug deep enough to determine the working face. Holes 30 ft. and over in depth have been dug by using box sheeting of 2 in. boards 4 ft. long. It is an easy matter to construct a windlass operated by hand, and with a hole 4 ft. square a fairly large bucket can be attached for raising the material. The samples should be taken at the time of digging. The requirement is a sample of 500 lb. pit-run material. The samples should be taken from several different holes. Probably the best method of handling is to sack the material in cement sacks. Tags are filled out and one is placed inside the sack and one attached, after which the sacks are sent express or freight collect to the laboratory at Madison. The man supervising the work also fills out an aggregate sheet furnished by the Commission describing the deposit, which sheet he sends direct to the materials department. Here a duplicate is made and sent to the laboratory and the original is kept in the files.

From these samples tests are made, both on the fine aggregate and the coarse. Sand briquettes are made for breakage at three, seven and ten days. Coarse aggregate is tested in specimens 18 in. long, 8 in. wide and 4.3 in. thick. Specimens of standard material are made at the same time. Both are tested at the same time in a rattler and later in tension and compression. By always running these tests with a standard, we not only can compare the material with the standard, but with any other.

The information thus obtained is placed in the hands of prospective bidders through the medium of the district offices. The cost of testing material from one deposit is estimated to be about $35. If a prospective bidder is still not satisfied he may make an investigation of the material himself, and should by all means make a most careful investigation of all the physical features surrounding its use, such as water supply, topography, soil and roads.

Of course no proposed gravel pit can be guaranteed to be absolutely safe. Even with the best kind of test-pitting a few deposits when opened up will disclose objectionable features which were not apparent before. These may be a pit running to sand, too many oversize boulders, and a pit containing heavy seams of clay. These failures, however, are few, and often where there has been a failure some bit of negligence or ignorance was responsible for it.

All this detail of locating and testing has been given thoroughly to impress the fact that local production requires considerable gray matter before one should think of the equipment and operation.

Pit Equipment—The plant must be stationary; there is no such thing as an efficient portable plant for producing concrete aggregate. Another requirement is adequate bin capacity, for if there be a breakdown in the pit-operating machinery and the bins are filled, the trucks or other hauling equipment are still able to operate. Of course, the entire equipment must be efficient and efficiently operated. Too small a crusher or screens, not enough horse power, poor management, and a poor pump in case of washing, are some of the reasons for a plant not operating efficiently. The contractor in choosing his setup and machinery has quite a problem on his hands. He should look the proposed site over well and take all the factors into consideration. He must consider the distance he is to be from the project and also the method of hauling to and charging the mixer.

A well built and efficient gravel plant for producing aggregates should cost in the neighborhood of $10,000 to $12,000, including the items of erection. The difference is the difference in cost between a washing and a dry-screening plant, freight, erection, etc. A plant of this price has a bin capacity of about 200 cu.yd. which ought to be sufficient. Below is a table showing the approximate cost of a stationary gravel plant:

Crusher	$2,800	2—60 hp. motors	$2,200
Grizzly screen	50	Elevator	500
Blade feeder	300	Screens	400
Cables, sheaves, etc	300	Lumber for bins, etc	1,000
Hoist	1,000	Cost of erection	1,000
Drag line bucket	450		
			$10,000
Cost of washing equipment			$700

Another item, which is really an extra, is the measuring device. Where batch trucks, for instance, are to be used this is an absolute necessity. There have been attempts to construct home-made devices with moderate success. There are mechanical devices on the market which are quite successful. They are, however, expensive as an outfit costs about $500.

Plant Examples—Two plants of one contractor are identical and while not absolute models of perfection they are worthy of description. An arrow-shaped dragline bucket handling about a cubic yard at a time pulls the material up, where it is dumped through a trap onto the blade feeder. This feeder is in the form of an endless belt which has a number of blades fastened thereon. This turns slowly and constantly dumps the material onto the grizzly screen. Thus the material is fed gradually to the crusher while the dragline is making its return trip. The rejected gravel from the grizzly drops into a No. 4 gyratory crusher set at about 1½ in. Then the material is carried up to the screens in a bucket elevator about 50 ft. high and containing approximately 140 buckets. The screens are of the revolving type, 4 ft. in diameter and in sections. The first section is 6 ft. with ¼-in. round openings; the second is 4 ft. with ¼-in. round openings, and the third is 6 ft. with elliptical openings ¼ in. x 1 in. For dry screening a screen of the last section type is probably the best. However, the last section of screen should have 2-in. round openings to take care of any oversize material. A chute could be built from the end of this screen back to the crusher. It has also been found very necessary at times to insert a section of ½-in. round screen to waste the pea gravel sizes when the gravel in the deposit runs fine. Two 60-hp. motors furnish the power for operating this plant. One takes care of the blade feeder, crusher, elevator and screens, and the other operates the double-drum hoist operating the dragline.

The bins for this plant are 11 ft. wide, 36 ft. long, and 14 ft. deep. They are set on a concrete foundation 38 ft. long with a base of 3 ft. and tapering up to 16 in. The horizontal timbers resting on this concrete foundation and supporting the uprights are 10 x 12 in. The uprights themselves are 10 x 10 in. and 12 x 12 in. Seven 10 x 12-in. timbers are used as braces for the uprights. There are also fourteen cross braces 6 x 8 in. in size, seven on each side. The floor joints are 2 x 12 in. spaced on 6-in. centers. There is also cross bracing on the side of 3 x 12-in. timbers, two being used together making six pairs on each side. The floor and sides of the bins are of 2 x 12-in. planks, the studding being the same size as the floor joists. They are double rodded, the long rods being 1½ in. in diameter and the short ones 1¼ in. The bin supports or wales through which the rods are bolted are 6 in. x 12-in. timbers doubled. These hold the whole bin together and there are three tiers of them, the first 1 ft. above the sill, the second 4 ft. and the third 10 ft.

Washing Device—A large proportion of local pits contain enough dirty material to require washing. Washing also expedites the work of the screens, especially on damp days. A number of different types of washers are used. Probably the most common is the old tilting box. The valve control or discharge for the washed sand in this type is dependent upon the weight of the sand contained in the settling tank. There are a few mechanical objections to a washer such as this. First, the inertia of so great a weight makes the valve action slow, so that with uneven feeds the valve does not always close in time to prevent a "runaway." Secondly, a tank of this sort is operated by balanced weights which to operate quickly must be set so that the valve does not close tightly when the feed of sand ceases but while the water is still coming. Sometimes, unless the valve is closed by hand, an amount of water and clay gets into the clean sand already discharged.

There are also steel conical tanks on the market which are quite expensive, but more efficient as the discharge is controlled by volume rather than by weight.

A good many pit operators are using a washer of a different type. This is really a mechanical conveyor settling tank. It consists of a large rectangular wash box of wood, with a discharge for clay and dirty water at one end. The floor of this box slopes upward at the other end to the top. A number of blades are fastened to an endless chain which operates over sprocket gears at either end of the box. These blades dip down into the water, and by close contact with the slanting floor carry the washed sand to the top where it is dumped over into the bins. There is a space at either end of each blade, which permits excess water to return to the tank. These blades continually agitate the dirty water in the tank and keep the dirt in suspension until it is carried off over the spillway. Plenty of clean water must be poured into the tank continually, and it is well to have several sprinklers playing on material as it is pulled up to be dumped into the bins. These washers are sold in two sizes, 4 x 18 ft. and 3 x 18 ft. respectively, and are priced at about $500, exclusive of any wash box lumber. The former size has a capacity of 40 tons of sand per hour and the latter 35 tons.

Any of these washers, of course, is for sand only. It is sometimes and, in fact, always, just as necessary to cleanse the gravel. For this a water pipe with an end spray can be discharged into the screens. This will aid very materially in pushing the sand through the sand screen into the settling tank, and also for separating the sand from the stone, when it has a tendency to stick together in damp weather. It is also advantageous to have a section of closed screen containing angle irons bolted to the sides, which may be termed a scrubbing chamber. One of the principal requisites for a successful washing plant is plenty of clean water. Four-inch pipe should be used, if possible, and a pump powerful enough and an adequate water supply to produce 250 to 300 gal. a minute, is necessary.

Representative Job Costs—From one pit about 6.53 mlies were built. The total job was 7.29 miles in length or 77,176.4 sq.yd. of paving. The low bid on this was $1.07 per square yard exclusive of cement, as against the lowest price bid for commercial material of between $1.12 and $1.16. This is a difference of about 7c. per square yard or a total saving of $5,402.35 on the entire job. However, the facts that the pit was easily obtainable and afforded a good setup, that the hauls were good, and that several contractors were interested who wished to go into their own material production, all had a tendency toward producing one of the lowest bids per square yard in the whole state.

Another job consisted of about 8 miles of 18-ft. paving; the low bid was $1.19 per square yard and the lowest bid per square yard using commercial material was $1.49, or a saving of 30c. per square yard. This meant a saving of approximately $25,344 on this one job. This plant was equipped with a hoist and upright boiler, arrow scraper, one 60-hp. motor, a loader elevator, a bucket elevator, old style washing plant, screens and 160-cu.yd. capacity bins. Provision was made to shoot the rejected oversize stone back into the pit. From this plant approximately 25,400 cu.yd. of sand and gravel were hauled out on the road. This meant an average of 250 cu.yd. a day on the road and does not include an average of about 20 to 25 cu.yd. of material wasted each day. Material was hauled in trucks onto the road and stockpiled every thousand feet. From the stockpiles a fleet of Ford batch trucks carried the aggregate to the mixer.

Another road, 3.3 miles in length, was constructed, the low bid being $1.29 per square yard using local material. The lowest price bid per square yard using commercial material was $1.45, a saving of 16c. per square yard. This means a saving of $5,575.68 on the entire job. The material was hauled onto the roadbed, stockpiled and wheelbarrows used to charge the mixer. This was the second season that the contractor had operated this pit.

Another job of 4 miles was partly constructed, about 3½ miles being built. The bid per square yard using local material was $1.11, whereas the lowest bid per yard using commercial material was $1.35, or a saving of 24c. a square yard. This is a saving of [illegible] for the entire job. The material was hauled on the road, stockpiled and wheelbarrows used to charge the mixer. They had about 6,000 cu.yd. of material stockpiled on the subgrade before the actual paving work started. The equipment at the pit consisted of a bottomless dragline bucket, a plate feeder, a conveyor, a 9 x 15-in. jaw crusher, grizzly, a 36-ft. bucket elevator, a tilting box type washer, screens and bins, a 60-hp. tractor, a double drum hoist and upright boiler, a 10-20 tractor, and a centrifugal pump. The bin capacity was small, holding only 90 to 100 cu.yd. Provision was made to shoot the oversize stone back to the crusher. The 10-20 tractor furnished power for the pump which had a capacity of 450 gal. a minute, but only about 300 gal. a minute were actually used. The production of this plant was small as it averaged only about 150 cu.yd. of sand and stone to the road per day. The smallness of the crusher was greatly to blame for this as the 9 x 15-in. jaw crusher was only capable of a capacity of about 10 to 15 cu.yd. an hour. What they should have had in its place was a gyratory crusher No. 3 or 4-in. size. The bin capacity was small and the whole plant was not constructed in as stable a manner as possible, probably accounting for the numerous delays and breakdowns. It seems true also from various observations that a scraper of the arrow type will handle a larger amount of material than the bottomless bucket.

One county operated two local plants. One contractor built about 40,634 sq.yd. using material from one of the county pits. His price for this of $1.16 per square yard was based on material at $1 per cubic yard in trucks at the pit. This material had he shipped it in would have cost him $2.18 per cubic yard for gravel and $1.90 per cubic yard for sand in trucks at the destination. The comparative hauls were about the same.

The other county pit kept two pavers going and about 8 miles of road were built using this material. It is rather difficult to get at the saving involved here as the contractor's bid did not include a material price, this being furnished him by the county. The county highway commissioner, however, believes that material was being produced in stockpiles for about 70c. a yard. Shipped-in sand and stone would have cost $2.03 and $2.20 per yard respectively unloaded in stockpiles or bins. As in the neighborhood of 26,000 cu.yd. of sand and stone were used in building the road it will be seen that considerable saving was involved (at least $30,000) by developing a local pit.

Decline in Typhoid and Other Death Rates

The typhoid fever death rate fell from 19.1 to 5.6 per 100,000 in the eleven years between 1912 and 1922 among the risks of the industrial department of the Metropolitan Life Insurance Co., of New York City. In the same period the decline for various other communicable diseases was: Diarrhea and enteritis (all ages) 27.6 to 10.7; tuberculosis (all forms) 212.9 to 113.4; communicable diseases of childhood, (measles, scarlet fever, whooping cough and diphtheria) 46.2 to 29.6; influenza and pneumonia, 116.2 to 94.7 and pneumonia alone 103.9 to 73.3, but with an influenza increase from 12.3 to 21.5. The 1918 rate for influenza and pneumonia combined was 542.2; for influenza alone, 272.4 and for pneumonia, 269.8. Accidents (all causes) fell from 73.8 to 57.7 and railroad accidents from 9.2 to 4.1; but automobile accidents rose from 3.0 to 13.5. Even diseases of the heart fell materially for the eleven years 143.8 to 126.0, but a sudden drop to 113.9 in 1919, the lowest year of the eleven, was followed by a rise to 117.0 in 1920, 117.4 in 1921 and, as stated, 126.0 in 1922. The general death rate fell from 12.01 per 1,000 in 1912 to 5.6 in 1922. The curve continued to fall in 1918, the influenza year, when the rate was 11.5, and dropped suddenly to 7.3 in 1919. Details for these and other causes of death are given in *Public Health Reports* for Feb. 23, where it is stated that the rates for 1922 are based on company records of approximately 14,000,000 risks.

Tar Impregnation for Concrete Drain Tile

CRUDE water gas tar is being investigated by the U. S. Bureau of Public Roads as a protection for concrete subject to alkali water attack. The methods of impregnating the concrete and the tests themselves are described in a recent paper by E. C. E. Lord, as follows:

The materials tested consisted chiefly of sections of well seasoned 6-in. concrete drain tile containing very little coarse aggregate, and ordinary 1:3 tension and compression strength specimens. The tile sections, after thorough drying in air, were immersed in thin liquid water gas tar at room temperature for a few minutes until all air had been expelled. Then they were removed from the bath and allowed to drain and dry out in air, or they were heated in the air bath at 110 deg. C. for four hours. In some cases two treatments of this kind were given in order to assure a complete penetration of the tar. It was found that the maximum amount of tar absorbed in this way was from 7 to 8 per cent after draining for 24 hours, and about 4½ per cent upon drying out in the air bath at 110 deg. C. Mortar specimens for tension and compression tests were treated in the same way, but were allowed to remain in the tar for six days before drying in the air bath.

To estimate the penetrating value of this tar, sand-mortar cylinders 4 x 2 in. were cured for seven days in damp air, dried in the laboratory for six days and then placed in glass-stoppered jars containing 25 cc. of tar. After one month it was found that the tar had penetrated uniformly upward to a height of from 2¾ to 3¾ in. above its original level. A 3½-in. concrete slab (18 x 24 in.) cured in the same manner was given seven coats of tar at about 2-hour intervals. In all, this was at the rate of about ¼ gal. per square yard and the tar penetrated to a depth of ¼ in.

Exposure Tests—Analysis of disintegrated concrete drain tile after exposure to alkali soil waters has indicated in some cases a loss from the cement of about 30 per cent lime and the formation of gypsum (hydrous sulphate of lime) in large quantities. It was decided therefore to expose test specimens to a solution containing 1½ per cent sodium sulphate and 1½ per cent magnesium sulphate (which approximates an average maximum concentration of these salts in alkali soil waters) and to determine the amount of lime passing into solution as a measure of alkali attack. Sections of tile, both treated and untreated and weighing approximately 2,200 grams, were placed in porcelain-lined jars containing 10,000 cc. of the alkali solution and kept well covered. Determinations of lime were made from time to time and the solutions were renewed at frequent intervals.

The lime dissolved in the untreated samples did not increase progressively with the time exposed, but after reaching a maximum of about 4½ gr. in five weeks it appeared to decline, owing possibly to the formation of insoluble calcium sulpho-aluminate compounds. Comparing the total loss of lime in the untreated and treated samples for 38 weeks, the former had lost seven to nine times more lime than samples receiving a double tar treatment and half that amount for samples given only one treatment or two treatments followed by drying at 25 deg. C. The results indicate a 7- to 9-fold protection in the case of thoroughly impregnated material and about 4-fold protection when insufficient tar was absorbed or where the fixation of the tar residuum was incomplete before exposure to the alkali.

Tension and Compression Tests—These were carried out on mortar treated with water gas tar and on untreated material after remaining in 3 and 10 per cent alkali solutions and in tap water for 28 and 182 days. While the untreated samples failed completely after six months in a 3 per cent alkali solution, the treated specimens gave higher values for tension and about the same for compression as those stored in tap water for the same length of time. Treated samples stored in a 10 per cent alkali solution showed a loss in tension of about 50 lb. as compared with untreated samples after six months in tap water, but were 224 lb. stronger than untreated samples stored in the solution for the same length of time.

Bridging the Hudson River at Bear Mountain

Suspension Bridge of 1632-Ft. Span for Vehicular Traffic Being Built Above Peekskill—New Highway Connection

By Wilson Fitch Smith
Chief Engineer, Bear Mountain Hudson River Bridge Co., New York City

SINCE early days in the history of this country the Hudson River has been a natural barrier to the development of east and westbound traffic between New Jersey, Pennsylvania and New York on the western side and the New England States on the eastern side of the river, as well as within the Empire State itself. With the growth of the state's population there have been repeated efforts to bridge the river for vehicular traffic, but until the recent extraordinary increase in the use of motor vehicles, the ferries at various points have afforded sufficiently satisfactory service as not to warrant the undertaking. With the advent of the automobile and the continued rapid increase in its use, first for pleasure, and more recently for commercial purposes, the ferries, despite their greatly increased facilities, have been unable to meet the duty, and the need for a highway bridge has become an urgent public necessity.

SKETCH OF PROPOSED BRIDGE AND APPROACHES

The bridging of the Hudson River at New York City has been studied for thirty years, but the width of the river, its depth, and the requirements for navigation as prescribed by the war department, are conditions that make it a stupendous project, which up to now has not gotten beyond the project stage. The Vehicular Tunnel now under construction by a joint commission of the States of New York and New Jersey will give some relief to the city, but it is probable that its capacity will be largely taken up by commercial traffic, and a highway bridge across the Hudson River at a point as close to the city of New York as is practical to build it, will afford a much needed service.

The nearest practical location to New York City is at the entrance to the Highlands, about three miles above Peekskill, and forty-five miles from Times Square, where the rocky shores of the river approach within 1,600 ft. of each other. This site was selected thirty-five years ago by the late Edward W. Serrell for a suspension railroad bridge, and some work was done at that time by the Hudson Suspension Bridge and New England Ry. Co. The site is ideal for a suspension bridge. On the east side of the river Anthony's Nose rises abruptly to an elevation of 900 ft., a solid boss of granitic gneiss, through which the New York Central R.R. tracks pass in a tunnel. On the west side the base of Bear Mountain, upon which can still be traced the remains of Fort Clinton, is of similar rock formation. Between these two rocky shores the river has a channel depth of 130 ft. Suitable rock foundations for the towers exist on both sides of the river at the shore line. Adequate anchorages on both sides can be had by tunneling into the solid rock on line with the cable back stays. The elevation of the surface on both sides is advantageous for the support of the approach spans.

These natural conditions, together with the fact that on the west side of the river lies Bear Mountain Park, a state reservation of over 33,000 acres, an increasingly popular playground for New York's multitudes, and that it will afford a direct avenue of approach to the scenic attractions of the Highlands, the cities on the west shore of the Hudson, the Catskill Mountains and the western part of the state, as well as a direct route for the largely increasing traffic between southern New England and the west side of the Hudson, determined the selection of this site for the first highway bridge to be built across the Hudson River south of Albany.

The Bear Mountain Hudson River Bridge Co. secured a charter from the legislature in March, 1922, and having obtained the necessary rights-of-way and permits, and completed its financing, the contract for construction was executed March 24, 1923.

Bridge Structure—The bridge will be a suspension bridge of 1,632-ft. span. The steel towers will be 355 ft. high above the foundations. Two steel wire cables 17 in. in diam. will each contain 7,252 wires, No. 6 gage. The cables will be 60 ft. c. to c. The stiffening trusses will be 30 ft. deep and 55 ft. c. to c., supported on transverse suspender beams carried by double suspender steel wire ropes of 2½-in. diam. At the east end the approach span will be 210 ft. long and will span the New York Central R.R. right-of-way. At the west end there will be a 210-ft. truss span over the West Shore R.R., a 100-ft. truss and two 50-ft. plate girder spans. The total length between abutments will be 2,238 ft. The bridge floor will be at the level of the top chords of the stiffening trusses and will be 48 ft. wide between railings, providing a 38-ft. roadway and two 5-ft. sidewalks. The floor will be a reinforced-concrete slab carried on 18-in. I-beam stringers with a sheet asphalt pavement. The suspended span will have a 15-ft. camber giving a clear height above the water at the center of 153 ft.

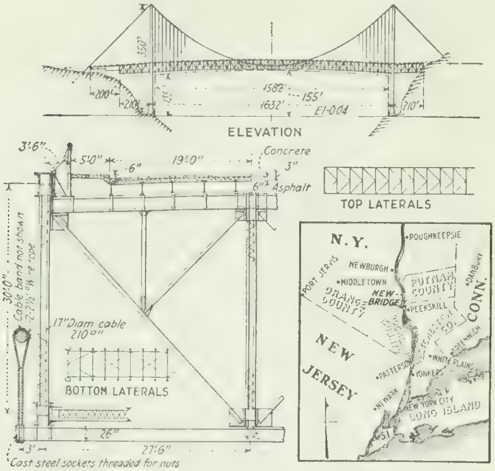
The weights of the various parts of the bridge are:

Towers	[illegible] tons
Cables and suspenders	[illegible] tons
Anchor bars and castings	[illegible] tons
Stiffening trusses and floor	[illegible] tons
Approach spans	[illegible] tons
Total	[illegible] tons

The cable wires and suspender ropes will be of 220,000 lb. ultimate strength. The stiffening trusses will be of silicon steel and the other portions of the bridge of carbon steel.

Approach Roads—The approach highway on the east side will leave Roa Hook road about a mile from the Albany Post road at Annsville, just beyond the entrance to the State Camp, and by a 6.5 per cent grade will ascend the southerly slope of Anthony's Nose to an elevation of about 200 ft. above the river, thence, generally following the contour but attaining a maximum elevation of 400 ft. will skirt the flank of Anthony's Nose to the bridge head, a total distance of about three miles. This will be a standard New York State concrete highway, with 18 ft. of paving. In places its construction will approach the boldness of the Storm King highway and it will afford many picturesque and spectacular views of the Highlands.

The west approach highway will be on the axis of the bridge and will connect with state route No. 3 at a point about 1,000 ft. from the bridge. This road will have a paved width of 38 ft. for its entire length. With the exception of two parcels on the east side, the entire length of the approach highways and the bridge piers will be on land either owned or controlled by the state.



GENERAL DETAILS OF BEAR MOUNTAIN BRIDGE ACROSS THE HUDSON

Conservative estimates indicate a traffic of over 600,000 automotive vehicles a year in the first year of operation.

The contract time for construction is twenty-two months.

Personnel—The bridge was designed by Howard C. Baird of Hodge & Baird, who will act as consulting engineer on the bridge. The author is chief engineer on the work and William H. Burr and William A. Welch are consulting engineers for the company. The general contractors are the Terry & Tench Co., Inc. The cable wires and suspender ropes are being manufactured by John A. Roebling's Sons Co. of New York, and the fabricated steel by McClintic-Marshall Co.

Reaction Jetty Works Successfully

Navigation of the Fraser River in British Columbia as far as New Westminster by vessels drawing 30 ft. is now possible due to the effects of the single reaction jetty which has been built near the mouth of the river. (*Engineering News-Record*, Aug. 24, 1922, p. 318.) Construction on the jetty was begun in 1912 and has been carried on intermittently ever since, until now it is completed for about two-thirds of its length. When the construction of the jetty was begun the depth over the bar was only 16 ft.

Suggestions for An Engineering Employment Service

Plan Proposed for Nation-Wide Paid Service Under the Auspices of the National Engineering Societies

By Morris Llewellyn Cooke
Consulting Engineer, Philadelphia, Pa.

TINKERING with the system by which at present engineers out of work find jobs may easily reduce the unit cost of placements. Tinkering may even result in increasing the number of jobs found—especially in metropolitan districts. But no amount of tinkering will give us an employment system representative of the profession's capacity for organization, or meeting the legitimate expectations of those requiring the service, or fulfilling our obvious obligations to the nation and to society at large.

The new service must be of a character which will inspire inquiries from sources not now open. In only a negligible number of instances where vacancies occur in what may legitimately be called the engineering field are inquiries made of the existing agencies. I do not recall one employer who considered this *the* way to fill an engineering position. At best it is looked upon as a possible source of likely prospects for the more highly standardized jobs. It is equally true that applicants for positions approach existing agencies with no real confidence in the outcome. For jobs above a certain grade the "probability of hit" is very low.

The "load factor" of the present service is very unsatisfactory principally because we are seeking to cover a very broad field with an entirely inadequate plan. In consequence the record made—let us admit that it is a good one in its way—is based either (1) on occasional and largely accidental service rendered to a widespread national constituency, or (2) much more frequently on service to a comparatively limited number of members in the large cities—especially in New York City—seeking jobs of a rather unspecialized variety. There does not appear to be any way by which the "load factor" can be radically improved without a radical change in our conception of what constitutes an adequate employment agency for the engineering profession.

The Service Should Not be Free—Fortunately any service sponsored by the engineering profession does not need to be run for gain. In fact the demand will be that the service be rendered at cost—cost including the support of continuing an adequate research into all those phases of personnel work on which any effective placement and employment service for engineers must rest. *Such a service cannot be free.*

Placement fees must be charged. But these can be lower than those charged by agencies operated primarily for profit. They can be reduced of course after the initial capital outlay has been amortized and they can be made discriminative in favor of those who support the profession through engineering society membership.

Personnel management more and more works on the theory that for each job there is one best man. But to find him in the least possible time means job standardization and classification, the systematization of interviewing, the separation of the exceptional from the routine in placement work, symbolization to permit prompt—even telegraphic—exchange of data about supply and demand, telling advertising methods, etc.,

etc. It means the close integration of all factors in the engineering field, colleges, technical societies and employers both public and private.

Independent of National Societies—Any paid employment service for engineers to be successful should stand clear of the organization of all national and local societies. Some method can be evolved by which the profession can hold title in perpetuity and exert its authority at stated intervals, should the necessity therefor arise. But to be effective the new agency must not only be manned by the leaders of the profession but should be untrammeled by the frequent elections and other cumbersome paraphernalia of our largely accidental political system.

The governing boards of the five largest engineering societies might be given the power every fifth year to vote as to whether a change in the management in whole or in part was desirable. If the agency was running along smoothly and successfully there need be no interruption in the management. If a more direct expression of engineering opinion is desired referendums could be taken at regular intervals or at the request of a majority of the membership.

The new paid employment service for engineers can be developed and operated without any reference whatever to existing free agencies—national or local. Its success will not be conditional on making the placements now more or less successfully made by these existing free agencies. The new agency can wish all present free agencies Godspeed. In fact co-operation can be established at once between the two types of service. The ideas are by no means mutually exclusive. Free employment service is such an integral factor in most engineering organizations that one cannot look far enough ahead to predict its abandonment. As the paid service however begins to function the free service will naturally be retained only in those places where it can continue to demonstrate its usefulness. Both types of service can be simultaneously sponsored by the profession. It may easily develop that the more active the free service the better the paid service.

Organization and Operation—The directing organization of the proposed paid service might well be composed in part of the "best minds" within the profession and in part of outside individuals, each having some special contribution to make. An educator like Hopkins, president of Dartmouth College, who has had training in personnel work in large corporations; a lawyer like Owen Young, chairman of the General Electric Board; a psychologist like Walter Dill Scott, president of Northwestern University, and a banker like Dwight Morrow of the Morgan firm would each add effectiveness.

There is no reason why the organization should be of a standard type or even "frozen." There is room for experimentation and it would be well to let experience freely suggest the possible line of quick evolution. An annual meeting of the policy-forming Council, or at most semi-annual meetings would make it possible for busy and widely separated engineers like Rae, Hoover and Morgan to sit. Especially during the formative years it might be well to have an additional administrative board with monthly meetings and a membership recruited geographically so as to make attendance possible.

If for no other reason than to provoke discussion I submit an estimate of the earnings of such an agency. It is well within the actual figures to state that there are 100,000 engineers in the United States, and that on the average they change jobs once in five years. This means 20,000 new jobs secured every year. Further we can assume that an energetic and ably managed paid employment agency backed by the entire profession could in two years become responsible for finding 20 per cent of these jobs or say 4,000 a year. (This means 333 a month or 13 in a day.) Surely this is not an unwarranted expectation. Dividing the jobs secured in accordance with the salary ratings of over 300 engineer employees in the City of Philadelphia and using a 5 per cent fee for all salaries over $2,000 a year and a 2 per cent fee for all below that figure there would result a revenue of $8,400 for each 100 placements or $352,000 a year on the assumed 4,000 jobs. On any such volume of business the fees could soon be cut as estimates of operating expenses do not appear to require this income. The fees suggested are less than those charged by existing agencies for other occupations. As long as free agencies for engineers are maintained no member of any society would be under any compulsion of course, to use the paid service. There is usually, however, an embarrassing interim "between jobs" which probably averages longer the higher the pay. At $2,000 a year, reducing this time by one week would be about equivalent to paying a 2 per cent fee. Better service may easily pay for itself in more ways than one.

If careful engineering studies such as should be undertaken before the enterprise were launched confirm the foregoing estimates the financing becomes easy. A two year underwriting of $40,000—to be borrowed in whole or in part during the first year—could be paid back during the second so that the underwriters would possibly at no time be out of pocket. If it should be decided to arrange for this underwriting without in any way utilizing the credit of engineering societies it would be relatively easy to secure 80 individuals to underwrite $500 each, or say 40 for $500 each and the balance in larger amounts.

This great new departure in engineering technique—important alike to the individual engineer and to society—can be set going without putting the slightest financial burden on our at present overtaxed engineering organizations. If the boards of four or five of the larger national engineering societies should endorse in principle this plan for a paid employment service there would appear to be no serious obstacles standing in the way of its fairly prompt execution.

Progress on Vehicular Tunnel

Five compressed-air shields will soon be in operation on the vehicular tunnel, according to the New York State Bridge & Tunnel Commission Report for the year 1922. Already 600 ft. of tunnel have been constructed and the Canal St. shield is out under the Hudson River. The contracts for the construction were let March 28, 1922. In December of the previous year, the commission obtained from the Erie R.R. Co. the water-front rights on the New Jersey shore and in June 1922 received similar rights from the city of New York. During 1922 the commission acquired all the necessary land for the New York approaches. Contract No. 5, covering the construction of these approaches will be ready for advertisement about June 1, and contract No. 6 for the New Jersey approaches will be ready soon after.

Truck Overloads Threaten Life of City Pavements

Truck Loads of 15 to 25 Tons, Free to Travel Any Street in Most Large Cities, Are Breaking Down Pavements Not of Heavy Rigid Types

Editorial Review

PAVEMENT damage by excessive truck loads which at times or somewhat commonly travel the streets is arousing concern in most large American cities. Except on the main business thoroughfares few city streets have pavements designed with motor truck traffic in mind. Few cities exclude travel of any kind from any streets except certain park boulevards and drives restricted to pleasure traffic. In these respects the practice of the days of horse-drawn vehicles continues into the present period of mechanical propulsion with all that it permits in the way of large loads and high speeds. Traffic and the road on which it moves have grown out of co-ordination. These statements do not express any unfamiliar thought but it is useful to consider briefly what have been the actual results arising from the conditions stated.

A survey of about twenty large cities partly through questionnaires but more often through visits to these cities and consultation with the city officials of streets, is the basis of the information which will be presented. The consideration resolves itself into five phases: (1) Loads and their frequency, (2) Nature of damages, (3) Limitations of traffic, (4) Regulatory practices and (5) Remedial plans.

Loads and Their Frequency—Traffic tonnage counts over a considerable period of years have rarely been kept and then for certain main streets only. The statement generally offered by the average observer is that tonnage has multiplied several times. In Manhattan, New York City, on a certain section of Third Ave., counts made in 1911, 1915 and 1922 show the tonnages of traffic per foot width of street to have been respectively 72 tons, 167 tons and 220 tons. In brief, in ten years the traffic tonnage carried by the pavement had tripled. Other streets in New York or some streets in other cities have probably experienced a greater increase and it is certain that on many the increase has been smaller. The fact to be held to is that rash guesses of the increase in traffic tonnage have to be guarded against; on only a few streets originally heavily traveled, is the tonnage per foot width more than three times as great as it was ten years ago. This statement excludes streets that have suddenly become heavily traveled through a shift in industrial centers or by a rerouting of traffic due to some other cause.

Traffic tonnage increase is due both to the increase in the number of vehicles carrying load and to the increased weights of the loaded vehicles. It is the last cause, aggravated by increased speeds, that is considered to be largely responsible for pavement breakdowns. Here it needs to be remarked that it is pavement breakdowns, either the surface by crushing or shoving or surface and base by crushing or pressing down into the earth below, and not pavement wear, that constitutes the heavy-load trouble which most concerns street engineers. The increased traffic tonnage, except as it is represented by the excessively loaded truck at low speed or by the less heavy truck at high speed, is not particularly worrying engineers as a pavement problem.

What are these excessive truck loads? Naturally the answer varies for different cities. In most instances it is not based on determined facts but is merely an estimate from observation. A few of the more definite figures obtained are as follows:

Seattle, Wash.—The extreme truck load is an oil truck which gives a combined load of 15 tons; 12-ton truck loads are common. These trucks constitute about 7 per cent of the total.

Minneapolis, Minn.—Truck loads of 15 to 20 tons travel the streets. They constitute a very small percentage, probably not over 1 per cent, of the total trucks.

Newark, N. J.—The heavier trucks weigh from 6 to 8 tons and carry loads of 5 to 10 tons, giving total loads of 11 to 18 tons. No records are had of the relative numbers of these trucks.

Philadelphia, Pa.—Gross truck loads are limited to 14 tons but it is fair to assume, however, that this gross weight is not uncommonly exceeded. Heavy motor truck traffic varies from 5 to 25 per cent of the total traffic on several important thoroughfares and probably averages 10 per cent.

Cleveland, Ohio—Truck loads of 21 to 25 tons travel the streets; they are perhaps a third of one per cent of the total.

Portland, Ore.—Loads are limited to 17,000 lb., 8½ tons, but some sand and gravel trucks exceed this by about 10 per cent.

San Francisco, Calif.—Truck loads of 12½ tons commonly travel the streets; these trucks constitute about 10 per cent of the total.

Manhattan, New York City—Coal companies own trucks carrying 12 tons net and weighing 19½ tons gross. Milk companies use trucks with 15,000 lb. on the rear axle and 15,700 lb. on the trailer axle. These loads constitute probably 1 to 2 per cent of the total traffic.

Chicago, Ill.—Standard 7½-ton trucks are common (about 10 per cent) and it is estimated that they are generally overloaded about 20 per cent.

St. Louis, Mo.—Trucks with gross loads of 12½ tons constitute about 1 per cent of the total.

In brief, 15 to 20-ton truck loads at times or somewhat commonly travel the streets of large American cities. In number, these excessively heavy trucks are probably less than 1 per cent of all vehicles using the streets.

Nature of Damages—Segregation of the damages to pavements by these very heavy trucks and by truck traffic in general is not made in city records. Observations by the street officials indicate the following effects on pavements of heavy truck loads.

In Detroit, heavy truck traffic has broken down asphalt pavements with 6-in. concrete base in spots where the subgrade was unstable. In Seattle pavements have broken down at expansion joints and also where the base or surface was raised because of expansion. In Minneapolis pavement base has been crushed and destruction of the surface has followed. In Newark the heavy loads have caused depressions where the soil under the pavement base is soft; the surface wear from heavy trucks is not excessive. In Philadelphia heavy truck operation is breaking down both surface and foundations. Asphalt, brick pavement and wood-block surfaces have suffered to a considerable degree and other types to a less extent. Concrete foundations have not generally suffered except where poor subgrade conditions existed. Broken stone and Telford foundation have been churned up following spring thaws in many portions of the city where natural drainage conditions are poor. Cleveland is one city which reports no pavement damage from heavy truck loads, 21 to 25 tons. San Francisco reports excessive rutting of asphalt pavements adjoining car tracks. In Manhattan, New York City, these heavy loads, if carried on steel tires, cut ruts in the asphalt pavements or shatter the granite pavements especially if moved at high speed. In Chicago, in the easily-moved clay subsoil, there is excessive wear and the concrete foundations break down. St. Louis records no unusual pavement damage but mentions excessive vibration in buildings adjacent to rough pavements.

Premised on the foregoing statements and other information collected, the effects on pavements of heavy truck loads exceeding 12½ tons are as follows: (1) With rubber tires, surface wear is not materially increased; (2) Surface damage, particularly of soft surfacings, is evident by increased rutting and shoving; (3) broken stone bases are crushed and dislodged; (4) concrete bases 8 in. or less in thickness are frequently broken down; (5) Soft or unstable subsoil aggravates base damage; (6) High speeds of heavy trucks augment all these injuries.

Limitations of Traffic—Except from park drives and boulevards, trucks are not excluded from any street in any of the cities studied. Expressed another way, trucks are not excluded from any street for any reason except traffic requirements; they are free to travel on pavements of any classification, and on any street—residential or business.

Regulatory Practice—Few cities are without some sort of legal regulation of vehicle loads. It is notable that two very large cities, with heavy truck traffic, Manhattan, New York City, and Detroit, Mich., have no legal regulation of truck loads although in Manhattan an ordinance is now before the Board of Aldermen which limits truck loads to "25,000 lb. gross weight, 8 ft. in width and 28 ft. in length, including load." Local ordinances exist in some cities and others operate under the general motor vehicle act of the state. The legal limitations vary greatly and some of them are obviously relics of the days of horse-drawn vehicles. A few examples indicate practice.

San Francisco, Calif.—Carrying loads in excess of 15,000 lb. is unlawful except that single articles in excess of 15,000 lb. may be carried by special permission. There is an ordinance regulating tire widths, viz.: Not less than 3 in. for 4,000 to 7,000 lb., and 4 in. for 7,000 to 10,000 lb. Ordinances are executed by the police department and the Board of Public Works. A new ordinance setting the maximum truck load at 25,000 lb. is contemplated; this will bring the regulations into conformity with the average heavy loads reported previously.

Chicago, Ill.—A committee of engineers of several city departments has the task of revising the present truck and trailer load restrictions. These are: Total gross load 30,000 lb.; total on any axle, 24,000 lb.; and total per inch width of rubber tires, 1,000 lb. The new ordinance when passed becomes a police regulation.

Cleveland, Ohio—Load regulation is in charge of the street division of the Department of Public Service. The load limit is 12 tons.

Philadelphia, Pa.—All vehicle loads are restricted under the state motor vehicle act of 1919. General responsibility for all traffic regulations lies with the Police Bureau of the Department of Public Safety but little or no work has been done on weight regulation.

Newark, N. J.—Vehicle loads are regulated by the State Motor Vehicle Department under the motor vehicle act. This act restricts the load to between 500 and 700 lb. per inch width of tire depending upon the wheel diameter. There is also a speed restriction of 16 miles per hour for 6-ton load and 10 miles per hour for 15-ton loads.

Seattle, Wash.—State laws and city ordinances provide that the gross weight on any axle shall not exceed 22,700 lb. Execution is in the hands of the Streets and Sewers Department which, however, has no equipment for weighing load but must depend upon the state highway department.

Minneapolis, Minn.—A city ordinance puts the maximum load at 28,000 lb., and 800 lb. per inch width of tire. The execution of the ordinance is in the hands of the city engineer. Two loadometers have recently been purchased and it is planned to put two men at work weighing vehicles on the streets.

St. Louis, Mo.—Loads are restricted to 28,000 lb. gross, 22,400 lb. on one axle and 800 lb. per inch width of tire. The department of streets and sewers executes the regulations through a special inspection.

None of these specific figures is of particular significance but together they indicate (1) That there is no close agreement in thought of what vehicle loads should be or of how they should be designated, (2) that there is similar uncertainty of thought in respect to who or what department should have the regulation of vehicle loads, and (3) that almost no city has the organization or equipment to detect violations of load regulations and enforce obedience to them.

Remedial Plans—Except a few cities, perhaps five of twenty which express themselves as contented with their present practice, there is general development of plans to meet heavy truck loads by changes in pavement design and types. The following are some of the plans:

Chicago, Ill.—On through streets new pavement base has been increased from 6 in. to 8 in. of 1:3:5 concrete, with an asphalt surface course of 1½-in. binder and 2 in. of top.

New York (Manhattan)—The failures of foundations are increasing and an increase in strength is being considered but whether by changing the thickness or the proportions has not yet been decided.

Philadelphia, Pa.—The city is replacing as rapidly as possible all old granite block-pavement on gravel base and asphalt pavement on broken stone base. On narrow streets carrying heavy truck traffic the tendency is to substitute granite blocks for other types. Variations in the structure of street asphalt pavements have been made experimentally during the present season (*Engineering News-Record*, Sept. 28, 1922, p. 621) with a view to increasing the stability of this type of pavement under heavy truck traffic.

Detroit, Mich.—In 1920 the thickness of concrete base was increased from 6 to 8 in.

Seattle, Wash.—In laying all concrete a new method of seasoning has been adopted. Concrete is sprinkled for the first ten consecutive days following the laying, as tests in the laboratory have shown and observations in the field have indicated that greater strength is thus obtained. A mixture of 1:2:3½ is used in all one-course concrete pavements, and a mixture of 1:3:6 is used in concrete base for brick, asphalt, sandstone, granite or wood block. The thickness of the one-course concrete pavement is governed by traffic conditions, 9 in. of material being used on extra-heavily-traveled streets, while 6 in. is used in alleys.

St. Louis, Mo.—The division of design has adopted greater thickness of concrete base and is not constructing any soft surface roadways except on purely local traffic streets.

In pavement design then, as the result of heavy truck loads, two lines of development are noted: (1) Strengthening of the base by increased thickness or stronger material, and (2) strengthening the wearing surface to resist rutting and shoving.

Conclusions—A review of truck loading and overloading in large cities leads to the following conclusions:

1. City pavements generally as constructed in the last ten years will break down comparatively rapidly under the extreme truck loads of 15 to 25 tons which now prevail to some extent in most large cities.

2. Two ways of correcting the condition appear practicable: (a) prescribing by law reduced truck loads and vigorously enforcing the law, and (b) strengthening pavements and foundations to resist truck travel of the weights stated.

3. Logical load regulation implies in addition to general weight limitation provision that heavier trucks may travel designated arterial business streets, that is, routing of traffic according to load is an essential part of load regulation in city streets. This would help to lengthen the life of pavements on thousands of streets where lack of funds prevents rebuilding for many years.

4. Successful load regulation implies direct and absolute authority to enforce the established restrictions through a division or bureau organization adequately manned and provided with equipment to make load determinations and exercise police authority.

Manganese Deposit on Water Filter at Breckenridge, Texas

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AND

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Abstract of paper before Texas Section, Am. Soc. C. E.

GROWTH of crenothrix manganifera in a force main while standing idle for three weeks is believed to have been the cause of a black, greasy deposit consisting largely of manganese which occurred last year on the sand of the mechanical filters of the water-works supplying Breckenridge, Texas.

New works for this place were built in 1921 by the Walker-Caldwell Water Co., after plans by the senior author of this paper. The main source of supply is from impounding reservoirs on Clear Fork. This is supplemented by water from another impounding reservoir, which also affords storage for Clear Fork water. The Clear Fork supply is pumped through ten miles of 16- and 12-in. cast-iron pipe to a receiving reservoir and second pumping station in East Breckenridge. When there is a plentiful supply in Clear Fork the pumps are worked to their full capacity of 2.5 m.g.d., and the surplus 1.8 m.g.d. excess over the demand is forced to the supplementary reservoir.

Late in 1921 a decision to install mechanical filters was reached. On Jan. 28, 1922, two 0.5-m.g.d. units, having normal filter sand, were put in use. For some weeks Clear Fork water was applied to the filters but later on the Clear Fork pumps were shut down and the force main left standing full for three weeks. Meanwhile Lake Grande was drawn upon. Early in June, when the Clear Fork supply was plentiful, water from that source was pumped through the main direct to the filters. When the water from the river was turned into the preliminary basin, it had a bluish-black inky appearance. When after coagulation and sedimentation the water was applied to the filters, it left a black greasy looking deposit, although the filter effluent was clear and colorless. In a short time, large cracks appeared on the surface, and, upon washing, this black deposit apparently was not disturbed although the mud on the filter was wholly removed by usual washing. The sand also appeared to form in lumps or masses like the usual "mud balls." When washed, the lumps apparently turned over without disintegrating.

Upon examination, it was thought that the sand was coated with a deposit of oily or asphaltic materials, as Breckenridge is the center of a vast oil field, draining into the Clear Fork. A number of solvents—carbon disulphide, carbon tetrachloride, naphtha, alcohol, ether and chloroform —were tried without removing the deposit from the sand. The residue was, however, soluble in citric acid.

A portion of the sand was placed in a large casserole of distilled water and rubbed very thoroughly with the fingers until much of the black deposit was loosened. These washings were then decanted from the remaining sand and evaporated to dryness. An analysis of this air-dried residue showed the following results:

	Per Cent
Ignition loss	29.34
Silica, SiO_2	25.26
Alumina, Al_2O_3	18.21
Iron oxide, Fe_2O_3	4.89
Calcium oxide, CaO	2.55
Manganese oxide, MnO*	19.71
Total	99.96

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*The manganese is reported as MnO but this was the state after oxidation by ignition. Undoubtedly the manganese in the raw water was a hydrated oxide in various states of oxidation.

The origin of the manganese still being unaccounted for, an analysis of the pipe coating was made. This showed no manganese. Clearly then, the manganese came from the water. A number of river-bed stones were examined and all of them showed the presence of manganese, some in rather large amounts. (At the headwaters of the river, in Dickens County, about 140 miles northwest of Breckenridge, there are several pyrolusite deposits almost large enough to warrant mining operations.) It was then assumed that the black deposit was the result of the action of a species of the higher bacteria, known as Crenothrix manganifera and after some correspondence it was definitely concluded that this was the case.

The water had been lying in the pipe line for a period of three weeks prior to its use at the filter plant, with every condition favorable for the development of this species of organism. The water was somewhat deficient in dissolved oxygen, high in organic matter and temperature and was in the dark. Somewhat later, the water was examined for manganese which was found to be present to the amount of 0.036 p.p.m. No further trouble was encountered.

No similar occurrence of manganese in the state of Texas is known to the writers.

On account of the high cost of replacing this "black" sand ($12 per ton) some experiments were made to find a means of dissolving the coating. One of the filter plant operators found it to be soluble in lemon juice. Laboratory tests with "citric" acid having given fair results an attempt was made to dissolve the coating "in situ." The acid appeared to "cut" only a small part of the coating, unless used in a very concentrated solution. Dilute solutions appeared to have little or no effect. Concentrated solutions attacked rapidly but for a very short time only. Clearly, the expense of citric acid treatment would exceed that of new sand.

Railway Mileage of the World

The railways throughout the world had an aggregate length of 748,000 miles in 1920, according to a bulletin of the National Association of Railway Executives. This mileage is distributed as follows: North and South America, 380,194 (or 50.8 per cent); Europe, 237,888 (31.8); Asia, 74,110 (9.9); Africa, 32,239 (4.3), and Australia, 23,569 (3.2 per cent). The United States has a total mileage of 264,373 miles, or 35 per cent of the world's mileage.

Importance of Oxygen and Stirring for Activated-Sludge Growth

Tests Indicate Forced Aeration Unnecessary as Little Oxygen Needed—Air, Suspension and Stirring Factors Evaluated

HOW to reduce air consumption to a minimum consistent with good results is one of the vital economic problems in the treatment of sewage by the activated-sludge method. Earlier investigators, mostly engineers, have attempted to replace the stirring action of the air by mechanical means. They failed largely. (See Coulter, W. S., "Air Diffusion in Activated Sludge," *Engineering News-Record,* May 3, 1917, p. 255; Brosius, A. M., "Activated Sludge Novelties at Hermosa Beach, Calif.," *Engineering News,* Nov. 9, 1916, p. 890; Orbison, R. V., "Tests of Trent Activated-Sludge Device at Pasadena," *Engineering News-Record,* Dec. 30, 1920, p. 1287; and Nordell, C. H., "Mechanical Agitation of Sewage Proved Unsuccessful," *Engineering News,* Nov. 2, 1916, p. 856.)

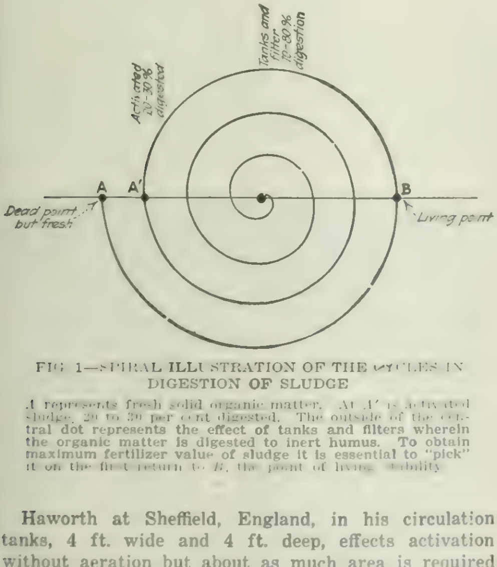


FIG. 1—SPIRAL ILLUSTRATION OF THE CYCLES IN DIGESTION OF SLUDGE

A represents fresh solid organic matter. At *A′* is activated sludge, 20 to 30 per cent digested. The outside of the central dot represents the effect of tanks and filters wherein the organic matter is digested to inert humus. To obtain maximum fertilizer value of sludge it is essential to "pick" it on the first return to *B*, the point of living stability.

Haworth at Sheffield, England, in his circulation tanks, 4 ft. wide and 4 ft. deep, effects activation without aeration but about as much area is required as for tanks and filters. Nordell concluded that so much air is required for oxidation that it will furnish all the agitation necessary but he defined no other condition than air as necessary for the growth of activated sludge. Subsequent investigators, with few exceptions, seem to have accepted Nordell's conclusion, and to have been discouraged from further experimental work along this line.

After the microscopic investigation of the organisms occurring in activated sludge reported in *Engineering News-Record,* Jan. 18, p. 119, Dr. A. M. Buswell, chief, Illinois State Water Survey, concluded that possibly Nordell's conclusions were in error because of confusion over the rôle of the various factors. Dr. Buswell set up experiments to evaluate the factors which air accomplishes when it is blown into the aeration chamber. Results of his studies, which attack the problem from the biological and chemical standpoint, are given as follows in a paper presented recently to the Illinois Society of Engineers:

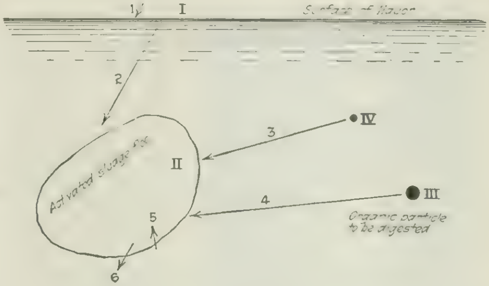


FIG. 2—GRAPHICAL REPRESENTATION OF THE SIX PROCESSES IN DIGESTION OF SLUDGE

1. Oxygen rapidly enters skin of liquid. 2. Slow process of getting air to organic particle. 3 and 4. Also slow diffusion process of getting dissolved molecules and colloids to particle. 5. Comparatively rapid action of digestion by organisms of the sludge floc. 6. By-products of biological growth must diffuse away to prevent poisoning the growth. This is a slow process.

The Sludge-Digestion Spiral—In nature organic matter is worked over by succeeding generations and races of micro-organisms until a large percentage of it has been broken down to ammonia, nitrates and carbon dioxide, leaving a relatively small amount of black humus as a residue. The course of this reaction might be represented by a spiral. Suppose at a point *A* we start out with the dissolved and colloidal organic matter in sewage. Microbial spores thus develop producing bacteria, molds and sometimes even higher forms whose nourishment is drawn from the organic matter, until when we arrive at point *B* all of the organic matter has been taken up to form the living substances of the growths which develop. If these growths continue their life processes they produce a certain amount of carbon dioxide and ammonia and then eventually die and decompose bringing us to the point *A′*, where we again have dead and more or less liquefied organic matter. The distance from *A* to *A′* would represent what some authorities refer to as the "wet-burning" or "moist combustion" which has taken place during the first lap around the spiral. If we continue to go round and round this spiral we eventually arrive in nature at a condition where a fairly considerable portion of the organic matter has been mineralized and a black stable humus substance remains.

Sewage treatment by means of biolytic tanks, sprinkling or contact filters and subsequent secondary tanks gives us practically the result indicated by the spiral. The heavy solids are attacked and worked over by certain groups of bacteria in the sludge digestion chamber of the Imhoff tank until practically nothing but a black humus remains. The liquefied product, together with the colloidal and dissolved organic matter in the sewage, is taken in by the organisms of the biological jelly on the sewage filter. In this jelly the same spiral of activities goes on. A cross-section cut with a knife through the growth on the sewage filter stone shows on the outside the new whitish growth composed of various types of bacteria and protozoa. Just below this new growth there is a layer of less active and dying or dead bacterial filaments upon which varieties of protozoa are feeding. These protozoa in turn die and various forms follow, undoubtedly, including some of the same anaerobic forms which are active in the sludge digestion chamber of the tanks, which produce immediately adjacent to the stone a black stable humus. From time to time this humus sloughs off and is finally worked over in the digestion chamber of the secondary tanks. As a result of allowing this process to go on to the limit we obtain a relatively small amount of comparatively inoffen-

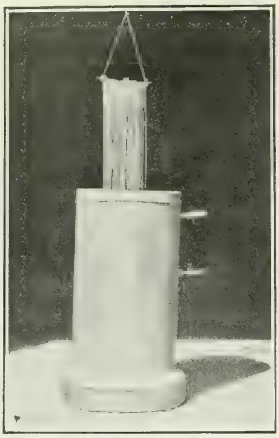


FIG. 3—DIPPING RACK

Aeration and stirring were produced at the same time. The rate at which oxygen was taken in was determined by substituting oxygen free water for the sewage.

sive sludge. The process, however, requires rather a large area for its practical application.

In the Activated-Sludge Process, however, we apparently start out with the idea that the sludge is a valuable fertilizing material and therefore for the most economical operation of the process we should try to get as much sludge as possible. Since it is a biological process the course of the reaction will be along the course of the same spiral described above. But since we are going to considerable expense in order to provide a condition favorable for the growth of the microscopic life, namely, by blowing air into the sewage, we will waste considerable effort if we allow the process to proceed very many laps around the spiral. The most efficient process would seem to be one which removes the sludge as near the point *B* as possible; that is as soon as a luxuriant growth has been developed and before any of this growth begins to die and decompose. This fact is the fundamental distinction between tank-and-filter treatment and activated-sludge treatment, the object of the former being to go round the spiral approaching the center as nearly as possible, that is with the maximum of wet-burning, while the latter should go only to the point *B*.

There is also a mechanical difference between the activated-sludge process and the tank-and-filter system. Hering has shown that the amount of purification is proportional to the surface exposed. Since it is necessary to use rather large stone in filters to avoid ponding it is obvious that the ratio of surface to volume, that is the efficiency per cubic foot, is comparatively low, while in the activated-sludge process the floc surface is relatively enormous, being in the neighborhood of 500 sq.ft. of surface area per cubic foot of aeration tank volume.

The organisms which we see composing activated-sludge flocs we have also seen growing in stagnant pools and ditches and along polluted streams where we are sure the oxygen available was far below that which seems to be necessary for the activated-sludge process. This observation leads to the very pertinent question as to whether oxygen is as essential to the success of the activated-sludge process as it is now considered to be. We are unable to find any direct evidence on this point because in every case the air blown into the sewage or the mechanical force applied, as in Haworth's case, was producing several different effects, any of which might obviously be of fundamental importance to the success of the process.

What Diffused Air Does—When air is blown into the aeration chamber of an activated-sludge plant it does three things: (1) It maintains the sludge in suspension. (2) It maintains aerobic conditions. (3) It stirs up the mixture, allowing fresh liquor to come into contact with the sludge. We are not able to tell, therefore, which one of these three factors determines the critical minimum air requirement. In Haworth's process we also have the same three factors determining his critical velocity, namely, 1½ ft. per second, which he found necessary to maintain in his circulating chamber. The importance of maintaining the sludge in suspension depends upon the fact that otherwise the sludge could not come into contact with the liquid and second, that if the sludge is allowed to stand it very soon begins to putrefy and the work done in building it up is lost; in other words, the reaction starts to go on around a lap or two on the spiral. The relative importance of aerobic conditions and stirring cannot be balanced by means of any present data. Accordingly we have undertaken an investigation to determine the minimum air requirement of the microbial growths composing the sludge. To do this it was necessary to hold one at least of the three variables constant, thereby allowing us to balance the other two.

Mechanical Methods of Sludge Suspension and Oxidation—We decided upon adopting some mechanical means for maintaining the sludge in suspension thus making it possible to balance the relative importance of stirring and oxygen requirement and to obtain data on critical stirring velocities and minimum oxygen necessary for biological growth. The necessary experiments were carried out in small tanks of approximately 12-gal. capacity. Various materials, such as strings, copper, zinc and iron gauze, were used to support the sludge while arrangements were made for circulating and aerating the sewage. A few rough experiments carried on more than two years ago had demonstrated that the organisms ordinarily forming activated sludge would quickly attach themselves to and grow upon any suitable surface placed in the sewage.

In the first experiments these sludge holders or nidus racks were dipped in and out of the tank containing the sewage, thereby producing aeration and stirring at the same time. The amount of oxygen introduced in this manner was determined by observing the rate at which water containing zero dissolved oxygen became aerated when substituted for the sewage. It was impossible to determine the rate of aeration of the sewage directly since some of the oxygen is used as fast as it is taken in. In another set-up we provided our tank with a filtros plate in the bottom and a rotating nidus rack. Previous experience with the dipping rack had shown that the amount of air required was comparatively small. We therefore arranged to feed air in very small quantities by means of an aspirator bottle. As a result of several such experiments we were able to produce an abundant growth of sludge, very good clarification and a substantial purifica-

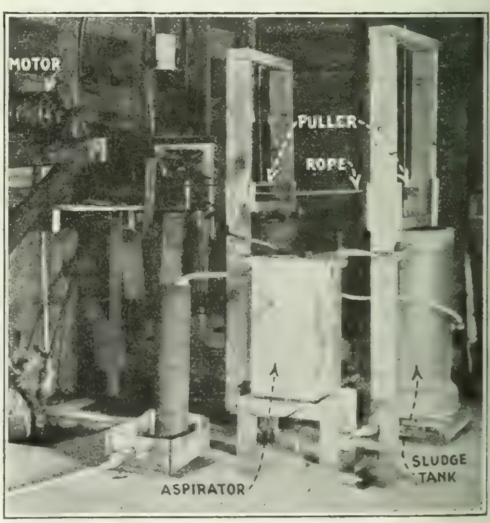


FIG. 4—TANK WITH FILTROS PLATE AND ROTATING NIDUS RACK

Gallows frame over tanks made from clay pipe supports pulleys on shaft carrying nidus rack. Pulleys are actuated by rope driven by small motor.

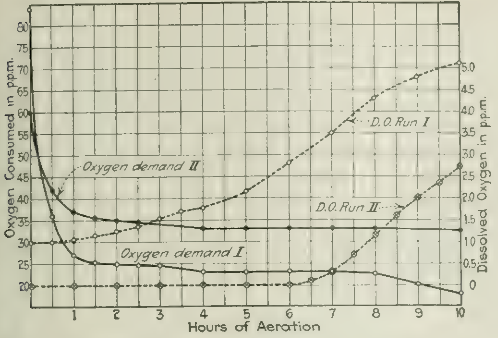


FIG. 5—RELATION BETWEEN OXYGEN CONSUMED, DISSOLVED OXYGEN AND TIME OF AERATION WITH NIDUS RACK MAKING 16 DIPS PER MINUTE

On raw sewage oxygen consumed was determined on the unsettled samples. Samples taken during the aeration were settled one hour before running oxygen consumed.

tion of sewage in from three to six hours when using as low as 0.002 cu.ft. of air per gallon. Finally we abandoned forced aeration altogether and have repeatedly been able to remove from strong domestic sewage 30 to 50 per cent of the difficultly removable "colloids" (*i.e.*, substances not removed by two to three hours sedimentation) without introducing air other than by gentle stirring. Purification results were judged by turbidity and O_2 from $KMnO_4$ tests. In other words as long as sludge is not allowed to settle down in the bottom of the tank and putrefy and as long as circulation is maintained activated sludge will grow and develop at oxygen levels so low that they can scarcely be measured. Stirring apparently is very much more important than is oxygen.

Why Stirring Is Important—If we consider the various steps which must take place in the activated-sludge process it will be apparent why stirring is of such great importance. There are apparently four important points involved in this process, each of which we will represent as follows: (1) The water surface, by a straight line; (2) an activated-sludge floc, by a rough oval; (3) a colloidal particle of organic matter, by a large dot; (4) a dissolved molecule of organic matter, by a small dot. We shall discuss the process in terms of six reactions. (1) The air must saturate the liquor or water immediately below the surface of contact. Langmuir has shown that enough molecules strike such a surface to saturate it in an infinitesimally short time, giving us a thin layer of water saturated with oxygen immediately in contact with the air surface. (2) This oxygen must then diffuse to the activated-sludge particles. This is an exceedingly slow process, as was pointed out more than twenty years ago by Noyes and Whitney and later emphasized by Phelps. (3) The dissolved molecular or organic stuff must diffuse to the activated-sludge particles. This also being a diffusion process is slow. (4) The colloidal particles must get to the activated-sludge floc somehow or other. The actual change of position of colloidal particles is practically zero. (5) The organic material and the oxygen must be taken up and worked over by the organisms of the sludge floc. As far as we are able to tell this is a comparatively rapid process. (6) The by-products of the biological growth must diffuse away from the sludge floc; otherwise they will accumulate and poison it.

Of the six steps which must take place, all except (1) and (5) are comparatively slow. The only way that we can speed up the other four steps in this process is by stirring. Stirring will sweep away the saturated film from the air surface and bring it down in contact with the activated-sludge particles. It will move the dissolved and colloidal organic matter about so that they come in contact with the floc and will sweep away the metabolic products of the sludge organisms. In view of this analysis it does not seem so strange that stirring should prove to be more important than air in the carrying out of this process. Stirring by means of blowing air through sewage is, however, a rather inefficient process. We do not get as much stirring for the power input as we would if the power were applied in some other way. When air is blown into sewage, the activated-sludge flocs, air bubbles and liquid are all driven in the same direction. The most efficient process would be one in which the air surface and flocs would be held stationary while the liquor is caused to flow past them. The experimental apparatus which we have used approaches some such condition and it is for that reason that we were able to obtain the results described.

Propose Restudy of Pan-American Railway Project

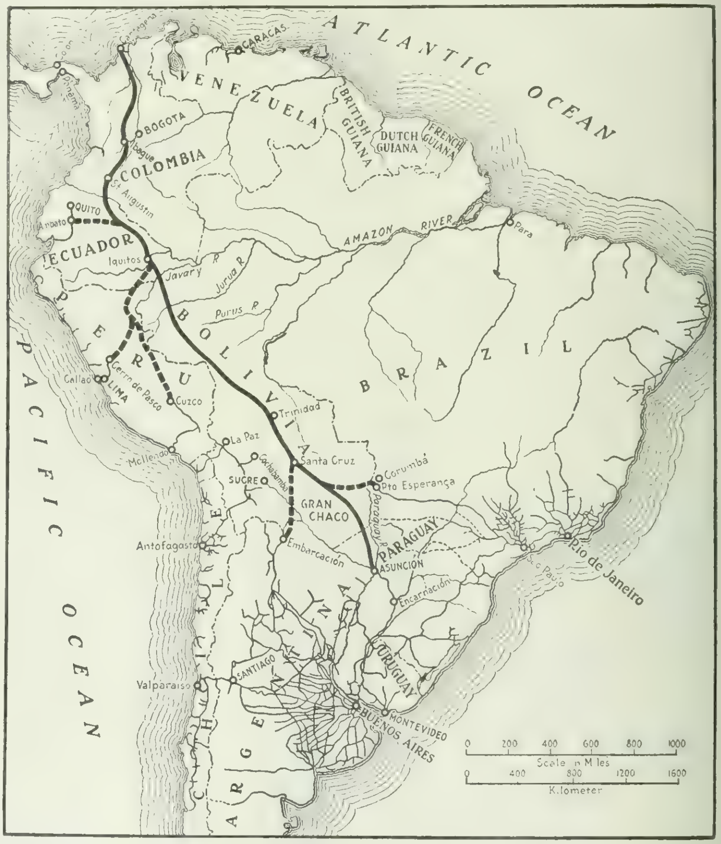
Proposed Route from Colombia to Argentina Would Tap Vast Region and Enable Connection With Many Existing Lines

By Frank B. Morris
Civil Engineer, Liberty Engineering Corp., New York City

Developments at the International Engineering Congress recently held at Rio de Janeiro direct attention once again to the project for a Pan-American railroad to provide through rail transportation between the two American continents. Resolutions adopted by the congress express the confidence of those present in the need and practicability of the project and provide for the appointment of a commission of three members, who would arrange in turn for the appointment of a commission to consist of one member from each country of continental America, with Charles Pepper, the only living member of the permanent Pan-American Railway Commission, as chairman. It is proposed that this committee should take up at once the task of determining a commercially practicable route.

Studies made late in the nineteenth century for a line along the principal range of the Andes, using the existing railroads where their location could be considered as adhering to the general direction of the Pan-American route, developed various obstacles which resulted in the temporary abandonment of the project. The principal objections offered to this plan are as follows: Existing railroads originally were built to serve local traffic and local development. They were built to conform to topographical conditions in particular areas rather than with the intention of forming links in a through system. Grades and curvatures are prohibitive. Gages are numerous and varied. Tracks and bridges are of light steel. Distances are excessive, caused by developments for grades. Unnecessary vertical lifts have been overcome. Tunnel sections are inadequate. In many instances directions not in harmony with a north and south trunk line would necessitate an expenditure probably as great as would be required to construct an entirely new line, and the additional length that must be added to these existing lines to accomplish a reduction of grade to a maximum of 1 per cent would so lengthen the system that competition with water transportation would be impossible and the Pan-American Railroad would be nothing more than a carrier of insignificant local commerce.

An alternative route that eventually would serve every nation in South America with direct rail connection would run from the Caribbean Sea directly to Buenos Aires, passing through Colombia, Ecuador, Peru, Brazil, Bolivia, Paraguay and Argentina. This route, the South American International Railroad, would be the ideal solution and probably would have substantial co-operation from the governments of all these nations as well as from Chile and Uruguay. The northern terminus would be Cartagena, the most important Atlantic port of Colombia; thence it would run south through the valley of the Rio Magdalena to its head just southeast of the village of St. Augustin, where it would cross the eastern spur of the Colombian Andes near the northern boundary of Ecuador at an elevation of approximately 6,000 feet.



PROPOSED PAN-AMERICAN RAILWAY ROUTE

This location will enable connections to be made as shown with existing railways that serve all the South American countries and will tap a rich territory in eastern Bolivia and western Brazil.

The principal Andean range which forms the continental watershed throughout the length of South America breaks into three distinct ranges near the southern boundary of Colombia, the western or Pacific range, the central range and the eastern range, on the western slope of which is located the city of Bogota, capital and principal city of Colombia. The western range extends northward through the Isthmus of Panama, forming the watershed between the Atlantic and Pacific oceans. The central range, the highest and most rugged of the three, is separated by the Cauca River from the western, and by the Rio Magdalena from the eastern range. This central range ends at the junction of the Cauca and Magdalena Rivers, while the eastern range extends northward and eastward into Venezuela, to the Caribbean coast.

That portion of Colombia along the route of the proposed railroad is rich in mineral, agricultural, forest and animal products, and although hampered by the present inadequate transportation facilities the greater part of Colombia's commerce, both foreign and domestic, originates in the immediate vicinity of the proposed line. From the St. Augustin Summit, the line would descend southeastward along the eastern slope of the Andes, through eastern Ecuador, a district of which little is known except that it is rich in hardwoods and virgin rubber, and has an excellent climate and fertile soil. This district is believed to contain much mineral wealth, because of specimens brought into western Ecuador by the Napo Indians.

Continuing southeastward, the line would pass through the northeastern part of Peru, crossing the upper Amazon near Iquitos, thence crossing the Rio Javary, into Acre territory of Brazil. That section of Peru traversed by the proposed line has shown remarkable agricultural development during the past few years, in spite of the heavy freight charges on the Amazon.

On entering Brazil, the line would pass through the western part of the state of Amazonas and the territory of Acre, where exist numerous towns, the principal one being Cruzeiro do Sul, the capital of Acre territory. This section abounds in virgin rubber and hardwoods, has an equable climate, and a fertile soil, suitable to the production of grain, sugar, cotton and coffee. Continuing southward the line would enter Bolivia at its northern boundary, and continue through that country to the border of Paraguay in the Gran Chaco, passing through the city of Santa Cruz, which in spite of its isolation, is a commercially important city of 35,000 urban population and about 100,000 in the district, and the fourth in importance in the republic.

The entire northern area of Bolivia offers great possibilities. The famous Yungas district and the Cochabamba valley lie a short distance west of the proposed railroad, while the route itself traverses a section rich in gold, silver, timber of all kinds, cotton, coffee, fruits and the best quality of rubber. Surveys are now under way for the extension of the Antofagasta Railway from Cochabamba, east to Santa Cruz; a line is proposed also from Santa Cruz south to Embarcación Argentina, through the petroleum district of eastern Bolivia, thus giving another rail connection with Buenos Aires and northern Argentina, while the line from Cochabamba to Santa Cruz would give direct rail connection with western Bolivia, Peru, and the entire length of Chile, via the Chilean longitudinal railroad.

From Santa Cruz southeastward to the connection with the Paraguay Central R.R. at Asunción, the route passes through the enormous flat plain of the Gran Chaco, following the watershed between the Paraguay and Pilcomayo Rivers, and passing through a district unsurpassed for stock-raising, now inhabited only by Indians, except along the Paraguay River, where are located important towns and industries. The Gran Chaco abounds in hardwoods, the most important of which is the red quebracho from which tanning extract is produced. This product reaches its northern markets via the Paraguay River and Buenos Aires, necessitating a southbound haul of from 1,000 to 1,500 miles.

At Asunción connection would be made with the Paraguay Central-Entre Rios system, as before mentioned, this system being a well constructed line of 945 miles length, from Asunción to Buenos Aires, built to 4 ft. 8½-in. gage, and crossing the Paraná River at Encarnación by train ferry. The present running time for trains between Asunción and Buenos Aires could undoubtedly be decreased to thirty-two hours.

Length of Line—This proposed trunk line from Cartagena to Buenos Aires would be approximately 4,450 miles in length, with a maximum grade of one per cent, and with only one lift of importance, that at St. Augustin pass, and capable, therefore, of maintaining a running schedule that would enable trains to make the trip between termini in 168 hours, or seven days. Of this 4,450 miles total length, deducting the Paraguay Central-Entre Rios division of 945 miles, which is now in operation, there would remain approximately 3,500 miles to be built, of which 70 per cent could be cheaply and easily constructed; the section crossing the Andean Spur, about 980 miles long, being the only portion of the line where moderately heavy construction would be encountered.

In addition to the railroads now under consideration, from Santa Cruz south, and west, which will form connections with this trunk line, there is in Peru a project to extend the Cerro de Pasco Railroad east to Amazon navigation. This could easily be extended further to a junction with the South American International R.R. at Iquitos, thus connecting the proposed line with Lima, the capital, and Callao, Peru's most important Pacific port. The Cuzco branch of the Peruvian Corporation R.R., now being extended into the Amazon district, would form another feeder, giving connection with southern Peru and western Bolivia. In Ecuador, a line is now under construction from Ambato eastward following the headwaters of the Rio Pastasa, a tributary of the Amazon. A short extension would serve to connect this railroad with the trunk line, thereby linking the entire Ecuadorean system to the Atlantic seaboard.

Another extension which would undoubtedly be made to form a junction with the trunk line, is from Porto Esperança, on the Paraguay River, and the present terminus of the Noroeste do Brazil Ry. This connection could be made with a short stretch of line, of cheap and easy construction, joining the trunk line in the Gran Chaco, thus furnishing direct rail communication with the cities of São Paulo, Rio de Janeiro, and all southern Brazil Atlantic ports. In addition to the Paraguay Central-Entre Rios R.R., before mentioned, other roads now in operation that would become feed lines for the South American International R.R. and furnish immediate traffic, are the Puerto Berrio-Medellin; Puerto Wilches-Búcaramánga; La Dorada-Ambalema, and the system operating between Ibagúe and Bogota, all in Colombia, which were primarily constructed for local development.

The proposed South American International Railroad would cross the following rivers now open to navigation, which would furnish other commercial routes of great importance in the exploitation of the Upper Amazon forestal resources: Rio Marañon or Upper Amazon, Rio Javary, Rio Jurua, Rio Purus, Rio Madre de Dios, Rio Beni, Rio Mamoré and the Rio Paraguay. These rivers with the several existing railroad lines would greatly facilitate railroad construction, enabling this work to proceed simultaneously at no less than twelve different points.

Climate—Climatic conditions along the route are favorable. The season of rains occurs during November, December, January and February, and the temperature varies between an annual average of 55 deg. F. on the Colombian plateaux to 70 deg. in the Bolivian and Paraguayan plains, and 82 deg. in the lower Magdalena valley, where the rainy season extends from June to November. The railroad route lies west of the fever district of the Amazon basin, and at only two points is to be found any evidence of fevers. In the lower Magdalena valley and northern Bolivia there is a mild form of malaria, which readily yields to simple treatment.

The following table of comparisons will give an idea of the saving in time between New York and a few of the principal South American cities, by the construction of the South American International R.R. The sailing time over the ocean routes is based on 18-knot steamers.

City	Present Time, Days	Time via S. A. I. R.R., Days
Buenos Aires	18	12
Montevideo	17	12
Asunción	20	10
Corumbá (Brazil)	26	11
Santa Cruz	25	9
La Paz	15	11
Iquitos	21	7
Bogota	15	6

Exclusive of the Indian population, there are at present located within fifty miles of the proposed South American International R.R., between Cartagena and Asunción, approximately 2,750,000 inhabitants from which to draw labor for construction and foodstuffs, which would be readily produced as soon as the demand is created. With this nucleus, and by intelligent effort to colonize this area while the present spirit of unrest throughout Europe and Asia tends to increase emigration among the peasant classes, together with the substantial inducements to immigration that all the South American nations are offering, it seems natural to assume that the present population would be increased by more than 2,000,000 after ten years, or after completion of the railroad. Under these conditions, the natural result would be the rapid development of a district rich in natural wealth and resources.

Engineering in the Early Days of the Delaware & Hudson

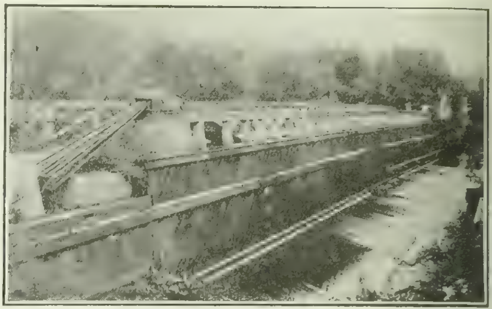
Some Unusual Items in the History of Engineering Progress Recalled by the Celebration of the D. & H. Centennial

CONSIDERABLE interest has been aroused in the transportation situation in this country during the early part of the nineteenth century by the information given out by the Delaware & Hudson Co. at its recent centennial celebration. Out of the whole mass of data which the company's historians have collected the following items were selected as being of peculiar interest to engineers.

Previous to the war of 1812 anthracite coal, as a commercial necessity, was practically unknown. But during the war the stoppage of all importations of coal from England made it necessary to find new sources of fuel in this country and stimulated interest in the so-called "stone coal" which up to that time had been little more than a curiosity. It was this condition of affairs that in 1814 started the Wurtz Bros., prosperous Philadelphia merchants, prospecting for coal in the Lackawanna River valley. After nearly eight years of arduous work they opened a coal mine at Carbondale, Pa., and shipped their first lot of coal down the Delaware to Philadelphia only to find that market already supplied by coal from the nearer markets on the Schuylkill and Lehigh. Undaunted by this reverse they set out to find a way to reach the New York market, and after a good deal of reconnaissance they discovered that, except for the high ridge of land separating Carbondale from the valley of the Lackawaxen, there were no insurmountable difficulties in the way of constructing a canal to the Hudson at Rondout. With this object in view they first obtained authority from Pennsylvania to canalize the Lackawaxen and then went to New York City to enlist the aid of influential men there in raising the necessary capital, and in obtaining authority from the state of New York to build a canal across to the Hudson. They succeeded in both undertakings. On April 23, 1823, the Delaware & Hudson Co. was incorporated by the state of New York, and in January, 1825, $1,500,000 of the company's stock was issued and immediately over-subscribed.

DOCKS AT HONESDALE, PA.

In 1823 the company had engaged Benjamin Wright, one of the principal engineers of the Erie Canal, to prepare plans and estimates for the proposed canal and to devise a scheme for getting coal from Carbondale over to Honesdale, the proposed western terminus of the canal.



A SUSPENSION AQUEDUCT OF THE CANAL

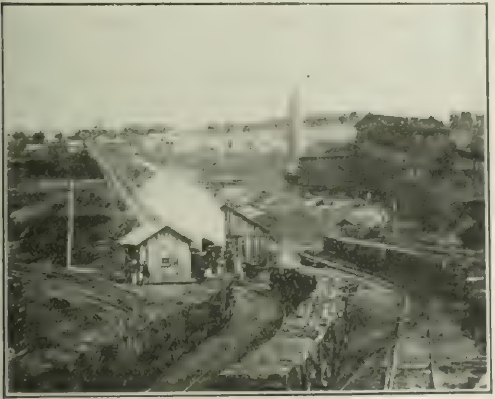
This picture was taken some years after the canal had been abandoned. It shows the inside of the aqueduct, and one of the cable anchorages.

Construction work on the locks was begun in 1825, but general construction on the canal proper did not start until 1827. By December, 1828, the canal was completed and the first boats had come through to tidewater at the Hudson.

But the items in the early construction of peculiar interest to the engineer are not in connection with the canal; they are, rather, in some of the details of the incline railway which J. B. Jervis, who succeeded Benjamin Wright, had designed as a means of getting over the ridge between Carbondale and Honesdale. The general scheme of this railway was a series of steep planes connected by low-grade planes wherever the ground formation permitted. On the western side there were five such steep planes with a stationary steam engine at the head of each. By means of long chains these engines hauled from three to five loads up one track and let the same number of empties down the other track. On the eastern slope there were three steep planes down which the loads went by gravity, pulling the empties up on the other track; their speed being regulated by friction brakes on the shaft of a large fanwheel. At the bottom of the lowest plane there was a low-grade line extending to the terminus of the canal at Honesdale. It was on this line that Wright proposed to use locomotives to move the cars.

The track construction is of particular interest in view of the present day practice. Hemlock ties 6 x 9 in. and 8 ft. long were used. These were spaced 10 ft. apart and were laid on individual piles of stone ballast wherever the ground conditions permitted. At all other places the ties were supported on posts, up to an elevation of 4 ft., or on trestles made of hemlock timbers for greater elevations. Two gains were cut into the top of each tie and rails of 6 x 12-in. hemlock 20 to 30 ft. long were set into these gains and held to the gage of 4 ft. 3. in. by hardwood wedges. Iron rail plates, 2 x ½ in., brought from England, were secured to the top of the wooden rails by screws spaced 18 in. apart. The screw holes were elongated to allow for expansion. (This type of rail was continued in use for a number of years but it was later found necessary to substitute spikes for screws and to put a hardwood strip under the rail plate.)

The First Locomotives—In January, 1828, Horatio Allen was sent to England to buy four locomotives, and the iron plates to cap the rails. He bought one locomotive, the *America*, designed and built by George Stephenson, and three of a different type built by Foster Rostrick & Co. of Stourbridge. The *America* and one of the Rostrick engines, the *Stourbridge Lion*, were the first locomotives to arrive in this country. They were set up for demonstration purposes in New York and then, some weeks later, were loaded on canal boats for shipment to Honesdale. After the locomotives arrived at Rondout all record of the *America* ceases. Its disappearance was as complete as it was mysterious, until, a few weeks ago, an official of the D. & H. Co. found at the National Museum in Washington, the right-hand cylinder among what had previously been supposed to be the parts of the *Stourbridge Lion*. To add to the mystery surrounding the *America* no mention was made of it at the time the shipment arrived at Honesdale. For some reason not now clear Horatio Allen, who had ordered the two engines in England and who was charged with making the first tests of them on the track at Honesdale, selected the *Stourbridge Lion*, and on Aug. 8, 1829, had it drawn up over an incline plane laid from the canal boat to the railway track. A fire was built in the fire-box with some of the Lackawanna coal and soon there was sufficient steam to make the trial trip.



FOOT OF PLANE G AT OLIPHANT, PA.

It had been the intention of Mr. Jervis, when preparing the specifications that Mr. Allen took to England when ordering the locomotives, that they should weigh about 6½ tons and that this weight should be distributed over six driving wheels. But when Mr. Allen got to England he found so much opposition to the use of six driving wheels that he had to accept engines with four wheels instead. So when the boiler of the *Lion* was filled with water it was found that it weighed nearly seven tons and that two-thirds of the weight came on the forward pair of wheels. This was about double what Mr. Jervis had figured when designing the track. Some critical observers upon learning of this excess of weight predicted that the engine would break down the track on the trestle work; while others, noting that the four wheels were set rigidly in the frame, declared that the leading wheels would climb the outer rail on curved track and be derailed. As these gloomy predictions did not seem to be without foundation Mr. Allen decided to make the first test himself. He later stated that he was undecided whether to go slowly around the first curve or whether to take it at full speed, but finally decided that if he was to go off the trestle into the creek below he was going to do it gloriously, and so when the engine had enough steam he opened the throttle wide and was going at a good rate of speed when the engine reached the curve. The engine neither broke through the trestle nor jumped the track but continued around the curve and was soon lost from sight of the cheering spectators. Later on, however, it developed that the engine was unduly straining the track and that its continued use would soon break it down. Studies were made to see if the track could be strengthened but as the cost seemed prohibitive it was decided to build horse-ways along the side and abandon the locomotives. The *Lion* was therefore taken off the track, set to one side, and later dismembered. Many years later most of its parts were recovered and are now in the National Museum at Washington.

The incline railway remained in existence until 1899. It was greatly modified as the years passed and locomotives were again used on it much as first planned. The accompanying photographs of it were taken some years before it was finally abandoned.

One of the changes made in the canal is also of peculiar interest. Some time during the forties it was decided to eliminate the flights of locks in and out of the channels of the Rondout, Neversink, Delaware, and Lackawaxen Rivers by the construction of aqueducts across them. John A. Roebling suggested that they be of a suspension type, prepared the plans for them, and later supplied the cables and built the aqueducts. The cables for the Delaware aqueduct were 8½ in. in diameter.

Water Supply for a New City in India

In planning the new capital city for the government of India at Delhi (distinct from the existing commercial city), water supply was one of the most important features in view of the exceptionally hot and arid climate of that part of the country. It was decided to design a system which will provide for future development into a combined system serving both cities. Water will be taken from the Jumna River about ½-mile above a polluted tributary and pumped to settling tanks from which a covered conduit will lead to filters at the present water-works plant. According to the engineer's report these filters will be of the Paterson type, as the existing slow-sand filters are not effective. These latter filters have to be cleaned frequently by manual labor and there is always the danger that the men employed in this work may be diseased and may pass on the infection to the water supply. From the clear water reservoir the water will be pumped to a main reservoir having conduits to two distributing reservoirs. Automatic valves will ensure delivery of water in proper proportions to the reservoirs. Three steam-driven Worthington-Simpson centrifugal pumps, each with a capacity of 5,000 gal. per minute under 45-ft. head, will be provided at the intake. Two Worthington steam-driven high-duty direct-acting pumping engines with a combined capacity of 3,000 to 4,500 gal. per minute at different speeds will deliver water to the reservoirs against a total head of 146 ft.

This plant will cost $2,300,000 and will furnish 30 gal. per capita for the population of 1,955 by eight hours' pumping. The distribution system is based on the same supply, with complete metering to prevent waste. Water for sprinkling streets and flushing sewers will be taken from the unfiltered irrigation water supply

Technical Proceedings of Baltimore City Planning Conference

Eleven Papers Deal with Baltimore, Washington and Maryland Problems—Regional Planning and Zoning Given Attention

REGIONAL planning, city planning progress and practice in Baltimore, and street traffic problems with particular relation to automobile parking were features of the fifteenth annual National Conference on City Planning held at Baltimore April 30 to May 2. In addition, a number of zoning clinics were held. Of about 250 persons registered some 10 per cent or more were engineers.

Regional Planning—A lengthy paper on "Regional and Metropolitan Planning," by George B. Ford, New York City, outlined the underlying principles and reviewed the work in this field done in various parts of the United States and in other countries. Mr. Ford summarized his general conclusions as follows:

1. The character and direction of growth of contributory areas beyond the city limits should be controlled by a metropolitan or regional planning commission, or where such areas lie entirely within a county by a county planning commission.
2. Such a commission should include official delegates from each municipality affected. Each municipality should contribute to the support of the work on a pro-rata basis or if that is not feasible it should be supported by private subscription.
3. There should also be a Citizens' Regional Plan Committee composed of representatives of the leading civic and economic organizations of each community within the area. This committee should co-operate with the official commission at every stage of its work. This committee should interpret the official plans to the public and to the authorities in their respective towns and should aid in securing local backing and support. The committee should also act as a watch-dog over changing official commissions to maintain the continuity of the plans.
4. The official commission should cause a regional plan to be made which should include every physical feature which could affect more than one municipal unit. It should be made for many years to come and such a plan should be officially recognized by each of the municipalities affected by it.
5. No project affecting more than one community, be it for a thoroughfare, bridge, transit line, railroad, waterfront development, park, public or private reservation, subdivision, building code or zoning ordinance, should be executed without having received the sanction of the regional commission as well as of the local bodies affected.
6. All physical improvements affecting more than one community should be paid for by pro-rating the cost among the municipalities interested.
7. If in a given case the state constitution or laws prevent or hamper any of the above operations, steps should be taken to amend them.
8. Serious consideration should be given to the causes and the effects of concentration of population and, in so far as an undue "load on the land" is found to cause harm, the effect should be mitigated by regulation and means found of encouraging decentralization.
9. Guesswork and unscientific judgment should be reduced to a minimum in regional as well as in city planning. Every plan recommended should be the logical deduction from a quantitative as well as a qualitative analysis of all of the contributory facts.
10. Everything possible should be done to counteract the sordidness of most larger agglomerations and to bring back to the environment of the city dweller the charm that he craves.

In the course of a lengthy written discussion of Mr. Ford's paper Charles H. Cheney, Redondo Beach, Calif., said that the two important differences between city planning and regional planning are: (1) Planning for a region is a larger order, requiring broader and more imaginative planning; (2) it usually includes differing political units which create problems not so much of planning as of administration and financing. In regional planning the first great need is an airplane survey. Morris Knowles, Pittsburgh, Pa., cited the Essex Border Utilities, across the Canadian line from Detroit, as an example of getting together, first, as was done in the case of the Boston Metropolitan District, for one purpose and then taking on others. In the Canadian case water and sewerage came first and then municipal co-operation in water supply and later in plotting new areas. In a paper on "Inter and Intra-urban Traffic as a Regional Planning Problem," George A. Gamon, Pasadena, Calif., suggested major highways 100 ft. wide and one mile apart and auxiliary highways of lesser widths halfway between each major highway.

Baltimore, District of Columbia, and Maryland—Eleven papers were scheduled on various phases of the Baltimore city plan and city and regional planning for the District of Columbia and for Maryland. These were largely descriptive in character. W. W. Emmart, architect of the Baltimore Planning Commission, outlined a study for new railway terminal facilities at Baltimore in which it is tentatively proposed that the Pennsylvania R.R. through the city be given over to passenger service and the Baltimore & Ohio to freight service. Col. C. Keller, recently engineer commissioner, District of Columbia, discussing "The Relation of Washington to a Plan of the Baltimore Region," suggested among other things the correlation of the parks and parkways systems of the two cities with connecting highways, and referred to the plan that has been up from time to time for a national forest between Washington and Baltimore. Jefferson C. Grinnalds, Baltimore, in a paper on "A Regional Plan for Maryland," said that the Maryland state highway system is a skeleton on which regional planning should be built up. Water transportation facilities, especially in Maryland, divided as the state is into two parts by Chesapeake Bay, should be given careful consideration.

An analysis of the requisite area for school buildings and associated playgrounds of various classes was presented by Henry G. Perring, supervising engineer, Public Improvement Commission, Baltimore, in which he showed that altogether some 11½ acres for schools and playgrounds are needed per square mile of city territory. In congested districts it is impossible to provide so amply on account of the expensiveness of land. In a section which may change to a manufacturing district later on a heavy type of construction for school buildings was adopted so that the building could be turned over to manufacturing use later on. Among other Baltimore papers there was one on port development, by Bancroft Hill, harbor engineer, whose talk was given around a large model now exhibited in a temporary building; water supply, by William A. Megraw, water engineer; the major street system, by Maj. Joseph W. Shirley, long connected with the topographical survey of Baltimore and city planning there. The topographical survey for the annexed district of Baltimore, which has an area of about 60 sq.mi. as compared with the previous area of 30 sq.mi., was begun as soon as possible after annexation in 1918 and completed on May 30, 1921. The maps were made on a scale of 200 ft. per inch of 5-ft. contour. The survey was based on a triangulation of the United States Coast and Geodetic Survey, which co-operated with the city.

Zoning—The program announced that "Mr. Bassett will conduct zoning clinics at all free times throughout the conference." These took place at meal times and were devoted to questions and answers and an exposition of zoning principles, law and court decisions. In addition, Mr. Bassett presented a review of "Court Decisions on Zoning Up to Date" at one of the meetings.

In a thoughtful paper on "Zoning in Relation to Regional Planning," Robert H. Whitten, Cleveland, Ohio, stated that the first essential is a barrier between the large central commercial city and outside territory. The larger city in a region, as well as the satellite cities in its vicinity, should each be encircled with open space used for parks, forests, playgrounds, golf courses, cemeteries, truck gardens, or any one of many various purposes that will leave the general surface of the country undisturbed and require but a small population to conduct such operations as are carried on.

Automobile Parking and Storage—Under the title "Day and Night Storage and Parking of Automobiles," Hugh E. Young, Chicago, stated that the number of motor vehicles registered in the United States has increased from 1,700,000 in 1914 to 12,357,000 in 1923. To provide for this vast increase we have for the most part streets laid out fifty years ago.

In the Chicago district there are some 300,000 motor cars and the number is increasing rapidly. Parking facilities are available to a small handful out of the total. Shall the few automobiles that could be accommodated by parking infringe on the many that cannot? Some 45 per cent of all the automobiles which enter the business district of Chicago require one-half to one day storage. This should be provided in garages, located outside the business center.

Discussion of Mr. Young's paper was opened by John C. Long, secretary of the National Automobile Chamber of Commerce. Mr. Long said that the use of vacant lots for parking is materially helping the motor traffic situation in some cities. Many cities are finding urgent need for "parallel arteries near the present main thoroughfares to care for the growing volume of street traffic."

E. P. Goodrich, New York City, said that to allow parking on public streets is equivalent to permitting a street to be used as garages. Omaha, Mr. Goodrich said, is the only city he knows of where the streets in the business districts are wide enough for parking. J. R. Bibbins suggested the use of streets in "blighted districts" to accommodate automobiles. One-way streets, he said, afford only temporary relief. Parallel streets are needed for permanent relief. In the Springfield road tests in Illinois it was found that 35 per cent of passenger automobiles were used for business purposes. This fact must be recognized in dealing with traffic and parking problems. The possibility of underground storage for automobiles was mentioned by Mr. Bibbins. Herbert S. Swan, New York City, said that the necessary street widening to provide for present and prospective traffic would be prohibitive in many cities, but by better traffic regulations double the present traffic could be accommodated.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Compensating a Grade for Curvature

Sir—It seems to me that there is an easier method of compensating a grade for curvature than the one given by L. F. Hammond under "Four Problems in Surveying" in your Job and Office Section for April 26, p. 756. It is: Multiply the sum of the central angles in degrees (they are generally given on railroad plans) by the adopted compensation factor; to this product add the difference in elevation; divide this sum by the distance in stations to get the rate of grade on tangents. This percentage of grade is then to be decreased by the product of the compensation factor and the varying degrees for the various curves.

BENNO A. WISE,
City Engineer, Bradford, Pa.

April 28, 1923.

Lettering Jigs

Sir—In your issue of April 26, 1923, p. 771, under the heading "Equipment and Materials" you note a "Guide for Lettering Drawings"—the "Wrico lettering system." The note leaves the impression that this is a new system.

Similar lettering jigs have been in use in Europe for several years, and are prescribed in standard lettering on drawings by some European standards committees. I believe these jigs originated in Switzerland.

L. B. TUCKERMAN,
Engineer Physicist, Bureau
of Standards.

Washington, D. C.,
May 1.

Doubt Fixation of Atmospheric Nitrogen by Activated-Sludge Process

Sir—With respect to the article appearing in your issue of March 15, p. 487, entitled "Fixation of Atmospheric Nitrogen by Activated Sludge," I should like to call your attention to the data included in an article from this laboratory entitled "Chemical and Biological Reactions in the Dorr-Peck Tank" appearing in the *American Journal of Public Health* for April, 1922. In the table on nitrogen balance our data over limited periods checks that of Mr. Peck's in that very considerable amounts up to 25 per cent of nitrogen are apparently "fixed." In subsequent experiments, the data for which will appear in our Bulletin 18 within the next few weeks, as much as 55 per cent nitrogen was apparently fixed over a 7-day period, but, on the other hand, over other periods there is apparently an appreciable loss of nitrogen, running as high as 34 per cent.

After working on this problem for a little over a year, we concluded that these erratic results are due to the accumulation of sludge in the tanks during one period and unloading in a subsequent period. Experiments on sampling the tank for the actual amount of nitrogen at any one time showed that such a procedure was exceedingly difficult, and we concluded that no nitrogen balance results were reliable unless they were run over a long enough period so that the actual amount of nitrogen in the tanks would be inconsiderable in comparison with the total amount which had gone through. When averaging the results over a period of eight months, there is found to be only an increase of 1.8 per cent.

In cases where there is considerable nitrification, it has usually been the experience that there is a greater loss of nitrogen. Our experiments were carried on with low air and without the formation of nitrates.

During part of October, November and December, 1921, we dosed the tanks with from [illegible] to [illegible] p.p.m. of iron without obtaining any fixation of nitrogen. Dr. Hague of the Department of Botany of the University of Illinois and Mr.

Long of our Division identified crenothrix in considerable quantities throughout our experiments. We have photomicrographs of our sludge.

A. M. **Buswell**
Chief, Illinois State Survey Division.

Urbana, Ill., March 30.

Sir—A study of the article by C. Lee Peck on "The Fixation of Atmospheric Nitrogen by Activated Sludge," in your issue of March 15, p. 487, leads us to make the following comments.

Some two years ago, through the courtesy of the Dorr Company, who conducted the tests at Mt. Vernon, we examined the data obtained bearing on the fixation of atmospheric nitrogen, and were also supplied with a copy of D. D. Jackson's report. We did not feel at that time, nor do we now, that these data warranted the conclusion that atmospheric nitrogen had been fixed.

Mr. Peck has not stated the period of time covered by the actual test (Test 1) upon which his conclusion is reached, nor does he state the flow. Our study of the Mt. Vernon data leads us to believe that he has drawn his conclusions from a period of eight days only, and that during this period the tanks were unloading. This will upset any reasoning on the phenomena occurring. For the period Dec. 29 to Jan. 5, the following data are summarized.

	PARTS PER MILLION		
	Raw	Effluent Tank 1	Effluent Final
Total solids	535	590	585
Suspended solids	141	212	210
Total ammonia	49.3	49.7	51.3
Insoluble ammonia	7.9	16.3	16.3

Our experience in operating the Dorr-Peck tanks has shown that where the settling compartment is agitated, as Mr. Peck states it was, it is very difficult to prevent a loss of suspended solids in excess of the daily input from the influent. Longer test periods are required than even the nineteen days—apparently the total of all tests made on nitrogen fixation at Mt. Vernon. It is entirely possible that more sludge would be discharged than was produced during the same period, and also show thereby more nitrogen in the effluent than was introduced in the influent.

The proof of such a fundamental phenomenon as the fixation of nitrogen requires careful operation and detailed sampling extending over many months, and exceedingly careful analytical work. The technique in the determination of Kjeldahl nitrogen, both soluble and insoluble, requires skilled attention and constant re-checking. Nitrogen as insoluble nitrogen is determined indirectly by difference between the nitrogen in the total and in the filtered samples. Consequently errors in both determinations affect the results for insoluble nitrogen. Excessive variations from day to day in the percentage of nitrogen in the suspended solids indicate lack of caution in checking analyses. Our experience has been that the nitrogen content of activated sludge is remarkably uniform from day to day, varying only a few tenths of 1 per cent during the course of several weeks. If this be true how can the excessive variations shown in the following table be explained? These calculations were made from the data on the blue-prints submitted to us as records of the analytical work:

	Raw Sewage			Effluent, Tank 2		
	Tons per Million Gallons		Per Cent	Tons per Million Gallons		Per Cent
Date 1919–20	Suspended Solids	Insoluble N as NH_3	NH_3 in Suspended Solids	Suspended Solids	Insoluble N as NH_3	NH_3 in Suspended Solids
Dec. 29	0.750	0.037	4.9	894	0.089	9.9
30	471	034	7.2	562	056	9.9
31	417	047	11.2	836	054	6.5
Jan. 1	500	028	5.6	521	012	2.3
2	771	031	4.0	855	083	9.7
3	792	030	3.8	960	087	9.1
4	459	036	7.8	1.857	110	5.9
5	521	023	4.4	542	058	10.7
Average	585	033	5.7	878	068	7.7

Mr. Jackson, in his report, draws his conclusions from the results of three tests made in five-gallon bottles, from Jan. 2 to 19, 1920. In all, 98 liters of sewage were added to the first bottle (Bottle 5), 63 to the second and third (Bottles 6 and 7). The remarks under "Nitrogen Fixation" are;

1. Bottle 5, New York City sewage. Gain in NH_3 during experiment, 42.7 per cent.
2. Bottle 6, New York City sewage and activated sludge from Mt. Vernon. Gain in NH_3 during experiment, 25.1 per cent.
3. New York City sewage, activated sludge from Vt. Vernon and iron. Gain in NH_3 during experiment, 2.9 per cent.

Nitrogen fixation was claimed on the basis of the first two tests, *in which no iron was added.* In Test 3, when iron was added, practically no fixation was indicated.

It is difficult to see how a nitrogen balance was calculated for these tests as the analyses in the report show only results for free ammonia and *albuminoid ammonia,* not total organic nitrogen.

A clear distinction must be drawn between true fixation of atmospheric nitrogen and coagulation or adsorption of soluble ammonia nitrogen on the surfaces of insoluble particles of activated sludge. In the first case the total nitrogen of the complete system must be increased; in the second case, the total nitrogen of the complete system does not increase, in fact, it usually decreases, but a small amount of soluble ammonia is removable in an insoluble form. While most investigators of the activated-sludge process admit that the latter occurs, there are very few who believe as yet that the fixation of atmospheric nitrogen by the activated-sludge process has been demonstrated.

The most painstaking work that has so far been done on this problem has been reported by E. H. Richards and G. C. Sawyer (Jour. Soc. Chem. Ind., 41, 62-72, March 15. 1922) who describe many experiments made at Harpenden, at the Rothamsted Experiment Station, on the microbiology of activated sludge, and on the nitrogen relations of sewage and activated sludge, with particular reference to nitrogen fixation. All tests showed a loss of nitrogen, in some cases as high as 30 to 40 per cent. Among other conclusions the authors state:

"In all our experiments, both at the sewage-works and in the laboratory, there is no evidence of any fixation of atmospheric nitrogen. The amount of nitrogen recovered in the sludge is always less than the amount removed from the sewage during treatment. This does not, of course, prove that no fixation of atmospheric nitrogen occurs, but the amount fixed must be less than that lost as the result of the partial aerobic fermentation of the sewage."

On the basis of the data which Mr. Peck has outlined in brief, the Dorr Company definitely abandoned the Dorr-Peck process by the announcement made in your journal on Feb. 9, 1922, p. 251. Out of four trials—at Mt. Vernon, Argo, Urbana and Decatur—three had proven negative and the fourth and original was open to doubt even in the minds of the company financing the tests. It is our understanding that the Dorr-Peck process as originally put forward involved the claim of nitrogen fixation.

We have outlined our criticism at some length because we feel that the fundamental facts concerning the activated-sludge process should be developed with great care, taking due account of the variable conditions met with in different sewages. Facts can be established only by tests extending over periods of months with all operating and analytical data under rigorous control.

F. W. **Mohlman**, Chief Chemist,
Langdon Pearse, Sanitary Engineer,
Sanitary District of Chicago.

March 28.

Sir—Replying to the criticism by Messrs. Mohlman and Pearse of my paper on "The Fixation of Atmospheric Nitrogen in the Activated-Sludge Process:" I asserted that in certain tests at Mt. Vernon and at Columbia University atmospheric nitrogen had been fixed in the presence of so-called activated sludge. My claim is limited to this statement. There is no claim that it can always be accomplished. It is not asserted that the proper environment for such a result is known. A list of failures is given.

As my critics say, before such a fundamental phenomenon can be accepted it must be established by clear and indubitable evidence. I am prepared to supply the details of this evidence to any engineer, society or scientific journal desiring to examine it. I cannot here enter into a thorough discussion of this evidence, but the following discussion will, I believe, dispose of the objections of my friends Messrs. Pearse and Mohlman and raise the presumption of probable truth of my statements in the minds of those who read it.

TABLE I—AMMONIA CONTENT OF SEVERAL CONSTITUENTS OF THE SLUDGE

	Per Cent NH_3
B Vortiella....	16 95
B Crenotrix.	8 00
Fibre and paper pulp	1 26

Messrs. Pearse and Mohlman draw their assumptions from a tabulation of two tank tests at Mt. Vernon and the report of Dr. Jackson on the Mt. Vernon and Columbia University tests. They assert that the data submitted to them do not warrant my conclusions. They assign the following reasons:

1. That the tabulations indicate that during the period of the tests the tanks were "unloading" and that this would upset any reasoning on the phenomena occurring.
2. That excessive variation from day to day in the reported sludge analyses indicates lack of caution in checking analyses and casts doubt on the accuracy of the results.
3. That the duration of the tests was too short to warrant any conclusions.
4. That nitrogen determinations appear to have been made up from "free ammonia" and "albuminoid ammonia" instead of from "total organic nitrogen" determinations. That results so obtained are no evidence of the total amount of nitrogen in the complete system, and therefore no evidence of fixation.

Now these are errors, every one. But before discussing them I would state that had I no more evidence than that cited by my critics I would not have laid the results and my conclusions before your readers.

As to the first objection, that the tanks were unloading nitrogen which I mistook for fixed atmospheric nitrogen: At the start and at the finish of each of the tank tests the amount of nitrogen and of solids in the tanks was carefully determined. It was found that the tanks *had* unloaded. The amount so unloaded was deducted from the excess of nitrogen and solids discharged and the balance, still in excess of the nitrogen introduced with the sewage, could have come from but one source, the atmosphere. In one case this increment in excess of nitrogen fed in with the sewage and unloaded by the tanks was approximately 15 per cent, in the other 5 per cent.

As to the second objection, unreliability of tests as shown by wide variations in daily solid nitrogen percentages: I agree with my critics that wide variation in nitrogen content of solids in sludge is evidence of careless work in sampling or determinations or both and such results cannot be trusted. I deny that the tabulations indicate any such variation. In Table II I have set down the daily analyses on dried sludge alongside the calculations of nitrogen in suspended solids and the amount of suspended solids as prepared for me by Dr. Mohlman. Below this tabulation is shown the effect of our method of determining ammonia in the dried sludge in concentrating the ammonia. Explanation: Our determinations of soluble and insoluble ammonia and suspended solids were made on *tank effluent*. During the period of the tests under discussion no settled sludge was drawn from the tanks, excess was permitted to overflow with the finished liquor through a recording meter and samples were taken hourly at the meter discharge. During the period of the test under discussion these solids ranged from 125 to 450 p.p.m. Samples of settled sludge were taken daily. These were treated with ½ c.c. of sulphuric acid per litre, drained through cheesecloth, dried and analysis made of the *dried* sludge. This treatment resulted in the solution of the alkaline constituents of the sludge and consequent concentration of the ammonia. The extent of this is indicated in the bottom line of the tabulation. *Now if* we apply the degree of concentration shown to attend the method of dry sludge analyses to the averages of acid-treated sludge analyses and compare with Dr. Mohlman's calculation, 8.60 per cent sludge would be derived from 7.5 per cent suspended solids. The calculation shows an average of 7.7 per cent. Sludge samples are taken in concentrations ranging from, say, 3,000 to 30,000 p.p.m. of suspended solids. They constitute a fair average of all the solids, and their analysis will result in a fair average of the ammonia content. Where the solids are sizable and of widely varying N content, and the samples are taken in dilutions of from 125 to 450 p.p.m. there will be considerable variation in analytical results. The solids in No. 2 tank effluent used by my critics in their illustration were of an unusual character. Only 0.05 cu.ft. of air per gallon per hour was used. Agitation was very gentle. The average period of sludge detention in the tank was perhaps weeks. Biological aggregates of considerable size developed. When dilute sludge from this tank was permitted to stand in an Imhoff cone these masses, white as snow and mostly composed of vorticella, settled to the bottom of the cone and formed a zone of their own. The wide difference in the ammonia content of different classes of suspended solids contained in the materials analyzed is shown in Table I.

TABLE II—SLUDGE ANALYSES UNDER CONDITIONS STATED

Showing consistent analysis of dried sludge and concurrent analyses of samples of same sludge taken at dilutions ranging from 125 to 446 p.p.m. also relative ammonia content of wet unacidulated sludge and sludge which had been acidulated, drained and dried before analysis

Date 1919	Per Cent NH_3 in Dried Sludge	Calculations by Messrs. Pearse & Mohlman: Per Cent NH_3 in Suspended Solids	Tons Suspended Solids per Million Gallons
Dec. 29	9 03	9 [illegible]	0 894
Dec. 30	8 90	9 9	0 562
Dec. 31	8 17	6 5	0 821
Jan. 1	7 83	2 3	0 721
Jan. 2	8 64	[illegible] 7	[illegible]
Jan. 3	8 94	9 1	[illegible]
Jan. 4	8 90	5 9	1 8[illegible]7
Jan. 5	8 34	10 7	0 642
Average	8 60	7 7	0 878

As to the third objection, that the period of the tank tests was too short to prove anything: If they stand alone, as my critics seem to infer, they are. I think they must be included in additional evidence rather than in the category of proof. *If* influent and effluent samples and analyses were accurate, and *if* stock of ammonia in the tanks at the start and finish of the tests were accurately determined, then a single day would prove whether or not ammonia was fixed. None of these conditions can in practice be met. I am sorry the tests were not of greater duration. One was terminated by poisoning the sludge. The other by "flu" in the staff. I hold them to be corroborative only of the bottle tests conducted at Mt. Vernon and at Dr. Jackson's laboratories at Columbia University.

TABLE III—RESULTS OF FIFTEEN MT. VERNON NITROGEN FIXATION BOTTLE TESTS

			Per Cent
Group 1. Showing fixation of atmospheric nitrogen in the presence of Crenothrix sludge.			
Bottle No.	II	Gain in total nitrogen	62 5
	V	Gain in total nitrogen	65 9
	VI.	Gain in total nitrogen	31 2
	XIII.	Gain in total nitrogen	21 3
	XVIII	Gain in total nitrogen	65 9
Group 2 Dosed with iron salts which proved inimical to Crenothrix			
Bottle No.	VII.	Gain in total nitrogen	1 0
	VIII	Loss in total nitrogen	0 8
	IX	Gain in total nitrogen	3 5
	XVI	Gain in total nitrogen	0.5
	XV.	Gain in total nitrogen	2.8
Group 3 Not dosed with iron No growing Crenothrix observed in the sludge			
Bottle No.	I	Loss in total nitrogen	17 4
	III	Loss in total nitrogen	21 6
	IV	Loss in total nitrogen	18 3
	X V	Loss in total nitrogen	30 8
	XV	Loss in total nitrogen	34 5

A summary of fifteen of the Mt. Vernon bottle tests is given in Table III. Analytical data on these tests are not subject to the criticisms and possibilities of error which are inevitable in commercial tests. The sewage used in the bottle tests was prepared by filtering it through cheese cloth. This made accurate sampling possible. All samples not tested immediately were preserved with an excess of chloroform, in cold storage. All samples and bottles were kept in a building separate from the laboratory. Charging, sampling, analyzing were performed by competent chemists of several years experience in organic analysis. All chemicals and reagents were tested for purity; separate beakers, pipettes, etc., were used for handling and sampling the several liquors and sludges. Accuracy was checked by the usual means. In short everything was done which our own staff or Dr. Jackson, consultant, could suggest to secure accuracy and reliability.

As to the fourth objection: The reported total ammonias in these tests are all Kjeldahl-Gunning determinations.

I feel that no engineer in possession of all the facts would hesitate to subscribe to my conclusion that "under certain conditions it is possible to fix atmospheric nitrogen in the presence of activated sludge." **C. Lee Peck.**

New York City, April 21.

How Can We Stop Duplication of Orders?

Following the publication of the editorial "How Can We Stop Duplication of Orders?" in its issue of April 26, p. 735, Engineering News-Record called upon a number of leading contractors and dealers for an expression of their opinion on the subject. The replies received to date follow:

Sir—Have read your editorial with much interest. I agree with your views absolutely. If your suggestion could be made a general practice I believe it would have a very stabilizing effect on the whole industry.

New York, May 4. **Fred T. Ley,**
President, Fred T. Ley & Co., Inc.

Sir—I have carefully read the editorial in *Engineering News-Record* of April 26 entitled, "How Can We Stop Duplication of Orders," and wish to say that I am in thorough accord with it. I know from personal knowledge that there are a tremendous number of duplicated orders at this time. There are only two ways to prevent this: (1) For dealers, non-cancellable orders; (2) for contractors, what are known as job orders, by which material ordered by the contractor can only go to one job, and only a sufficient amount of material can be ordered by a contractor to do that particular job. I think this would, in a large measure, stop duplication of orders. It would still, however, be possible for a contractor to order material for a certain job from two manufacturers, but I am of the opinion that very few would, as it would be discovered as soon as the job was started.

New York, May 4. **D. A. Garber,**
President, North-Eastern Construction Co.

Sir—I fully agree with the sentiments expressed in the editorial. I believe that not alone good economics but also good morals demand that the reprehensible practice of placing contracts which there is no intention of carrying out be stopped. It will be a sad day in our country when contracts come to be looked upon as "a scrap of paper" by a substantial part of our business community.

New York, May 4. **L. J. Horowitz,**
President, Thompson-Starrett Co.

Sir—I think you are quite right in the principle of over-ordering, and while it is an evil that I should very much like to see stopped, I doubt if it is as much of a practice with contractors in general as it is with many others who are near-contractors, such as the larger manufacturing companies like the various steel corporations which usually do their own work, a great many of the railroads which buy direct, and some of the highway departments. I understand from a very reliable source that the State of Maryland has work that will take actually about 750,000 bbl. of cement this year if the entire amount of work is done; they have actually bought against this 1,500,000 bbl. The old adage, "Every Jack for his own trade," is true in the construction business. States, municipalities, corporations and others, no more fitted to do construction work than my company is to do publication work, are attempting to carry on and the practice is growing with alarming rapidity. It is their belief that they are going to save money, but they are only fooling themselves because they do not keep accurate costs and records, do not charge in the proper overhead, nor do they ever reckon up to see whether the job comes within any reasonable estimate.

My experience is that work done outside of the regular contracting field, where the contractor either has to do the job for his limited cost by contract or go broke, is done largely on the principle of necessity. In these cases the owner pays the freight. There is no contractor to blame, but conditions compare with some of the worst instances claimed against the cost-plus-percentage system. Naturally, under such conditions, we are going to have a great many evil practices grow up that are a detriment to the construction industry as a whole and to the ultimate consumer.

With regard to the contract for materials which you speak of, this form is most prevalent in the cement and steel industries. In most other lines, such as brick, broken stone, sand and gravel, material is bought at a fixed price for the job and while probably no definite quantity is agreed upon, it is intended that all required on the particular project shall be furnished at that price and, of course, the orders are subject to cancellation if cancelled before delivery. I thoroughly agree with all you say about this particular form of alleged contract and I have worn myself out discussing this point with the cement manufacturers who, I believe, are entirely to blame for it.

I have tried for years to buy at the first of the year a year's supply on a definite number of barrels of cement at a definite price with no ups or downs and an agreement to take, within the year, the actual number of barrels specified. Invariably I have had the reply that they could not sell it to me on that basis unless I could tell them the particular projects on which I wished to use the material, that they would much prefer to sell me my requirements from job to job and that it would be unfair to me not to give me the benefit of any drops in the market and at the same time guarantee a maximum price.

I think you are working on a line that is well worth while and something we have often discussed in our A. G. C. councils. If you can arrive at a solution of the problem and get it adopted you will have been of great help to the industry, but in order to do so I believe your greatest amount of work will have to be done with the manufacturers who brought the evil upon themselves rather than the contractors, but I do not mean by this that the contractors are entirely blameless.

Buffalo, May 3. **J. W. Cowper,**
President, The John W. Cowper Co., Contractors,
Buffalo, N. Y

Sir—I have read with much interest the editorial which appeared in *Engineering News-Record* of April 26 on the subject of the duplication of orders for materials. Of course, my observation is based very largely upon the operations of my own company and I can tell you that it has not been the practice of our purchasing department to duplicate orders, but to place the orders with companies of dependable standing, companies where our experience has led us to believe that the service would be rendered as nearly as conditions would permit.

I have had some experience with a large steel-bar company selling to contractors and it was not the practice there to duplicate orders, although in some cases they may have purchased steel in anticipation of rising markets and have taken the steel to their yards for distribution. The conditions complained of have existed, I believe, among material dealers and I know the cement companies have had a great deal of difficulty in appraising the value of orders placed with them by dealers.

The problem, it seems to me, is in the direction of educating business men as to the sanctity of contracts; if business morals can be improved, this problem will be likewise improved. **H. C. Turner.**
President, Turner Construction Co.

New York, May 7.

More Power on the Susquehanna

The Susquehanna Power Co. has filed application with the Federal Power Commission for a preliminary permit for a power project on the Susquehanna River between tidewater and Conowingo, Md., downstream from the Holtwood power plant at McCall Ferry, to develop 260,000 hp.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

A New Bureau of Housing is to be established in the New York State Department of Architecture according to a bill passed by the legislature. The bureau is to supervise housing and regional planning, and will be in charge of an assistant state architect.

A New Transatlantic Cable is to be laid between New York and London in the immediate future by the Postal Telegraph-Commercial Cables System. The new cable will average 1,100 lb. of copper per mile, 400 lb. more than the largest existing cable, and will have a capacity of 600 words a minute in each direction.

Except For Some Double-Track work now under consideration, improvements for this year on the Nashville, Chattanooga & St. Louis Ry. are mainly of a miscellaneous character. The outstanding authorities for improvements already contracted for amount to $603,180 for roadway and $2,637,639 for equipment.

The Lehigh Valley R.R. Has Opened the first unit of its new Claremont Terminal on the New Jersey side of New York harbor (*Engineering News Record*, May 13, 1920, p. 970). The completed portion of the pier is two-thirds of a mile long and 400 ft. wide. It is provided with a gantry dock, a freight shed dock, and an ore dock, as well as a freight yard of 2,700-car capacity.

Bismarck, N. D., Will Vote May 14 on the question of the issuance of bonds for construction of a complete municipal waterworks system. Plans made by T. R. Atkinson, city engineer, contemplate reservoirs, filtration and softening plants, pumping station and distribution system, to cost $704,000. L. P. Wolff, of St. Paul, is consulting engineer for the project.

Construction Work on the Esquimalt drydock (*Engineering News-Record*, April 21, 1921, p. 670) has been postponed for about two months by the flooding of the entire dock excavation due to a break in the outer cofferdam early in January. The Pacific Construction Co., which has the contract for the repair work, is driving wooden piles to replace the 300 ft. of sheet piling carried away in the break.

Improvements Planned by the Great Northern Ry. for 1923 include 35 miles of double tracking; new engine terminals at St. Cloud, Fargo and Watertown; 345 miles of automatic block signaling; extending 34 passing tracks; completing the new steel ore dock No. 2 at Allouez, Wis. (to be in operation in May); and rebuilding timber ore dock No. 1 at Allouez.

Canada Votes $50,000 to Study Second Chippawa Power Project

On April 30 the Ontario Legislature appropriated $12,687,000 for the Provincial hydro-electric power system, distributed among the different developments as follows: Niagara system, $9,850,000; Muskoka, $360,000; Rideau, $20,000; Thunder Bay, $1,015,000; Central, $1,375,000; Nipissing, $17,000; and Essex, $50,000.

The sum of $50,000 was also voted for an investigation by the engineers of the hydro-electric system on a second Queenston-Chippawa development, looking to the possibility of another canal. Hon. Dougall Carmichael in asking for the appropriation stated that if present facilities were used to capacity the commission estimated that it could only supply the demand until 1926 or 1927. The total amount involved in the capital expenditure on the Queenston-Chippawa development up to October 21, 1922, was $65,495,248. In February last there was sold from the four units at Chippawa now in operation 180,584 hp. The total output of all the plants at Niagara is approximately 510,000 hp. After deducting operating expenses and maintenance charges there was left a little over $1,000,000 of a surplus from the sale of power from the Chippawa units for the four months ending February, to apply to the reduction of interest charges.

Delaware Gets Funds for Two-Year Road Program

As a result of action by the Legislature of Delaware the State Highway Department is authorized to undertake, during 1923, a road program involving $2,500,000 and a similar amount for the year 1924. It is planned to complete 175 miles of hard-surface road during the next two years.

The increased funds, according to information received from the State Highway Department, are derived from a 1-c. per gallon motor-vehicle fuel tax which went into effect Apr. 22. This tax will be increased to 2c. a gallon beginning in 1924.

Trenton Sewage-Works Plans Acted on by State Health Board

The State Board of Health of New Jersey refused on May 1 to approve Col. George A. Johnson's plans for treating the sewage of Trenton by the direct-oxidation process but gave the city a month's time to submit the plans for reconsideration as an experimental plant. The board stated that a less expensive plant, both as to first cost and maintenance, would meet the local needs and expressed the opinion that for ten years probably or considerably longer sedimentation alone would suffice or in lieu thereof fine screens, followed by lime precipitation in a tank equipped by a thickener.

Harding to Ask Special Report on Mississippi

New Orleans Engineers Seek Aid of President in Support of Spillway Project

Washington Correspondence

President Harding has promised to call upon the Mississippi River Commission for a special report in connection with the spillway project proposed by the city engineer of New Orleans. The President gave more than an hour of his time recently to a delegation from New Orleans that appealed to him for assistance in securing additional measures looking to flood relief. He evinced a keen personal interest in the situation and promised to help in any way within his power. He stated that he sees no reason why the Federal Government should not take counsel in a matter of this kind with such men as John R. Freeman, C. E. Grunsky or D. W. Mead.

The New Orleans delegation told the President that the Mississippi River Commission apparently is wedded to the theory that levees constitute the only method of handling flood waters on the lower Mississippi. John Klorer, the city engineer of New Orleans, supported by James P. Kemper, and W. B. Gregory, other civil engineers of New Orleans, have drawn up plans for a spillway intended to discharge waters from the flood plain of the Mississippi into Lake Borgne, an arm of the Gulf of Mexico. They contend that such an expedient will lower flood heights in the Mississippi at New Orleans and will provide a safe means for discharging 220,000 sec.-ft. of water, when the river is in flood.

The New Orleans engineers told the President that the Mississippi River Commission not only is opposed to the project but declines to give it sympathetic consideration. The New Orleans engineers filed with the President specific statements with regard to the engineering phases of the spillway. The President promised to submit these claims to the Mississippi River Commission for reply. With the contention of each party to the controversy thus outlined, it is anticipated that the President will seek the advice of distinguished engineers as to the respective merits of the two positions.

Southeastern Water and Light Association Formed

At the recent annual convention of the Tri-State Water and Light Association covering North and South Carolina and Georgia, it was voted to extend the territory of the association to include Alabama, Florida, Tennessee and Mississippi and to change the name to the Southeastern Water and Light Association. J. E. Gibson, manager and engineer of the water-works of Charleston, S. C., was re-elected as president, and W. F. Stieglitz, of Columbia, S. C., was re-elected secretary and treasurer.

W. L. Benham President of A. A. E.

New Head of American Association Is Consulting Engineer of Kansas City and Oklahoma City

Webster L. Benham elected president of the American Association of Engineers when the official ballot was canvassed last week and who was installed at the association's convention being held this week in Norfolk, is owner and chief engineer of the Benham Engineerin Co. of Kansas City and Oklahoma City, consulting engineers engaged in general municipal and industrial engineering work. He is an active member of various technical societies and has served the Association both in committee work and as national director.

Mr. Benham is a graduate of Columbia University, from which institution he received a C. E. degree in 1905. After graduation he was first employed by Columbia University in building work, and later by the New Jersey Zinc Co. Thereafter he became a member of the firm of Benham & Adams, engaging in general engineering including townsite surveys, paving plans and design of sewage and sewerage systems, waterworks and reinforced-concrete structures. In 1907 he was appointed assistant city engineer of Oklahoma City, a position he held until 1909 when he entered consulting practice. He engaged in private work almost exclusively until 1916 when he was made city engineer of Blackwell, Oklahoma. After the war he formed an association with Lieut.-Col. George A. Johnson under the firm name of Johnson & Benham, with offices in Kansas City.

He is a member of the following societies beside the American Association of Engineers:

American Society of Civil Engineers, American Society of Mechanical Engineers, American Society for Municipal Improvements, American Water Works Association, and the Oklahoma Society of Engineers. His work in the Association includes the chairmanship of the Committee on Services and Fees of Practising Engineers and membership on the Committee on National Department of Public Works.

A.G.C. Directs Chapter Programs

As a means of co-ordinating the efforts of the Associated General Contractors with those of its local chapters, the national organization is sending to the chapters topics for discussion at the monthly meetings and at the same time is inviting suggestions regarding topics of interest. By this method it is believed that the association may be brought more intimately into touch with the thought of its chapter membership. The executive board of the A. G. C. approved the plan, which was inaugurated at the Los Angeles convention. The first topic selected was overhead expense, subdivided into means of estimating and means of reducing it.

N. Y. License Law Not Operative Until August 1

By the terms of a bill signed by Governor Smith May 4 the last date upon which applications for engineers' licenses may be filed in New York State has been extended from May 5 until August 1, this year. That is to say the time in which practising within the state is possible without a license has been extended three months. After August 1 those engineers not having previously applied for licenses will subject themselves to penalties if they continue to practice. Examinations for licenses are not compulsory but the registration board is empowered to require examinations where it deems them necessary. Contrary to a previously published statement therefore, the matter of examinations, where and when they may be demanded is a discretionary power of the board. Passage of the bill which has extended the time for registration was largely due to the activities of the mining and mechanical engineers.

City Planning Conference at Baltimore Well Attended

The City Planning Conference at Baltimore, Md., April 30 to May 2, was largely attended. There was a full program of papers, as outlined elsewhere in this issue. George B. Ford, of the Technical Advisory Corporation, New York City, was elected president for 1923-4, and John Nolen, Cambridge, Mass., vice-president. Flavell Shurtleff, 130 East 22nd St., New York City, was re-elected secretary. A resolution was adopted advocating state legislation to authorize county authorities to provide for county-wide planning and for inter-county co-operation in planning.

Hetch-Hetchy Mountain Division Tunnels Near Completion

With an alignment discrepancy of only a few inches the 4-mi. section of the San Francisco Hetch-Hetchy water supply tunnel between Priest Portal and Second Garrote shaft was holed through on April 25, 19,847 ft. from Priest Portal and 640 ft. from the bottom of Second Garrote shaft. This leaves only slightly more than a mile yet to be driven before the tunnel will be continuous for the 18 miles from Early Intake to the forebay at Priest Portal, whence the Moccasin Creek power house will draw its supply. Of this mile all but a few hundred feet are in the section between the headings now being driven east from Second Garrote shaft and west from Big Creek shaft. The two other short sections yet to be holed through, lying between Camps 5-6 and Camps 8-9 and between Early Intake and South Fork, will be completed in May.

Of the placing of concrete lining, working from Big Creek shaft, about 2,100 lin.ft. was completed, except for invert, by April 25. With the specially devised concreting equipment used on this work it is expected to line 150 ft. of tunnel per day when the system is working at full efficiency.

New Orleans Opens Its New Inner Harbor and Industrial Canal

With a water pageant which reviewed in a realistic way the 112 years of river navigation on the Mississippi, the Port Commission of New Orleans on May 5 formally opened its $20,000,000 inner harbor and industrial canal. The development is the result of a desire on the part of New Orleans to provide industrial basin and ocean docks free from the impediment imposed upon the port's facilities by the variable level of the Mississippi River. The entire project is developed along a 6-mi. canal, extending from the river to Lake Pontchartrain, which is provided with a lock at the river end to maintain the water in the canal at the level of the lake. The water level in the lake only varies about 6 ft., while the river has a flood variation of nearly 20 ft. The river approach to the lock is provided with continuous river levees 23 ft. above low water and a channel 125 ft. wide and 30 ft. deep. The lock is 30 ft. deep over the sills and has a usable length of 640 ft. and a width of 75 ft. To provide against the reverse pressures due to the variation in the level of the river and the lake the lock is equipped with gates mitering in either direction.

The canal will ultimately have a bottom width of 150 ft., a surface width of 330 ft., and a depth of 30 ft.

A portion of the canal will be provided with diagonally placed ocean slips 225 ft. wide and 650 ft. long. They will be built as fast as required and will serve in lieu of turning basin. The canal is crossed by bridges for booth railway and highway traffic, and by a large siphon for the city's main drainage outlet. The four bridges are all of the bascule type and the ones within the city proper are double decked to separate the vehicular and surface-car traffic from the railway traffic.

The canal has been described in the following issues of *Engineering News-Record*: Aug. 15, 1918 p. 304; May 13, 1920, p. 940; Apr. 22, 1920, p. 808; and Sept. 15, 1921, p. 437.

Rock Island Railroad to Spend $6,500,000

The program for additions and betterments on the Chicago, Rock Island & Pacific Ry. for the current year amounts to $6,530,000. Construction of a second main track between Herington and Latimer, Kan., and Paxico and Bishop, Kan., a total distance of 29 miles, is estimated to cost $1,500,000 and part of the work is under contract; this includes a small amount of relocation of line. There will be considerable construction and extension of passing tracks in order to expedite train movements, this work being estimated at about $400,000. A few branch lines are under consideration and some separation of grades in cities may be carried out if necessary. Grading is in progress for a new freight yard and terminal at Omaha.

No large new engine terminals are planned, but extensions and additions are being made to a number of roundhouses in order to accommodate new engines of larger size.

Flood Prevention Status in Pueblo

Engineers working on the flood prevention problem of Pueblo, Colo., have decided that the best method will provide for a new channel near the bluffs supplemented by a small retarding basin. The favorable decision on the validity of the Conservancy law Feb. 27 will expedite the work. Barton Jones, resident engineer, Dayton-Morgan Engineering Co., in the *Engineers Bulletin* of the Colorado Society of Engineers, gives the following information:

The present river channel has a capacity of 35,000 or 40,000 sec. ft. while the new channel (see *Engineering News-Record*, Sept. 28, 1922, p. 530) will have a capacity of 125,000 sec. ft. The peak flow during the 1921 flood was 90,000 sec. ft. The plan as a whole will therefore protect against a flood much larger than the last. The outflow at the Rock Canyon Barrier will be limited to 100,000 sec. ft., which would be reached only in case of a flood 82 per cent greater in intensity than the last, and 82 per cent greater in duration. An allowance is also provided in the capacity of the new channel for a coincident flood of 25,000 sec. ft. from Dry Creek, immediately above Pueblo.

The plan, as proposed, does not disturb the arrangements of the railroads other than the Denver & Rio Grande-Western, whose yards must be relocated north of the new channel.

The appraisers of the district, appointed by the Conservancy Court on Nov. 8, 1922, have been at work since then, employing from 15 to 20 men, and good progress has been made. Until a plan has been finally adopted, they must confine their work to such features as would not be changed by any likely modification in the plan. As soon after the adoption of the plan as possible, the appraisers will complete their work conforming to the plan, and file the appraisal roll. Published notices and a court hearing also precede the adoption of the appraisals.

Contracts for doing the work will not be let until the sale of the bonds has been arranged. The bonds can be sold when a sufficient part of the appraisal roll has been approved to insure a margin of security satisfactory to the purchasers. The procedure providing for notices, hearings and adoption of the plan, and appraisals, will require 3 to 4 months after a recommended plan is filed. Without any delays, the work could commence in June or July.

San Diego Constructing Pier No. 2

The city of San Diego has work well under way on a new pier north of Municipal Pier No. 1 to be known as Pier No. 2. The construction is sand fill with reinforced-concrete apron wharves on both sides and the outer end. The pier will be 1,000 ft. long and 400 ft. wide, and will have a 143 x 940-ft. transit shed.

On May 1 the fill had been brought up above low water to heights of 5 to 8 ft. for the entire length and width of the pier. A total of about 300,000 cu.yd. of dredging is involved and the cost of the entire project is to be $850,000.

Frank G. White, chief engineer, State Board of Harbor Commissioners, was retained to prepare complete plans and specifications and to supervise construction, and is assisted by H. E. Squire.

Milwaukee Has Large Public Works Program

City improvements planned for the current year at Milwaukee, Wis., under R. E. Stoelting, commissioner of public works, include the following items: Riverside pumping plant, contract let at approximately $1,500,000; storm sewers, $1,270,000; various local sewers, $125,000; State St. bridge, $400,000; widening Folsom St. bridge, $150,000. Bids for these bridges will soon be invited. The street paving program includes 130,000 sq.yd. of reinforced-concrete paving, 75,000 sq.yd. of vibrolithic and 50,000 sq.yd. of asphalt, besides considerable alley paving with concrete. Improvements in progress which are not under the Department of Public Works include the extensive program for the sewage disposal plant of the Milwaukee Sewerage Commission and the grade separation on the Chicago & Northwestern Ry. between Allis and West Allis.

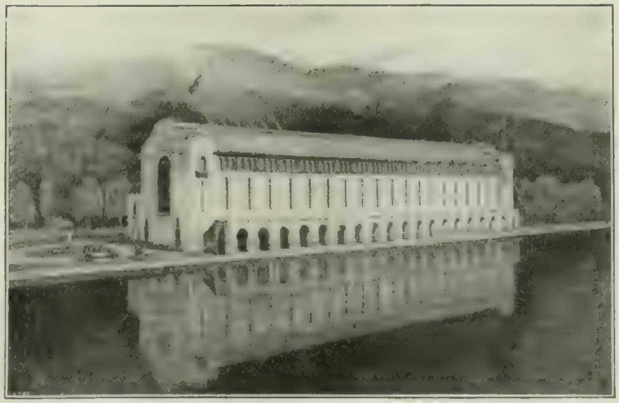
Aerial Maps of 220,000-Acre Tract Are Being Made

The Pioneer Aerial Engineering Co. of Beverly Hills, Calif., is preparing an aerial map covering 220,000 acres in the Volcano Lake district of Baja, California. The work is being performed under contract with the Government of Baja, California.

Approximately 1,000 photographs will be made from an altitude of 10,000 ft., thereby obtaining a scale of 1 in 10,000. The completed map will be 11 x 15 ft. in size.

The company claims that with the methods used a wealth of detail can be obtained more accurately than by ground surveying, and has guaranteed to produce a map of virgin territory previously unsurveyed in which the error will not exceed one-half of 1 per cent. The contract calls for delivery of the map within 90 days after completion of the aerial work.

Progress on Moccasin Creek Plant—Hetch Hetchy Project



CONSTRUCTION work is progressing rapidly at the site of the Moccasin Creek power house on the Hetch Hetchy project. Officials now estimate this plant will be in operation before the middle of 1924. On Mar. 2 1,680 ft. had been driven in the 5000-ft. tunnel from forebay reservoir to the top of the penstocks, and excavation for the four penstock lines was finished. Excavation for the power house is now under way, contract has been awarded for the structural steel frame of the power house and both electrical and hydraulic equipment for the power house has been under contract for some time; award of machinery contracts was noted in *Engineering News-Record* May 11, 1922 p. 803. All power house equipment is to be delivered before Aug. 31 of this year. An artist's conception of the power house as completed, is shown above.

The power house structure as now being built will be 225 x 70 ft. in plan with provision for the addition of 75 ft. in length to accommodate additional units to be installed later. Four generating units are going in under the present contract. These will include four 20,000 kva., 257 r.p.m., 3-phase 11,000-volt generators driven by double overhung impulse wheels rated at 25,000 hp. and operating under effective heads of 1,250 ft.

Where the penstocks enter the power house structure the flow will be controlled by eight 36-in. gate valves operated by hydraulic power. The power house equipment includes an overhead crane with a span of 50 ft. and a capacity of 135 tons.

The distance from the Moccasin Creek power house to the City of San Francisco is about 135 miles and survey crews are now in the field making final location for the double-circuit steel tower line which will be completed and ready for service before the power house is finished.

For the mountain and valley section of the transmission line a total of 525 miles of steel core aluminum cable has been ordered. This will have a cross-section of 389,000 circular mills, the equivalent of 250,000 copper circular mills. For the San Francisco Bay division of the transmission line an order has been placed for 177 miles of core copper conductor.

Transformers and switching equipment at the the new power house will be of the outdoor type. Thirteen 6,667 kw. single phase transformers will take the current at 11,000 volts, delta connected, and deliver it at 115,000 or 154,000 volts, star connected. Both oil and air break switches will be provided, designed to operate 154,000 volts, which will be the tension for which insulators and other transmission equipment will be provided.

Canadian Pacific Improvements to Cost $20,000,000

Capital expenditures of $7,630,100 for roadway improvements and $12,295,000 for equipment are planned for 1923 by the Canadian Pacific Ry. Some of the principal items of improvement are: Track material, ballasting and ditching, $1,250,400; rail renewals, $169,500; replacement and enlargement of structures in permanent form, $803,700; passenger and freight stations, shops and engine terminals, $318,400; sidetracks, $502,500; additional lining in the Connaught tunnel, $695,000; extension of Chateau Frontenac Hotel at Quebec, $2,800,000. In addition the construction or extension of three branch lines is proposed, funds for which will be raised by the sale of 4 per cent stock: Tuffnell and Prince Albert branch, 50 miles; Archive and Wymark branch, 25 miles; Kipp to Bow River, 22 miles. During 1922 the construction of branch lines amounted to $2,645,087 and improvements and betterments (exclusive of equipment) were carried out at a cost of $5,533,828.

French Society Celebrates 75th Anniversary

To celebrate the seventy-fifth anniversary of the founding of the Société des Ingenieurs Civils de France, the American section of that society held a joint meeting with the Four Founder Societies May 4 in the Engineering Societies Building, New York City. The meeting was addressed by Harrington Emerson, president of the American section of the society; Gaston Liébert, Col. Arthur S. Dwight, Gen. William Barclay Parsons and Charles O. Mailloux. A resolution was read from the Société in Paris. Henri Vigneron, a member of the French society, presented moving pictures of the mining of potassium in Alsace. Preceding the meeting, Mr. Emerson gave a dinner to some French and American engineers and members of the society.

American Marine Standards Committee Organized

At its meeting in New York April 17, with Captain R. D. Gatewood, U.S.N., as chairman, the general committee on standardization, recently formed by the American Marine Association for the establishment of standards for hull, engineering and operating details, adopted the name, American Marine Standards Committee, arranged a plan of organization, appointed administrative subcommittees and arranged for three technical sub-committees to carry on the project. A committee was appointed, consisting of E. H. Riggs, naval architect, New York Shipbuilding Corp., F. M. Hudson, Department of Commerce, and H. P. Frear, naval architect, Bethlehem Shipbuilding Corp., to present an outline of the project at the annual meeting of the Atlantic Coast Shipbuilders' Association to be held May 14 in Philadelphia.

The purpose of the American Marine Standards Committee is in line with the movement inaugurated by Secretary Hoover of the Department of Commerce for standardizing products and simplifying practices in the industries in order to eliminate waste and reduce costs.

T. H. MacDonald Will Address Road Builders at Annual Meeting

Results of the extensive traffic surveys in New England and California, made under direction of the U. S. Bureau of Public Roads, will be announced for the first time by Thomas H. MacDonald, chief of the bureau, at the dinner following the annual meeting and election of officers of the American Road Builders' Association, to be held at the Automobile Club of America, New York City, May 15. The traffic surveys have been under way for some time and it is understood that Mr. MacDonald's discussion of their results will bring out a great deal of new data on one of the most important problems in the highway field. Another feature of the dinner, which is scheduled for 6 p.m., daylight saving time, will be an address on highway maintenance problems by Frank Page, chairman of the North Carolina State Highway Commission and nominee for president of the American Road Builders' Association.

The annual meeting and election of officers of the association will be held at 3 p.m. standard time. Any one interested in highway construction and maintenance is invited to attend the annual dinner. Reservations at $3 a plate may be made through E. L. Powers, secretary of the association, 37 West 39th St., New York City.

India Approves £18,000,000 Sum For Barrage Across Indus

Announcement has been made by the Bombay Council, according to *Commerce Reports*, that the Government of India will finance the Sukkur barrage and canals project, and plans have been sanctioned by the Secretary of State for India. The project consists of a masonry structure across the Indus River at a point three miles below the Landsdowne bridge at Sukkur, Sind, India, with a system of canals taking off above it on each side of the river. The barrage, will have the form of a double bridge. The downstream bridge, 4,725 ft. long, will provide a traffic roadway across the river. The upstream bridge, with the controlled or automatic gates, will be 4,925 ft. long, including the land towers. There will be 66 spans in the barrage, each with a clear opening of 60 ft., arranged so that the openings can be closed, when required, by iron gates 18½ ft. high, in order to insure maintaining in the water at the barrage a level of 194.5 ft. above mean sea level at Karachi which will give a reading of 10.5 ft. on the Sukkur gage. Sluices will be provided at each end of the barrage, a group of seven spans at the left bank and a group of five spans at the right bank. The barrage openings provide for a maximum flood of 1,500,000 sec.ft. passing Sukkur, and it will be kept open during the flood months and closed when necessary to keep the required level in the canals.

For irrigation uses, four canals will take off on the left bank, and three on the right; drainage lines of the right-bank system will eventually tail into Lake Munchhar and thence into the Indus. Anticipated cultivation in the thirtieth year of operation is 5,308,408 acres, more than doubling the present 2,035,636 acres. The total project will cost approximately £18,000,000.

Engineering Societies

Calendar

Annual Meetings

NATIONAL HIGHWAY TRAFFIC ASSOCIATION, New York; Annual Meeting, New York, May 10.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Meeting, New York, May 15.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; Annual Convention, Ithaca, N. Y., June 20-23.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Detroit, Mich., May 21-25.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29.

The Society of Engineers of Eastern New York has elected as its president James E. Hewes, vice-president, the Albany Southern R.R. Roy Clark, professor of civil engineering at Rensselaer Polytechnic Institute, was chosen vice-president.

The Engineers' Society of Pennsylvania has nominated the following officers for 1923-1924: president, Robert W. Moorehead, Harrisburg; first vice-president, R. L. Gillespie, Steelton; second vice-president, Charles Haydock. The votes will be canvassed May 15.

The Boston Society of Civil Engineers will have motion pictures on the "Manufacture of Genuine Wrought-Iron Pipe" as the feature of its meeting May 16.

The North Carolina Drainage Association in annual convention elected F. P. Latham of Belhaven as president. W. D. Alexander of Charlotte was selected vice-president, and B. M. Potter of New Bern secretary and treasurer. The association will meet next year in Belhaven.

Personal Notes

W. L. ABBOTT of Chicago has been chosen chairman of the committee to make a nation-wide coal storage survey in co-operation with the U. S. Coal Commission and the Department of Commerce, according to the announcement made by the Federated American Engineering Societies. The other members will be named soon.

LEWIS B. STILLWELL, consulting engineer, New York City, has announced removal of his offices from 143 Liberty St. to 90 West St.

A. S. ZINN has resigned from the engineering department of the Missouri Pacific R.R. and will soon open a consulting office in Los Angeles, Calif. Mr. Zinn was resident engineer of the central division, Panama Canal, from 1906 to 1913. He was then appointed acting division engineer to relieve Lt.-Col. D. D. Gaillard. The central division included the Culebra Cut, since named Gaillard Cut In January, 1914 through the recommendation of General Goethals, Mr. Zinn was appointed consulting engineer for the republic of Panama, a position which he held until 1916, when he returned to the United States. During the war he was in construction work and after the war assistant engineer of the United States Railroad Administration as well as affiliated with the Missouri Pacific R.R.

C. J. Popelka, city engineer of Two Rivers, Wisconsin, has resigned to accept a position as street superintendent of the city of Beloit.

Frank J. Henry, formerly of the firm of Manske & Henry, Wisconsin Rapids, Wisconsin, has resigned and will open an architectural and engineering office at Wisconsin Rapids.

William J. Roberts, civil engineer, Tacoma, has opened offices in the Puget Sound Bank Building, where he will specialize in irrigation, waterpower, waterworks and flood-relief engineering. Mr. Roberts was state highway commissioner, 1911-13, and was chief engineer of the White, Stuck and Puyallup Rivers flood-control project.

R. T. James, formerly resident engineer with the North Carolina Highway Commission, has resigned and is engaged in industrial railroad and municipal engineering, with office at 1213 Realty Building, Charlotte, N. C.

The Canton Engineering Co., Inc., general contractors of Boston, have changed the corporate name to **Reynolds Brothers, Inc.** The offices of the company are located at 179 Summer St.

Woolfenden, Wood and Weber, consulting engineers, formerly located in the Ideal Building, Denver, Colo., have changed the firm name and location. The firm is now **Wood and Weber**, Tramway Building, Denver, Mr. Woolfenden having retired and moved to Detroit.

Edward T. Gray and **Frederick W. Claflin** of Johnstown, Pa., have formed a partnership, Gray & Claflin, engineers. Mr. Gray was formerly chief civil service engineer with the Cambria branch of the Bethlehem Steel Co. Mr. Claflin was resident engineer on construction of the Quemahoning dam and later worked with Perrin & Marshall, consulting engineers, New York City.

Carleton E. Davis has resigned his position as chief of the Bureau of Water, Philadelphia, Pa., to become manager of the Indianapolis Water Co., but the city council of Philadelphia has asked him, in a reslution citing the contemplated increase in the city's water supply and his knowledge of the city's needs, to reconsider his resignation. Mr. Davis has accomplished some of the most important construction work in the water-works field. A graduate of the Massachusetts Institute of Technology, he served as assistant engineer in water-works construction at Manchester, N. H., and New Bedford, Mass., and as resident engineer in connection with the Pequannock water system of Newark, N. J. In 1904 he was made engineer in charge of water-works, sewers and municipal engineering for the Isthmian Canal Commission at Panama, Colón, and other points in the Canal Zone. From 1905 to 1912 Mr. Davis was department engineer of the reservoir department of the New York Board of Water Supply's Catskill aqueduct work; the Ashokan Dam was one piece of construction put through during this period. Since 1912, as chief of the Bureau of Water at Philadelphia, he has had charge of maintenance, new works, extensions and improvements in that city, embracing also the assessments of revenues aggregating $5,500,000 a year. Mr. Davis is a past president of the New England Water Works Association.

George M. Wells, member of the consulting engineering firm of George W. Goethals & Co. of New York City and, some years ago, resident engineer in the building department of the Panama Canal, is going into private practice at 150 Nassau St., New York City.

J. L. Maher, assistant division engineer, Baltimore and Ohio R.R., Connellsville, Pa., has been promoted to assistant engineer, Pittsburgh Division, with headquarters at Pittsburgh, Pa.

Hon. **George P. Graham**, Canadian Minister of Defense, has resigned that position and has been appointed Minister of Railways and Canals. He has been Acting Minister of Railways for some months and was head of the Department of Railways in the Laurier government from 1907 until 1911.

C. R. Chadwick, formerly with H. G. Balcom, consulting engineer of New York City, has entered the structural division of Stone & Webster, Inc., Boston, Mass., as engineer.

Wesley H. Blank, formerly instructor in bridge and building design at Massachusetts Institute of Technology, is now in the structural division of Stone & Webster, Inc., Boston, Mass.

E. B. Powell, consulting engineer of Stone & Webster, Inc., returned from France on the S. S. "Paris" April 21. Owing to a severe illness he was confined to the American Hospital at Neuilly, France, for three months but is now much improved in health.

Alexandre Lariviere, civil and electrical engineer of Quebec, has been appointed chief engineer of the Quebec Public Service Commission. Mr. Lariviere is a graduate of L'Ecole Polytechnique, University of Montreal, served as assistant engineer of the electrical department of the Montreal Harbor Commission, and later was bridge, maintenance and district engineer of the provincial road department. Since 1919, in a partnership with Edouard Hamel, he has been engaged as consulting engineer.

Glenn H. Allen, formerly a detailer for the American Bridge Co., has accepted a position in the same capacity with the International Steel and Iron Co. at Evansville, Indiana.

William V. Bennett, for eighteen years associated with H. B. Spraul, contractor of Scranton, Pa., is president of a paving, repair and construction company of Binghampton, N. Y. This company is known as the Parlor City Construction Co. and maintains offices at 10 Exchange St., Binghampton.

Edmund I. Mitchell, recently with the New York City Board of Water Supply, has taken a position with Waldo S. Coulter, consulting engineer, New York.

C. M. Miller, formerly county highway engineer for Wake County, N. C., has been appointed county highway engineer of Forsythe County, with offices at Winston-Salem, N. C.

H. V. Joslin, engineer assistant to the chairman of the North Carolina State Highway Commission, has been appointed purchasing agent for the commission. Mr. Joslin's place has been filled by **L. R. Ames**, assistant to the state highway engineer.

T. H. McKibben has been appointed division engineer of the Chicago Division of the Atchison, Topeka and Santa Fe Ry., with headquarters at Chillicothe, Mo. Mr. McKibben has been chief project engineer for the same road for several years.

Harvey Mitchell Anthony, of Muncie, Ind., has been elected chairman of the state board of registration for professional engineers and land surveyors. He succeeds Prof. Robert L. McCormick of Terre Haute, Ind. Clyde A. Walb of Lagrange, Ind., was elected vice-chairman of the board.

Fred C. Doolittle, state highway maintenance engineer at Colfax, Wash., has been transferred from the Walla Walla to the Spokane district and will be located at Davenport. He will be in charge of work west of Spokane, under Guy G. Harvey, district highway engineer.

Richard L. Saunders, deputy highway commissioner of Connecticut, is to become chief engineer for the Amiesite Asphalt Co. of Philadelphia. During parts of 1912 and 1913 Mr. Saunders was assistant city engineer of Bridgeport, Conn., and previous to that he was an engineer for the New York City Board of Water Supply and worked on the Catskill aqueduct.

E. J. Steinberg, for the past ten years resident engineer of the Wisconsin railroad rate commission, will resign June 1 to become manager of the Wausau properties of the Wisconsin Valley Power Co.

Obituary

George H. Angell, civil engineer in Denver, Colo., since 1860, died recently in that city, aged 65 years. His work was connected with the Denver & Rio Grande R.R., the Colorado & Southern R.R., and the city engineer's office in Denver. He was a native of Michigan.

William H. Goll, contractor, died in Philadelphia, April 27, at the age of 52. During his business career in Philadelphia, Mr. Goll did a great deal of construction work for the Pennsylvania, Reading and D. L. & W. railroads, which included remodeling the Broad Street station, erection of the West Philadelphia station and the elevated structure crossing at 31st and Market Street.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Urge Early Release of Orders to Relieve Railway Jam

In anticipation of a shortage of railway transportation facilities later in the season, the Truscon Steel Co., Youngstown, Ohio, following recommendations made at the recent meeting in New York of the American Railway Association, is urging its customers to release all orders possible for early shipment. From the company's letter, dated May 1, and headed "A Word of Caution to Our Customers," the following is quoted:

"We are only a few days away from the time when the building season will be at its height, when everyone will want his material shipped "Immediately—Rush." Our stocks are in excellent shape to take care of any demand made upon us *now;* our shops are working efficiently; we can give real service *now.*

"But there are factors outside of our organization that affect our ability to ship promptly, and over these factors we have no control. We have for some time been experiencing difficulty in obtaining cars. This condition will get worse as the summer and fall approach, until we will be actually delayed in getting fabricated products away from and raw materials into our plant.

"In a formal statement following its recent meeting the American Railway Association urged every consumer and producer to anticipate the time when fruit, grain and coal movements will produce the annual peak load on the carriers and to ship everything possible in the early months of the year.

"We urge everyone to release their orders well in advance of the time when material will actually be needed on the job. Do not figure that the minimum time for shop fabrication plus the minimum time for transit from Youngstown constitutes sufficient time for notice of shipment, because the time will soon be here when that formula will not hold."

Commerce Dept. to Report Special Study of Labor

A report on the efficiency of labor and efficiency in handling labor will be issued soon by the Department of Commerce, Secretary Hoover having caused a special study of these related subjects to be made for some months. The report, it is said, will show that an "astounding" progress has been made in the United States in the last ten years. Labor turnover has been reduced materially by improvement of management, the report will show, while the efficiency of labor also has improved.

In view of the attitude of the Administration against material relaxation of the immigration laws the forthcoming report is considered of especial importance. In the opinion of Secretary Hoover industry must look to increased efficiency, not only of labor but of handling labor, to solve its labor problems.

To Confer on Reduction of Face Brick Varieties

A preliminary conference of manufacturers, distributors and consumers of face brick will be held May 11 with the Division of Simplified Practices of the Department of Commerce, Washington, D. C. The conference will discuss the advisability and practicability of reducing the number of types and sizes.

Limiting Factors in Record Runs of Equipment

Discussion of unusual performances stresses influence of co-ordinating all operations and need for considering "slowest link" in series of operations.

By L. B. Tuckerman
Engineer Physicist,
Bureau of Standards, Washington, D. C.

In the recent discussion of "Record Runs of Equipment" in your columns one important point does not seem to have been definitely stated, although it is clearly implied in the editorial discussion in your issue of April 19, p. 694. Every piece of equipment acts as one member of a series of pieces and a record run implies a record co-ordination of all the members of the series. In every such series there is always a limiting factor, a slowest link, in the speed, which may be either the limiting speed of one member or a limit in the possible co-ordination of two members of the series. The possibility of economically speeding up this process of construction depends upon a knowledge of these limiting factors. An essential part of this is the knowledge of a "record speed" of each member of the series.

Such a record speed should not be the record of a mere spurt, which ignores all questions of overtaxing the equipment or of necessary shut-downs for repairs and adjustment. The record speed of this piece of equipment should be its maximum steady speed in a series of which it is the slowest link. In the case of your illustration of the concrete mixer on the highway contract it is important to the contractor to know how far it will pay him to provide for increased speed of supply of crushed stone, sand and cement, without danger of overloading the mixer. Data of genuine record runs—not mere spurts—of the concrete mixer are, therefore, of great value to him.

Where the slowest link comes in the co-ordination between two pieces of equipment, data of record runs need to be supplemented by full details of the elements involved in the co-ordination before they become valuable engineering data. Reliable information about record runs of equipment is always of engineering value, but a contractor who accepts such data without analysis is about on a par with a structural engineer who would consider that a satisfactory quality of steel was all that was needed to make a structure safe.

Penstock Valve Patent Valid, Court Rules

In a decision recently handed down by Judge Westenhaber in the U. S. District Court for Northern Ohio, Cleveland, the validity of the basic Johnson penstock valve patent was affirmed and the Wellman-Seaver-Morgan Co., of Cleveland, was found guilty of infringement in the suit brought by the William Cramp & Sons Ship & Engine Building Co., Philadelphia. The valve in question, the invention of R. D. Johnson and designed to control great volumes of water, is widely used in modern hydro-electric plants in this country and Canada. In view of the court's decision the Cramp company has announced that in future it will adopt a more aggressive attitude toward infringement of the Johnson valve patent.

The Cramp company, which handles the manufacture of hydro-electric equipment through its I. P. Morris department, acquired the commercial rights to the Johnson patent two years ago. At that time the valves were being marketed by the Larner-Johnson Valve & Engineering Co., Philadelphia, and previously they had been manufactured by the Wellman-Seaver-Morgan Co. under a royalty agreement with Mr. Johnson. Shortly thereafter the Wellman-Seaver-Morgan Co. placed on the market a valve in competition with the Johnson valve as manufactured by the Cramp company, which was claimed to be a distinct and original design. The Cramp company served notice of infringement and the suit just decided followed in due course.

The Johnson valve is designed for great sensitiveness and utilizes the principle that by decreasing the cross-sectional area of a conduit carrying water, thereby increasing the velocity of flow, the pressure in that region can be correspondingly diminished.

Construction Equipment Exported

Figures issued by the U. S. Department of Commerce show the following exports of construction machinery for the month of February, 1923: 50 concrete mixers valued at $33,953; 36 steam and power shovels at $150,454; 187 hoists and derricks (except mining) at $61,535; 95 centrifugal pumps at $12,168; 93 steam pumps at $30,795; 1,064 other power pumps at $134,548; and 641,579 lb. of other pumps and pumping machinery at $178,096.

Japan took the largest orders of concrete mixers, totaling $17,000. Honduras was the leader in the steam and power shovel field with two units at $46,000.

Bascule Spans Ordered for Bridges in U. S. and Abroad

The Strauss Bascule Bridge Co., Chicago, has been appointed to prepare plans and specifications for the bascule span of the Gandy Bridge to be built across Old Tampa Bay between Tampa and St. Petersburg, Fla. It will be a double-leaf underneath counterweight type affording a clear channel for navigation of 75 ft. in width and a roadway 24 ft. clear. Detail plans and specifications will be completed early this summer.

Recent foreign orders have been received by the Strauss company from the Danish State Railways for the bascule span (30-meter channel) of a single-track bridge at Frederiksund across the Roskilde Fjord. A combined highway and railway bridge at Korsor, Denmark, will be equipped with a bascule span giving a 20-meter clear channel. The City of Stockholm, Sweden, has accepted a double-leaf bascule for the Skanstull bridge, the clear width of waterway being 17.4 meters.

Business Notes

Oscar A. White, since 1920 advertising manager of the Fate-Root-Heath Co., Plymouth, Ohio, manufacturer of gasoline locomotives, died April 22. He was 63 years of age and before his connection with the company had been prominent in newspaper work in the Middle West, having served from 1908 to 1912 as Chicago manager of the American Press Association.

The **Bond Co.**, with offices at 84-86 High St., Boston, was organized May 1 by Harold L. Bond, for many years president of the Harold L. Bond Co., and more recently president of Waldo Bros. & Bond Co. Associated with him in the new organization are his two sons, Harold C. Bond and Lowell Bond. The company will serve as New England representatives of manufacturers of construction equipment and materials and as dealers in all kinds of contractors' tools. Included in the line of equipment handled are the products of the Novo Engine Co., of Lansing, Mich.

Harold H. Perry, manager's assistant, Industrial Works, Bay City, Mich., sailed April 28 for England, where he will make an extensive study of locomotive and wrecking cranes.

A. Fletcher McClintock, Pacific Coast district sales manager for the Reading Iron Co., manufacturer of wrought-iron pipe, has been appointed assistant sales manager of the company, effective May 1. Mr. McClintock joined the company in 1919, after considerable experience in the sale of wrought-iron pipe, and shortly after was appointed district sales manager of the Pacific Coast territory with headquarters in Los Angeles.

W. C. MacDowell, formerly manager, mining sales department, Power & Mining Machinery Works of the Worthington Pump & Machinery Corp., has accepted the position of general sales manager of the Traylor Engineering & Manufacturing Co., Allentown, Pa.

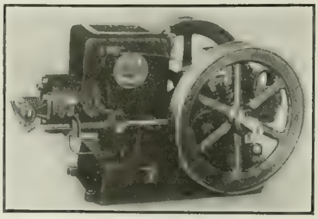
C. S. Sale, since 1918 assistant to the president, Railway Car Manufacturers' Association, New York City, has resigned to accept an appointment with the American Car & Foundry Co. His address will be 165 Broadway, New York City.

Combustion Engineering Corp., New York, announces the acquisition of the Quinn Oil Burner & Torch Co. W. R. Quinn, formerly president of the organization which bore his name, has become associated with the Combustion Engineering Corp. as manager of its fuel oil department.

Equipment and Materials

Gasoline Engine of 2½ Hp.

A 2½-hp. model with improved features has been added to the line of gasoline engines manufactured by the Fuller & Johnson Mfg. Co., Madison, Wis. The operation of filling the fuel tank is facilitated by a new filler pipe, and uninterrupted service is assured by a double-throw switch which is now standard equipment on all sizes with magneto ignition. The magneto mounting is high and dry—away from oil and grease. Strength and rigidity have been leading considerations in the design of the wide, heavy flywheels, the crank-shaft and bearings.



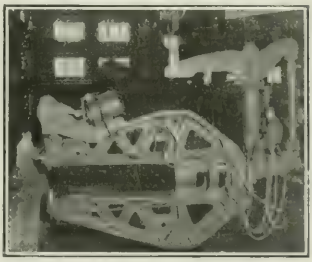
Lightweight Bucket Increases Locomotive Crane Capacity

An extra ¼ cu.yd. of capacity in the handling of sand, gravel and broken stone by locomotive crane is provided for by a new design of special, lightweight clamshell bucket manufactured in three sizes 1, ¾ and ½ yd., by the G. H. Williams Co., Erie, Pa. On cranes ordinarily rated to handle a ¾-yd. clamshell the new 1-yd. bucket, weighing only 2,650 lb., may be used without overloading the crane and, in like manner, the ½-yd. size weighing 1,875 lb. and the ¾-yd. size weighing 2,100 lb., the manufacturer claims, may be substituted for heavier equipment having ¼-yd. less capacity. The weight of the extra ¼-yd. of material, it is pointed out, is amply covered by the crane's safety factor.

While the new bucket is designed especially for light weight and speedy operation its strength is guaranteed as long as it is used for handling material such as sand and gravel, crushed stone, coal, etc. The bucket is built entirely of steel, including the sheaves. Power for speedy material handling is obtained by use of a 4-part closing line, giving twice as much power as buckets with only a 2-part line. The cable overhaul is cut down by a tandem arrangement of the sheaves on the power arm, further speeding up the operation.

Large Portable Riveting Machine

A 150-ton portable pneumatic riveter of 118-in. reach and 30-in. gap has been designed and built for the Niagara Falls Power Co. by the Hanna Engineering Works, Chicago. The riveter is primarily for fabricating the plates forming the volute of the casing and penstock for a 70,000-hp. hydraulic turbine. The volute plates vary in thickness from 1¼ in. at the entrance to ⅞ in. at the end, with rivets of diameter from 1½ to 1 in. and 7,800 in number. The longest grip for the 1½-in. rivets is 5 in. The penstock is approximately 18 ft. in diameter with plates of 1½-in. thickness and about 110 ft. long. Three such penstocks are to be riveted. Since the volute and penstock are to hold water under a pulsating pressure of about 110 lb. per square inch, the character of this work must be of boiler quality.



The total portable weight of the riveter is 57,750 lb., and the weight of the frame, a one-piece steel casting, without spindle or riveting mechanism, is 33,000 lb. The largest portable machine previously built by the Hanna works weighed 25,000 lb. Mechanical power is necessary to move this riveter into the operating positions. The two motions, revolving and tilting, are performed by two reversible, close-quarters, air drill motors of approximately 2 hp. each, manufactured by the Chicago Pneumatic Tool Co. In order to minimize the power necessary to set the frame into the required position roller bearings and ball bearings are employed at all points of rotation.

The Hanna motion, or riveting mechanism, assures tight rivets being driven with every stroke of the piston, without any adjustment of the die screw to overcome the ordinary variation in length of rivets, thickness of plates, diameter of holes, etc.

Steel Sheetpiling—**Bethlehem Steel Co.**, Bethlehem, Pa., has published a new 25-page illustrated bulletin on Lackawanna steel sheetpiling of the arched web, straight web and bent web types. The bulletin gives dimensions, weights, and properties of all piling sections now being rolled, together with information on connections and splices.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Halt $10,000,000 College Building Program

High Costs Force Columbia University to Suspend Work in New York

SUSPENSION of the $10,000,000 program for the construction of dormitories, lecture halls and laboratories for Columbia University, in New York, was voted May 7 by the board of trustees as a result of present high costs for labor and materials in the metropolitan district. Similar action was announced May 6 in the case of the proposed $4,000,000 Hebrew Orphan Asylum in New York on which it has been decided to delay construction until prices recede from the high levels now prevailing in the New York district.

In announcing the decision of Columbia's trustees, President Nicholas Murray Butler expressed regret at the necessity for the action taken and stated that the program would be resumed as soon as the interests of the University and the public would permit. For the present, however, no further contracts will be let.

Another development in the New York building situation this week was the announcement by Michael J. Colleran, of the Building Trades Council, of a willingness to attempt to stabilize wages of skilled labor if manufacturers of building materials and building contractors would take similar action.

Car Loadings Break Record

The railroads continue to smash previous records for this time of year in the number of cars loaded with revenue freight, according to the Car Service Division of the American Railway Association, and are not far off from the peak loadings which ordinarily come in the fall of the year when crop movements are heaviest.

Loading of revenue freight for the week ended April 21 totaled 957,743 cars. This was not only the greatest number loaded during any one week since Nov. 17, 1922 but exceeded the corresponding week last year by 251,606 cars, when coal shipments were reduced by the miners' strike. The total also exceeded the corresponding week in 1921 by 253,111 cars, while it also exceeded by a wide margin the corresponding weeks in 1918, 1919 and 1920. The total for the week of April 21 was within 6 per cent of the total for the week of Oct. 15, 1920, which was the largest in the history of the railroads.

Loading of freight cars this year to date, compared with those of the two previous years, follows:

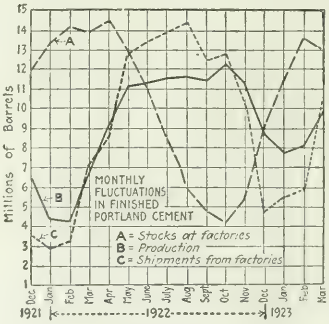
	1921	1922	1923
Month of January	3,380,296	2,785,119	2,823,759
Month of February	3,366,965	3,027,886	2,739,234
Month of March...	4,583,162	4,088,132	3,453,941
Week ended Apr. 7	895,767	706,013	694,881
Week ended Apr. 14	946,759	700,155	702,116
Week ended Apr. 21	957,743	706,137	704,632
Total for year to date	14,130,692	12,013,442	11,117,563

Production and Materials Stocks in Nine Cities

Record Iron and Steel Output—Lumber Cut Above Normal—Enough Cement to Meet Demand—Brick Shortage Near

Iron and Steel—April pig-iron production reached an average output of 118,252 gross tons per day, or the record for any single month in the history of the industry. The present rate of output is approximately 44,000,000 tons annually, or 4,000,000 tons heavier than any previous yearly average. Steel ingot production continues at the average rate of 45,000,000 tons per year, the rate reached in March, which was somewhat higher than the record average of March, 1920.

Lumber—Total production for the entire country as reported to the National Lumber Manufacturers' Association, reached 1,018,952,538 ft. for the four weeks ending Apr. 28, as compared with 970,773,211 ft. for the four weeks ending Mar. 31. April shipments totaled 1,017,521,210 ft., against 1,057,151,751 in March and orders reached 962,787,124 ft. compared with 942,776,090 ft. in March. Production now stands at 7½ per cent above normal, with shipments 108 per cent and orders 97½ per cent of normal production. Output was 7½ per cent below normal, May 12, 1922.



CEMENT STOCKS, PRODUCTION AND SHIPMENTS

Cement—A total of 25,669,000 bbl. were produced throughout the entire country during the first quarter of the current year, against 15,254,000 bbl. for the corresponding period in 1922, according to the Geological Survey. A total of 21,708,000 bbl. were shipped during the first three months of 1923, compared with 13,218,000 during the first quarter of 1922, leaving a reserve of 13,055,000 bbl. on hand Apr. 1, 1923, as compared with 13,848,000, on the same date last year. Shipments during 1922 were only about 80 per cent of mill capacity. Since then the capacity has been increased about 4,000,000 bbl. Requirements for 1923 are estimated at about 125,000,000 bbl., while the annual mill capacity is now close to 150,000,000 bbl., indicating that there should be no cement shortage unless unforeseen labor, fuel or transportation difficulties arise.

Brick—Reports received from 128 members of the Common Brick Manufacturers' Association of America, as of Apr. 1, show 3,796,000 fewer burned brick on hand, with an increase of 160,847,000 in orders on books, compared with the month preceding. With the greatly increased number of plants in the northern section now in operation, it is to be expected that production will show substantial increases.

San Francisco—Plenty of sewer pipe, crushed stone and hollow tile; big stocks of road oils, asphalt and reinforcing bars; fairly well supplied with lime, triangular mesh, structural steel and galvanized sheets; stocks of track supplies, metal lath, common brick and manila rope in good condition. Limited supplies, however, of rivets, nails, blue annealed and black steel sheets.

Denver—Plenty of all construction materials; stocks in normal condition.

Minneapolis—Stocks of all building materials reported ample. Face brick, somewhat short last month, has caught up, and demand is being met without delay. Cement situation good. Lumber stocks unusually large for the season; 100,000,000 to 110,000,000 ft. estimated as in Twin City yards. Much of this has been sold, so that there is no real surplus. Lateness of season has resulted in holding back deliveries with consequent accumulation in yards.

Detroit—Plenty of sewer pipe, and common lime; small reserves of cement and hollow tile. Plenty of cement, however, available at nearby mills. Several days required on large deliveries of hollow tile. Brick, lumber and asphalt stock conditions normal.

Chicago—Sewer pipe and lumber stocks in good condition. Fairly well supplied with cement, lime, hollow tile and structural steel. Shortage of brick. Limited supplies of asphalt. Prompt deliveries on cement and asphalt. Lime shipments in 24 hr. Brick and sewer pipe take two to three weeks. Hollow tile deliveries require seven to ten days; steel, two to seven days and lumber, thirty to sixty days.

New Orleans—Lumber mill stocks low; engaged chiefly in special cutting for railway car material. Plenty of other materials except asphalt and crushed stone.

Atlanta—About fifty cars each of lime and cement; forty to fifty cars of asphalt and between six and ten cars of structural steel. Plenty of pine lumber and common brick. Sewer pipe and hollow tile deliveries take four to five days.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Lumber, Minneapolis, 110,000,000 ft.); time required for delivery of carload lots to city job, example: (hollow tile, Atlanta 4 @ 5 days); and stocks on hand in general terms, example: (brick, Chicago, shortage)

	San Francisco	Denver	Minneapolis	Detroit	Chicago	New Orleans	Atlanta	New York	Philadelphia
Sewerpipe....	Plenty	Del. 24 hr., local plant	Ample	Plenty available	Stocks in good condition	Ample	Del. take 4@ 5 days	Plenty small sizes	No surplus
Cement........	Mills running to capacity	Normal	Situation good	Small reserve; nearby mills	Fairly well supplied	Plentiful	About 50 cars	Output meeting demand	Stocks fair.
Lime............	Fairly well supplied	Plenty	Enough	Stocks ample del. normal	Del. in 24 hr.	Sufficient	About 50 cars	Enough; demand increasing	Del. prompt; stocks good condition.
Common brick....	Stocks in good condition	1,000,000	Plenty; face brick stocks caught up also	Supply normal in local yards	Shortage Del. take 2@ 3 wks.	Normal	Plenty	One months supply only.	No del. promised inside of 3 months.
Hollow tile ...	Plenty	Stocks normal	Sufficient	Local stocks small; del. take several days	Del. take 7 @ 10 days	Del. satisfactory	Del. take 4 @ 5 days	Scarcity	Stocks in fair shape
Lumber........	Big shipments continue	Shortage at mills	Unusually large for season 110,000,000 ft.	Moderate stocks in yards	Stocks in good shape. Del. take 30 @ 60 days	Stocks low. Mills have had no chance to accumulate	Plenty pine	Del. take 6 @ 9 weeks from mill	Yards re-stocking rapidly
Asphalt	Heavy native stocks	About 10 cars	Plenty	Normal del. good	Limited supply	None in stock	About 40 @ 50 cars	Heavy reserves in N. J.	Plentiful; shipments heavy.
Structural steel..	Plenty of bars, low on rivets	Warehouse stocks sufficient	Well stocked	No shortage	Del. in 2 @ 3 days from stock		About 6 @ 10 cars	Slow mill deliveries	Pressure for deliveries unrelaxed

New York—Present demand for common brick heaviest on record. About one month's supply of Hudson River common brick in reserve; no other districts shipping into New York market. Pine lumber demand a bit slacker; stocks are somewhat limited and deliveries take six to nine weeks from mill.

Philadelphia—Lumber demand eased for the time being; yards restocking rapidly. Active demand for sewer pipe, paving stone and wood blocks; no surplus stocks in dealers' yards. Plenty of asphalt and manila rope. Fairly well supplied with cement, lime and hollow tile. Brick deliveries slow; no shipments promised inside of three months. Sand, gravel and crushed stone demand heavier than output; plants working at capacity.

Report on Freight Car Shortage

Shortage in freight cars on April 22 totaled 44,299 cars, which was a decrease of 4,285 since April 14, according to reports filed May 4 by the carriers with the Car Service Division of the American Railway Association. Of the total, 19,349 represented box cars, which was a decrease within a week of 2,613 cars, while there was also a decrease of 300 in the shortage of coal cars within the same period, which brought the total to 20,725 cars.

Surplus freight cars in good repair and immediately available for use if necessary numbered 11,062 on April 22, compared with 14,241 on April 14, or a decrease of 3,179. Surplus box cars in good repair numbered 4,071, an increase of 221 within a week, while surplus coal cars totaled 2,582, or a decrease of 677 within the same period.

Motor Vehicle Output for April Breaks Record

With a production exceeding 364,000 motor vehicles, all previous records were shattered by the automobile industry in April according to Alfred Reeves, general manager, National Automobile Chamber of Commerce. The April figures show a gain of 10,000 vehicles over those for March and are 66 per cent greater than for April of last year.

The outlook for the motor truck industry, Mr. Reeves stated, is the best in five years. Production in March was 62 per cent greater than February.

To Reduce Seasonal Unemployment

Through the Boston (Mass.) Building Congress, an organization composed of representatives of all elements of the building industry—building investment, architects, engineers, contractors, labor and material men—an attempt is being made to reduce seasonal unemployment, especially in repair work. Printed literature and diagrams are being distributed showing that in the building trades the average workman is out of employment 25 per cent of the time each year.

This condition is caused by concentration of demand in certain periods due largely to weather conditions. Much of this work, it is pointed out, could be done as well at other periods. It is suggested that the following types of work be done during the periods indicated: Roofing, in September, October, and November; painting, from December to April; Plumbing, from January to May; heating repairs and overhauling, during the spring; electric wiring, from September to January; masonry, carpentry, plastering and lathing, from Dec. 1. to April 1.

Announcing Engineering News-Record's Construction Barometer

In formally establishing the Business Side of Construction, in April, 1921, "Engineering News-Record" recognized the need for accumulating and presenting each week the current data of the construction industry.

It is now proposed to extract the essential information from the financial, industrial and construction news of the week and publish it weekly as a guide for the busy reader.

The first issue of this additional service will be found on the first page of the Construction News section. The aim of the CONSTRUCTION BAROMETER is to give in the smallest space and in the simplest terms sufficient significant information to permit of a ready understanding of the current situation and a possible forecast. Each week it will appear in its present location.

Structural Steel at New Record

A new high record in sales of fabricated structural steel was made in March, according to figures received by the Department of Commerce through the Bureau of the Census, in co-operation with the Structural Steel Society. March sales amounted to 95 per cent of shop capacity, as against 80 per cent in February and 88 per cent in April, 1922, the previous high record at the present shop capacity. Total sales reported for March by 153 firms, with a shop capacity of 220,790 tons per month, amounted to 210,716 tons, the first time that actually reported tonnage has exceeded 200,000 tons in any month.

Tonnage booked each month by 168 identical firms, with a capacity of 225,155 tons per month, is shown below, together with the per cent of shop capacity represented by these bookings. For comparative purposes, the figures are also prorated to obtain an estimated total for the United States on a capacity of 250,000 tons per month.

1922	Actual Tonnage Booked	Per Cent of Capacity	Estimated Total Bookings
April	198,228	88	220,000
May	182,112	81	202,500
June	163,615	73	182,500
July	154,547	69	172,500
August ...	153,797	68	170,000
September .	144,319	64	160,000
October ...	129,816	58	145,000
November ...	109,435	49	122,500
December	130,853	58	145,000
1923			
January ..	168,227*	75	187,500
February	178,223†	80	200,000
March	210,716‡	95	237,500

*Reported by 166 firms with a capacity of 224,455 tons.

†Reported by 166 firms with a capacity of 224,[illegible] tons.

‡Reported by 153 firms with a capacity of 220,790 tons.

Gain in Lumber Production

Based on reports from regional associations the National Lumber Manufacturers' Association reports the following comparison of lumber movement for the first 17 weeks of 1923 and for the same weeks of 1922:

Year	Production	Shipments	Orders
1923	3,811,[illegible]	4,[illegible]	4,380,503,789
1922	3,041,[illegible]	[illegible]	3,[illegible],392
1923			
Increase	770,[illegible]	1,2[illegible],030	1,145,925,397

Decision in Metal Trim Case Expected This Month

Washington Correspondence

Lively interest is being displayed regarding the decision which the Joint Board for Jurisdictional Awards in the Building Industry will render in the so-called metal-trim case. The decision is expected at the next meeting, the latter part of May. While the metal-trim case involves comparatively little money the decision will have an important bearing on the future of the jurisdictional awards board.

The issue is between the carpenters' union and the sheet-metal workers' union. Previously, the board decided that metal-trim work belonged to the sheet-metal workers. The carpenters refused to accept this ruling, and several expensive strikes in the building trades have resulted. At its last meeting the board re-opened the case.

The case is felt to present unusually delicate features for the board because of its previous ruling and the attitude of the conflicting unions. If the new decision is not accepted by the losing side it is feared that the entire authority of the board may be placed in jeopardy, as adherence to its decisions is voluntary.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete **quotations for all construction** materials and for the important cities. The last complete list will be found in the issue of May 3; the next, on June 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	+$3.64	$4.30	$4.50	+$3.40	$3.55	$4.20	$3.85	$4.10	$3.75
Structural rivets, 100 lb	+4.40	5.00	5.25	3.75	4.25	5.15	5.00	+4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb	+3.54	4.25	3.15	+3.32½	3.45	3.85	3.40	4.10	3.50
Steel pipe, black, 2½ to 6 in. lap, discount	49%	50%	45%	59½%	53-5%	36%	+35.2@47.6%	30.15	32.76
Cast-iron pipe, 6 in. and over, ton	58.50	−56.00	+61.00	+60.20	60.50	+69.00	60.00	+70.00	60.00
Concreting Material:									
Cement without bags, bbl	2.70@2.80	3.25	2.25	2.20	2.39	2.85	2.71	2.90	2.68
Gravel, ¾ in., cu.yd	2.25	1.90	2.25	−2.00	1.75	1.90	2.15	1.25	1.50
Sand, cu.yd	+1.25	1.24	1.90	−2.00	1.00	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd	1.75	2.00	2.50	−2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	65.00	+42.00	53.00	60.00	+46.75	+44.00	41.00	31.00	90.00
Lime, finishing, hydrated, ton	+18.60	+23.50	22.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	3.00@3.25	+1.50	2.50	1.50	1.25	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	+14.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.0893	.115	.1032	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	+.1573	.0893	.115	....	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal	1.16	−1.26	1.42	+1.35	−1.29	+1.44	1.24	.86	1.15
Common Labor:									
Common labor, union, hour	.75	.35	....	......	....	.50@.55	.56¼	....	......
Common labor, non-union, hour	....	.30	.30@.50	.72½	.35@.50	.35@.50	.50	+.50@.62½	+.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 81¼c.; building laborers, 75c.; minimum for pick and shovel men, 50c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers. Steel-pipe, per 100 ft. net.

Montreal quotes on Douglas fir. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.03). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Despite weaker undertone of pig-iron market, cast-iron pipe advanced $2 in Chicago and Denver and $4 in Dallas during last two weeks. Atlanta, however, reports drop of $2 per ton, in week.

Recent steady advance in steel mill prices, reflected in higher warehouse quotations in New York, Chicago and Seattle, on shapes, rivets and bars.

Mill prices, however, easier at present, particularly in steel bars. Structurals and reinforcing bars more quiet. Dropping off in demand for oil storage tank-plates and car material. Plates quoted at $2.50@$2.65 per 100 lb., f.o.b. mill, for deferred deliveries; earlier shipments commanding $2.75. Shapes now $2.50@$2.60, shipped at convenience of mill; $2.70 named where deliveries are specified. Bars quoted as low as $2.40 for indefinite delivery; $2.65 and higher on orders involving earlier shipping specifications.

Sand advanced 25c. per cu.yd. in New York, during last two weeks, owing to higher production costs. Chicago, however, reports reduction of 25c. per cu.yd. in sand, gravel and crushed stone.

Hydrated finishing lime advanced 50c. in Atlanta and $1.50 per ton in New York, during last two weeks. Brick also reported higher in Atlanta; prices stable elsewhere.

Lumber developing a stronger market. Yellow pine timbers up $2 in Atlanta; Douglas fir advanced $1 in Minneapolis and $1.25 per M. ft. in Denver.

Linseed oil rose 3c. in Denver and 10c. per gal. in Chicago. Decline of 5c. reported in Minneapolis and 2c. per gal. in Atlanta, during week.

The wage schedule for the following trades has been adopted in Montreal for the balance of the current year: painters, 60c.; stonemasons, 90c.; plasterers and bricklayers, $1 and common laborers, 30c. per hour.

Granting of wage demand to brick handlers in the Hudson River District, supplying the New York market, will bring the cost of unloading brick barges to $1 per M. or $25 per day per man. New York price remains unchanged at $20 per M., alongside dock, despite increased cost in handling.

A Consolidation of Engineering News and Engineering Record
McGraw-Hill Company, Inc.—James H. McGraw, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren, *Editor*
Frank C. Wight, *Managing Editor*

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This Water-Works Issue

IN RECOGNITION of the promising convention of the American Water-Works Association at Detroit next week, much of the space of this issue is devoted to water-works and related topics. In range of subjects, interest, and value, particularly interest and value to the water-works operator, we feel that this water-works issue surpasses any that has been brought out by this journal or either of its predecessors. A new feature is afforded by devoting nearly all of the current Job and Office Section to the water-works field.

Locomotive Water Supplies

QUESTIONS of water supply have been considered hitherto mainly from the point of view of domestic and manufacturing uses or consumption, but increasing attention is being given tc railway water supply, both for drinking purposes and for the locomotives. On the part of railroad officials there is a growing appreciation of the fact that water service means something more than providing water of some sort at convenient intervals for filling the tender tanks. It involves supplying water of good quality as well as in adequate quantity and at the required places. Furthermore, it has an important relation to the operating efficiency of the railway. As a result of wider appreciation of these economic aspects there is an increasing tendency to establish water service departments having control of the entire question of water supply on the railway, instead of having this service divided between the engineering, mechanical and bridge and building departments, as has been general practice in the past.

Backfilling Reforms

BACKFILLING is the one element in installing underground services in paved streets which is most commonly poorly done. Pavement failures have always been numerous because of settlement over trenches loosely filled and quickly covered, but now with increasing truck traffic and far heavier loads these failures are becoming alarming. So bad has the situation become in some large cities that drastic correction is contemplated. In Philadelphia the Bureau of Water engineers predict that it may be necessary to retain 5 per cent of the contract price for 12 months if present experience with sunken trench fills shall continue. The penalty it will be noted is put on the contractor. As specifications for trenching are commonly written it may be questioned whether the contractor can be justly held responsible for the stability of backfill. Disquisition on abstract justice will, however, gain the contractor nothing. He has to correct the fault or submit to the penalty, if the engineer chooses to make him. Almost any trench can be backfilled so that there will be no considerable settlement. Every experienced contractor knows how. He knows too that it will cost more money than the city engineer is in the habit of thinking ought to be paid for backfilling. To meet competition and get the contract he takes the chance that everyday practice will pass the inspector and that the pavement will bridge over any defects for a long enough time to furnish the backfilling an alibi. Altogether the situation is one for which the city engineer is as largely responsible as is the contractor. For better practice both must regard backfilling as an essential unit of the structure and, therefore, as something which has to be paid for at a cost proportionate to its quality.

Courageous Pioneering

PIONEERING on a large scale and in the face of considerable opposition is now going on at the Port Reading Creosoting Plant in New Jersey. The superintendent of the plant, basing his action on the results of a test of some pine ties which are still in good condition after eleven years of service although impregnated with only three pounds of creosote to the cubic foot, has started treating ties with a mixture of thirty per cent creosote and seventy per cent fuel oil. This mixture gives approximately the same amount of creosote per cubic foot in the treated ties as is in the test ties and in addition there will be a few pounds of fuel oil. No other plants in the country, except those using zinc chloride in combination with creosote, have gone so far in an attempt to conserve the limited supply of creosote. The step is opposed by many members of the American Wood Preservers Association in spite of the demonstration of the test ties still in service which they saw on their inspection trip last week. Unfortunately it will be years before the results of this vast experiment will be known. But if it is as successful as the ties in the test section seem to indicate this action will have been a notable step in the direction of economical timber preservation.

A Job for the Engineer

ANYTHING that can be done to reduce the killings and maimings due to the motor vehicle is worth while. The horror at the multiplicity of such accidents is growing and the demands for a cure become more and more insistent. The danger now is that too much reliance will be placed in driver control. We find, for instance, that the country's police chiefs, assembled in New York City, are "agreed that the remedy is a more careful system in licensing drivers, a system that will exclude the careless and the inefficient from the operation of cars of any kind." Such control is most necessary—but it will save only a part, and a small part, of the accidents. Most motor accidents are due either to a state of mind which inheres in the driving of an automobile or to conditions beyond the control of the driver. More elaborate examination of drivers will do little to change this state of mind. On the other hand overcrowded streets, unnecessary parking, lax crossing regulation, inadequate and unsystematized traffic lanes, are the main sources of motor accidents. To cure these evils is a job for the engineer.

High Spots in a Business Meeting

MEETINGS such as that of the Chamber of Commerce of the United States are worth while not so much for the actual production of constructive thought or action at the meeting itself as for the dissemination of ideas throughout the country. At New York last week four or five thousand of the influential business men of this country met in sober consideration of national business problems. They listened to papers and reports of their committees and at the end they adopted without objection some rather colorless resolutions provided for them by a committee. On the face of it this was not worth the cost. But the real benefit is to come when all of these men go home there to spread, both formally and informally, the thoughts they absorbed in the three days' sessions.

By intent the meeting emphasized the problem of transportation. The restriction of proper business expansion by the confused treatment of the railroads, and the lack of co-operation between rails, waterways and highways cries out for correction. To that end the Chamber has initiated the so-called Transportation Conference to formulate some program for reform. That conference has only just started and could not therefore report at the meeting but the outline of what it proposes to do, which was reported, indicates an investigation of unprecedented scope and authority. Merely to inform the members of the extent of the problem and the prospective information to be obtained was distinctly worth while, for it should serve to restrain those who see in the transportation problem only those difficulties which affect them alone and who are too prone to rush into proposed solutions which would complicate more than solve.

On the other major subject of the meeting, immigration, the results of the meeting are not so impressive. The Chamber's committee—and the resolutions' committee—advocate some letting down of the immigration bars, not to the extent which those seeking cheap labor would wish but sufficient to get what they believe would be a better selection of new blood. The difficulty is that they offer no constructive recommendations as to how this selection is to be made and there is still much vagueness as to just what quality in an immigrant makes him desirable. The danger of selection by nationality was pointed out by one of the invited speakers and another, who holds the strategic position of chairman of the immigration committee of the House of Representatives, while admitting that we need "more producers and fewer peddlers" stated unequivocally that restrictions are to be tightened rather than loosened. The net impression from the meeting is that there is considerably more imagination than fact in most of the ideas regarding the immigrant, but that the average business man is afraid of too free an immigration policy.

One further fact was hammered home to the thousands who heard Secretary Hoover's address. That is the individual's responsibility for the business stability of the next few months. Mr. Hoover made clear the changed production and consumption status of the United States since the war and said a needed word against extreme caution or panicky fear for the future, but at the same time none of his hearers—all of whom have control of the reins of some business—could go away and think that he could proceed happily on any unrestricted path of price elevation or overproduction and hope to gain while his fellows exercised more sane judgment. To have done this was an excellent reason for the existence of a Secretary of Commerce.

Finally, an engineer commenting on this business mans' meeting must perforce note the almost complete absence of his professional fellows. Enough has been said to show that the topics discussed were not only of interest to engineers but such as would have been illuminated by their discussion. The engineer, however, continues to consider himself aloof from business or possibly the business man continues to consider the engineer only an employee or professional adviser. That both business man and engineer would benefit by closer co-operation goes without saying. To bring about that co-operation continues to be one of the greatest problems for the engineering profession.

Water Waste in Chicago

WATER waste continues merrily on its way in Chicago. The latest annual report of Alex Murdock, city engineer, states that the peak in the daily pumpage is more than a billion gallons or at a rate of 367 gal. per capita. The really significant fact however, is that Chicago has so little pressure—18 lb. is the average normal in the summer. Unless some method is devised to check waste Mr. Murdock baldly and prophetically states that there are no limits to the needs of additional stations, mains and pumps.

What is Chicago going to do about water waste? How? When? Engineers and thinking citizens who have looked closely into the situation, as did the Chicago Bureau of Public Efficiency six years ago and the Western Society of Engineers at its annual mid-winter convocation in January are certain there must be an end point soon. The estimable report of the bureau was brought up to date and the latest phases of the situation were put before the society but not much headway seems possible, for the solution requires general education of the citizens to push the mayor and council. However, two vulnerable points of attack which politicians and the general public can understand were made available. Mr. Murdock's discussion of the low pressure discloses that 75 per cent of the people do not get adequate service. L. R. Howson, in a most exhaustive paper, replete with figures, charts, diagrams and comparisons, showed diagrammatically this drop-down curve of pressures after leaving the pumping stations. The second point of layman vulnerability is the fact brought out by Maj. Myron B. Reynolds, engineer of the water department, to the effect that the water business is no longer a money-making proposition. It is beginning to run behind. No more can the budget makers look to the water consumer to make up deficits in the corporate fund. Last year for the first time the plotted line of expenditure hopped over the line of receipts by a million or so.

The newly elected mayor of Chicago, if he and his council are wise, will be able to make a "showing" quicker in the water department than in any other municipal activity. No place else can he make such a saving and at the same time increase service to such a large majority of his constituency. If within a reasonable time he shows no sign of attacking the problem, engineers should lose no time in making their influence felt in backing up the judgment of the department's staff, which for years has advocated waste elimination.

A Turning Point

AN EPOCH is marked in the life of the American Association of Engineers by the Norfolk convention of last week. The organization has now definitely passed from promise and hope to productive achievement. Its committee reports show work of real and extensive value. Certain of the results outmatch anything that has been brought forward by other engineering organizations in the field of professional activities. The report of the convention on another page of this issue briefly sets forth the record of production.

Why has this work been accomplished? The men in the American Association are no different from those in other societies. Perhaps there is a larger proportion of younger men, and also more of the men whose temperaments lead them to seek results rather than dignity or distinction. But otherwise they are much the same kind of men as are found in the technical societies. The distinctive thing about the association, we are inclined to believe, is its atmosphere of courage. No fear prevails there in the matter of a frank attack on professional evils—unfair competition, abuse of position to obtain personal advantage, unsatisfactory relations between engineers or between public and engineers, political activities, or such plainer evils as incompetence. That quality of courage can carry the association far. It provides an atmosphere in which many engineers find their best working conditions, in which they can think and act without too many hampering fetters, joining their strength with that of other men of the same temper.

With this great asset of courage and with the record of production it now has made, the association is at the entrance to a worthwhile career. Its achievements so far are fruitful beginnings of broader and more influential activities. The opportunity is before it to become a lasting force in the field of professional engineering—*if it survives.*

If it survives, we say in all earnestness. For at the very moment when it demonstrated its ability to produce, the association also gave signs of being stricken with serious, perhaps fatal, disease. Selfishness, misunderstanding and quarrelsomeness are at work. Perhaps they are in part an outgrowth of the very quality of courage which is the association's chief virtue. However, they all but paralyzed the activities of the convention and were prevented only by a small margin from splitting the organization in two.

Disintegration threatens today almost as much as at the convention. The danger is less threatening only because the full extent of the evil is now apparent and all the forward-looking elements of the association understand the challenge to their efforts for progress. They are united—or will be if they realize their opportunity. The issue is disintegration into non-coherent and worthless fragments. It can be met, we feel confident, and progress assured, if the association's supporters will rally under the banner of harmonious purpose for the advancement of the profession, devoid of narrow-visioned planning for group advantage.

Out of such union of purpose, we believe, there will develop a truer understanding of the association's essential problem. For there is a real problem, and it is a difficult one. Because it is misunderstood, and seen from one-sided viewpoints and interpreted narrowly rather than because of sinister purpose, the internal strife and bickering have come about. The problem lies in the fact that much of the work and the inspiration of the organization centers in its national activities, while the chapters are the source of nearly all its life blood. It will be solved only when, while maintaining the national functioning unimpaired, and indeed extending it, the chapters are so developed as to acquire lasting vigor and independent productiveness. The solution is to be attained not by decentralization, not by dispersing national authority and national initiative to a hundred chapters, but by fully awakening the local initiative and applying it to the local problems and opportunities. That is and will remain a local problem.

Two years ago, when the association first entered upon the experiment of decentralization into local groups held together by rather loose federation, we were apprehensive of the outcome. "Tradition would lead us to be fearful of the plan," we said. "If the chapters throughout the country grasp and handle the local problems to the credit of the profession, and at the same time continue loyal adherence to the national body, the decentralized policy will be adjudged successful." Today we have the answer to these questioning doubts. The policy has not proved successful. The attack on local problems has, with some exceptions, been neither energetic nor successful, and the aim to support national work has been submerged by local aims.

Local activity can be made a success—that has been demonstrated in the American Association of Engineers itself; and inasmuch as some of the local sections of other societies have managed to be no more than dignified and respectable failures, the association need not be discouraged if only a few of its chapters have succeeded in developing vital work in their own communities. But more than any of the technical societies, the association, because of its nature and objectives, must make its chapters strong, for it is there that the interest and the coherence of the membership are born. And the chapters must make the national work strong, and must support it with faith, enthusiasm and initiative.

Finances, of course, are an always present problem, just as is that of chapter activities. And so also is it a problem how to satisfy those who feel discontented because they have not received a money return through the association's activities to outbalance their membership dues. Not all of the membership realizes as clearly as it should that the profession jointly must work out the difficulties which beset all of its several parts and that no single small group can look for much assistance in its individual narrow problems elsewhere than in a general lifting up of all parts of the profession.

But at the present turning point in the association's existence, these matters of detail may be left to one side. All members and all groups must fix their view on the purposes and ideals on which the association's future will be built. It is possible that they may have been forgotten, and may need to be recalled. In the end, each single member of the association must carry within himself a true appreciation of the real justification of his membership, namely, the wish to join in a large-scale co-operative movement for the solution of the professional problems confronting the engineering profession itself and the community as a whole, for the betterment of community life, and for raising the profession by increasing its usefulness to the world. Through such an appreciation the association can avoid ruin and go forward to safety and success. It is now at the turning point of its career.

Detroit 320-M.G.D. Filtration Plant Is World's Largest

Eighty 4-M.G.D. Units Treat Detroit River Water at the High Rate of 160 M.G.D. per Acre—Steel Roofs Over Filters and Coagulant Basins Give Uniform Appearance—Whole Plant on Piles

By Theodore A. Leisen
Consulting Engineer, Department of Water Supply, Detroit, Mich.

DETROIT'S new water purification works will be the largest single rapid sand filtration plant in the world. The plans in their entirety provide for a plant of from 320 to 360 m.g.d., with facilities for meeting peak loads of short duration up to a 400-m.g.d. rate. No provision has been made for future extensions to the filter because, when the average daily consumption approximates 250 to 300 m.g.d., the limits of capacity of all equipment and structures at this location, including the intake tunnel and the pumping engines as well as the filter plant, will have been reached, and any further development on the present site would be injudicious if not impossible. Some of the more novel features of the plant include higher rates of filtration than usual, revolving screens for ice removal, steel roofs over filters and coagulant basins, triangular spacing of columns in the filtered-water basin and rapid mixing at high velocities.

As a prelude to a description of the filtration plant, a brief general description of the water-works as well as some allusion to the developments leading up to the adoption of plans for a filter would seem desirable. Prior to 1874 the pumping station and intake were located at the foot of Orleans St. about three miles farther down the river than the site of the present station. The rapidly increasing pollution of the river made water from the Orleans St. intake unsafe and in 1873, in an effort to get beyond the contaminated zone, the property on East Jefferson Ave. was acquired and construction started on a new pumping station, a small settling basin and an intake pipe. This intake pipe and two subsequent ones extended but a short distance into the river. With the increasing concentration of urban population upstream, within a comparatively few years the supply again began to exhibit evidence of excessive pollution, virtually a repetition of the earlier experience at the Orleans St. site. To combat this growing menace and to provide a larger supply a new intake crib and connecting tunnel were built in 1904, the crib located farther upstream and sufficiently distant from the shore to avoid normal pollution-laden currents.

Since that date the water supply for the city of Detroit has been taken from the upper end of the Detroit River, close to the point where Lake St. Clair flows into it, the intake crib being located near the head of Belle Isle and opposite the easterly section of the city at a distance of 3,200 ft. southeastward from the shore line at the pumping station grounds, locally known as Water-Works Park. The intake site was selected after a careful survey had demonstrated it to be the point most remote from and least likely to be affected by the polluted shore currents or incidental contamination from the main ship channel. Time has demonstrated the soundness of the judgment of the engineer who made the selection. A brick tunnel 10 ft. in diameter extends from the intake to the shore shaft whence the water passes through a 10-ft. conduit and several smaller conduits, either into the small settling basin or directly to the suction wells of the pumping stations.

In the effort to secure a pure source of water supply through the medium of shifting locations of the intakes, the ultimate available goal had been attained in the present intake, as there is no evidence extant to warrant the belief that a further extension of the tunnel towards Lake St. Clair would be productive of better results. As a natural sequence, some method of treating the water appealed to reason as the logical solution for safeguarding the supply. In 1913 calcium hypochlorite was resorted to as a sterilizing medium for ameliorating a typhoidal condition which had been gradually exceeding a normal stage. Liquid chlorine was adopted in 1914 and has been used continuously to the present time. That the treatment was necessary is evidenced by the fact that for eight years prior to 1914 the death rate from typhoid fever averaged 22 per 100,000 of population, while for the eight years since then the average typhoid death rate was only 11, and during the past two years was but 5 per 100,000 population.

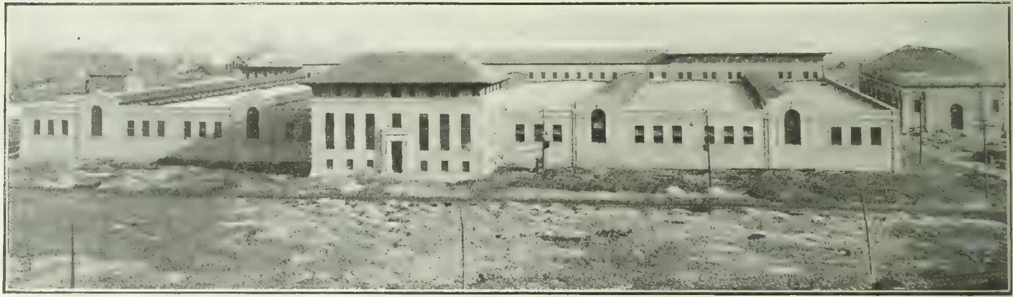

FIG. 1—GENERAL VIEW LARGEST FILTRATION PLANT IN THE WORLD—320 M.G.D. CAPACITY

Administration building in front houses two circular wash-water tanks. Filters are housed under one roof which is supported on steel trusses. Effective sand area is the high ratio of 67 per cent of total area covered by the filters.

The foregoing statements outline the evolutionary efforts taken to provide a better water supply and mark the steps which pointed inevitably, if undesignedly, towards filtration. Official interest in the question of filtration was finally enlisted and authority granted in 1917 to construct a small experimental plant, the chief object of which was to prove conclusively the correctness or falsity of the hypothesis previously advanced that Detroit River water could be treated at a rate considerably in excess of what heretofore had been deemed feasible or had been in general use. The experimental plant was completed and put in service the latter part of 1917. Several years' operation demonstrated that the water could be filtered with efficient results up to 200 m.g.d. per acre.

The operation of the experimental filter and the free distribution of its output, with the attendant publicity derived therefrom, in combination with a growing distaste for chlorine flavor, were potent factors in moulding public opinion in favor of filtration. In August, 1920, when the citizens of Detroit voted on the question of issuing bonds to the extent of $12,000,000 one-half of which was expressly designed for the filtration work, the verdict was overwhelmingly in favor of the bonds, and filtered water for Detroit became assured.

Final Flter Plans—A general plan for the proposed filtration plant for Detroit was prepared by the writer in 1916-17, founded on a careful study of existing works in their relation to the proposed plant. During the writer's absence for a period of two years in the army, certain other plans were prepared and a report submitted covering a complete filtration plant. Upon returning to the problem in 1919 the original plans prepared in 1916-17 were investigated and carefully compared with the plans subsequently submitted, from the viewpoints of both construction and operation. The conclusion was reached that these original plans provided for a more compact, more economical and more workable plant than was possible by any of the other plans which had been prepared meanwhile. In consequence, the original plans have been adhered to in practically every detail except where equipment previously ordered necessitated a change. (See *Engineering News-Record*, June 17, 1920, p. 1194, for general description of the plant before the details were worked out.)

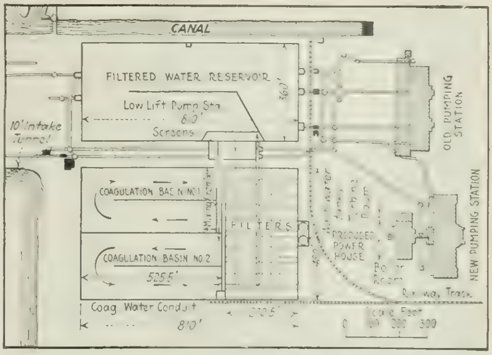

FIG. 2—LAYOUT OF DETROIT FILTRATION PLANT

The general design of what may be termed the complete filtration plant is divided into three separate structures: (1) The low-lift pumping station; (2) Coagulation basins, filter-beds and wash-water tanks, all combined under one roof; (3) Filtered-water reservoir. The complete plant occupies a rectangular space 810x937 ft. or slightly over 17 acres. The filters and

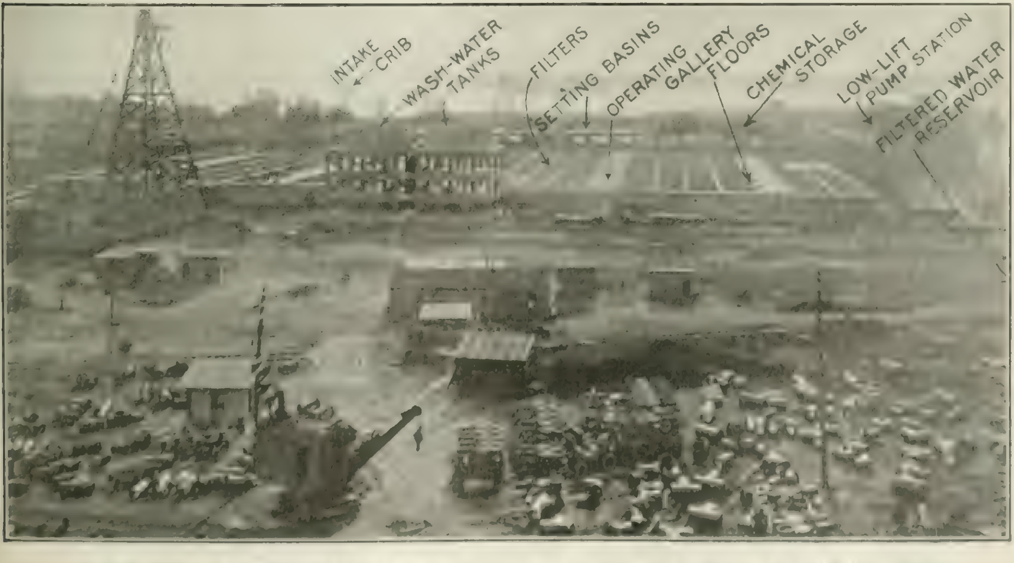

FIG. 3—DETROIT FILTRATION PLANT DURING CONSTRUCTION BEFORE ELEMENTS WERE HOUSED IN

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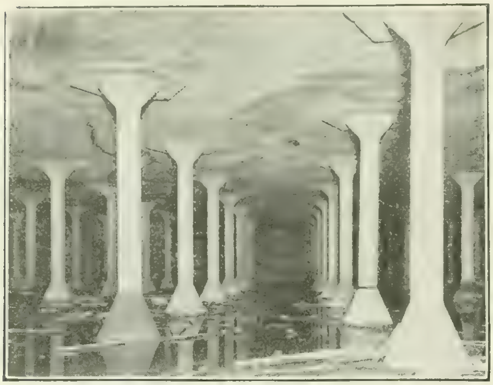


FIG. 4—FILTERED WATER BASIN WITH CIRCULAR COLUMNS AND FLARED TOPS AND BASES

coagulation basins combined cover 9 acres and the filtered-water reservoir 6.7 acres, the low-lift pumping station and intervening road making up the remainder of the area. The filter area, including beds, pipe galleries, etc., is 2.98 acres and the effective sand area is 2 acres, so that the actual filtering area is 67 per cent of the total area covered by the filters, giving a higher ratio of effective sand area to total area than exists in any other filter plant in the country, which means a greater degree of economy than heretofore achieved.

Low-Lift Pumping Station—The low-lift pumping station is a brick building, 65x175 ft. in plan, with concrete substructure, located between the filters and filtered-water reservoir, immediately over the 10-ft. diameter intake conduit, the latter being removed for the full length of the station and re-connected to the station at both ends. The water flows from the conduit into the screen chamber at the southerly end of the station, where seven electrically-operated revolving screens, each 6 ft. wide by 25 ft. high from base to normal river level, serve to intercept all coarse floating material and ice formation, provision being made for cleaning the screens while in operation. The screening element is composed of 14-gage copper wire, three meshes to the inch, which leaves clear openings about ¼ in. square, and provides a clear water-way through the screens in the ratio of six to one of the cross-sectional area of the intake conduit. From the screen

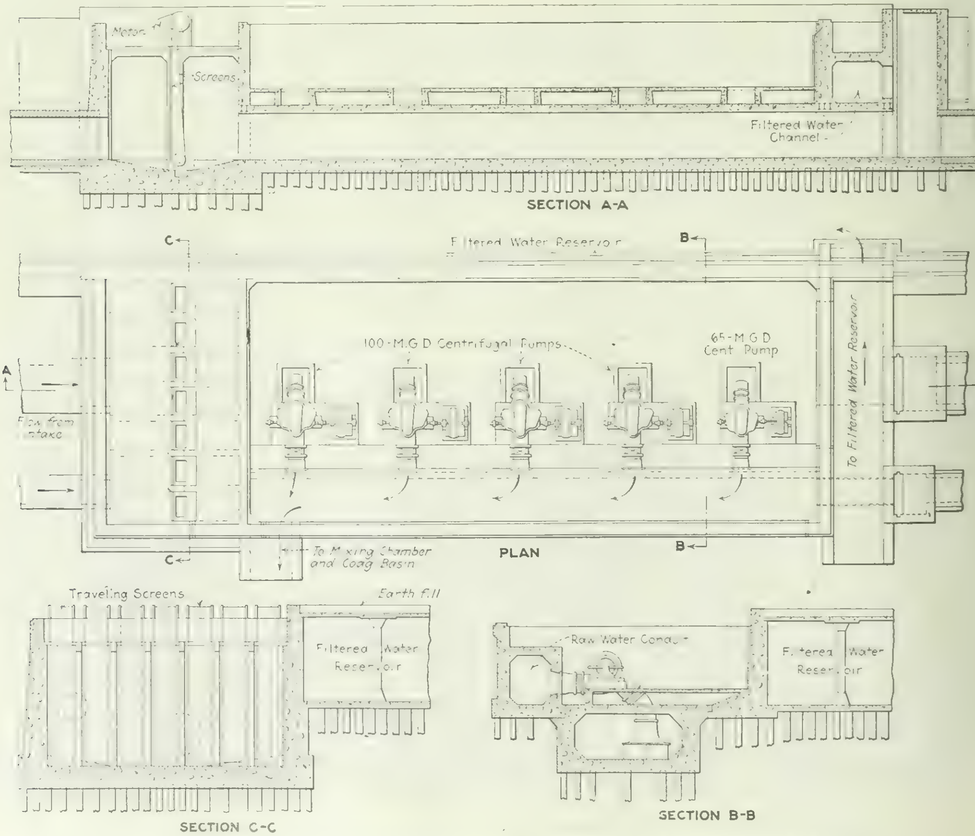


FIG. 5—LOW-LIFT PUMPING STATION FOR DETROIT WATER FILTRATION PLANT

chamber the water flows into the suction well, 26 ft. wide by 11 ft. deep, directly under the floor of the pumping station.

The station is equipped with five motor-operated centrifugal pumps having a combined capacity of 465 m.g.d., designed to deliver water to the mixing chamber of the coagulation basin against a head of about 26 ft. There are four 100-m.g.d. and one 65-m.g.d. pumps. Three of the pumps are operated by synchronous motors, and two by slip-ring motors, the latter two designed for a 10 per cent variation in speed to provide varying rates of pumpage, and automatically regulated to maintain a fixed level in the coagulation basins.

A balcony surrounds the interior of the station at the entrance level, with the pump floor 20 ft. below the ground level as a provision against excessive suction lift during periods of low water and high consumption.

Filters—The filtration works proper are all under one roof in a structure 480 ft. wide by 810 ft. long, with a three-story building at the center of the north end which forms the main entrance to the filters and constitutes the tower for the wash-water tanks. It also provides space for the chemical and bacteriological laboratory and other offices. Immediately south of the entrance building are the eighty filter beds occupying a space 480x270 ft.; and south of these are the coagulation basins, with the mixing chamber and chemical feed and storage space between the filters and coagulation basins.

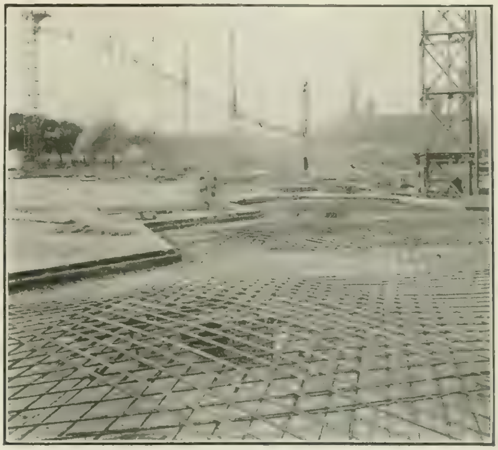


FIG. 7—THREE-WAY REINFORCING OVER COLUMN HEADS

Zigzag expansion joint in roof slab of filtered water basin, which is supported on columns spaced 2 ft. c. to c. at points of an equilateral triangle.

The mixing chamber is considerably smaller in proportion to the capacity of the plant than those which have been provided in most recent filter installations, but it is designed to provide thorough and rapid mixing at high velocities by means of a diversified system of baffles. The chamber is 18 ft. wide and 240 ft. long,

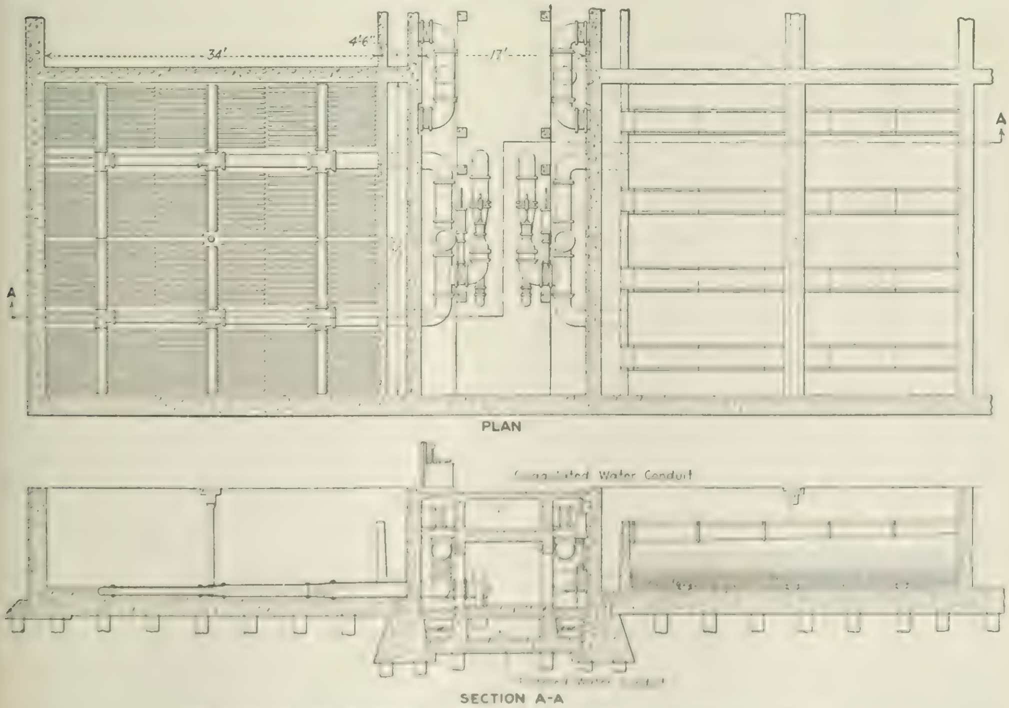


FIG. 6—PLAN AND SECTION OF TYPICAL PIPE GALLERY AND FILTER UNITS

covered for the greater portion of its length so that the water may start through under a slight pressure. Alternate sets of vertical and horizontal baffles are placed throughout the full length of the channel, and as the coagulant solution is introduced where the water flows in from the low-lift station, the result should be a perfect admixture by the time the coagulation basins are reached. At maximum capacity the velocity will approximate 90 ft. per minute, and the mixing period will be slightly less than three minutes.

The space over the mixing chamber and coagulated water conduit was carried up an extra story in height to provide space for the storage of chemicals, and at the westerly end to three stories to accommodate storage bins for feeding alum into the dry-feed chemical machines. The storage space is ample for more than three months' supply of alum. Two storage bins have sufficient capacity to feed the plant for 48-hr. periods, thereby enabling the filter attendants to operate through night shifts and over holidays without manual labor for handling alum. Five storage bins were installed to permit the use of sulphate of iron and lime should future conditions make the substitution necessary, but only three dry-feed chemical machines were installed, two being required for service under maximum consumption and one for reserve.

Coagulation Basins—The coagulation basin, which is divided into two equal parts, covers a space 480 ft. wide by 525 ft. long, and has a total capacity of 30 m.g., providing a subsidence period of more than two hours when the whole plant is operated at its maximum rate. During cleaning periods, which probably will not occur more than once a year, one section of the basin will be shut off while the other section remains in operation. Each section of the coagulation basin is subdivided for the greater part of its length by a baffle wall, so that the coagulated water flows at a low velocity a distance equal to twice the length of the basin. The bottoms are sloped to low points where mud valves permit flushing the accumulated sediment into the sewer.

On account of prevailing low winter temperature, the coagulating basins are covered and a steel trussed roof type of construction was adopted as affording a better opportunity for observation of coagulating effects, and also permitting a more pleasing architectural treatment at no additional cost. This arrangement makes the external elevation of both filters and coagulation basins practically the same.

Between the coagulation basin and the filter beds there extends a coagulated water conduit for the full width of the structure, from which the coagulated water flows into each of the conduits feeding a double tier of eight filter beds.

Filter Beds—The eighty filter beds each have 1,088 sq.ft. effective sand area, divided into five double rows of eight beds, with a pipe gallery between each two rows, the operating floor forming the cover for the pipe galleries. Each bed is one-fortieth of an acre in area and has a filtering capacity of 4.5 m.g.d. at the 160-m.g.d. rate or 4.5 m.g.d. at a 180-m.g.d. rate. The filter is covered with a steel trussed roof having continuous raised monitors over the operating galleries, affording ample light and ventilation.

Arrangements for sterilization by liquid chlorine are provided over one of the filter beds on the westerly side where, if found necessary, chlorine can be introduced at the end of the main filtered-water collector before it enters the filtered-water reservoir.

All water conduits up to the point where the water is delivered onto the filter beds through 24-in. gate valves are of concrete, and in the design of these conduits the effort has been to convey the coagulated water to the beds with the least disturbance possible, to prevent the breaking up of the floc.

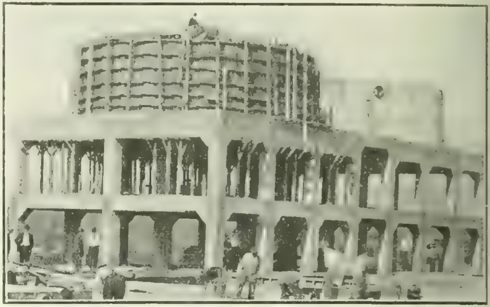


FIG. 8—HEAVY CONCRETE FRAME OF OFFICE BUILDING SUPPORTING WASH-WATER TANKS

Four circumferential rods around outside upright form timbers were cinched up with long turnbuckles.

The cast-iron wash-water troughs are 34 ft. long and extend from the rear end of the filter bed to the wash-water channel at the front of the gallery end of the beds. They are supported at the center from a beam which forms a walk across the middle of the beds.

The strainer system is a manifold of cast-iron pipes, branching from two main cast-iron collector pipes built partly into the concrete bottom. The collector pipes are 20 in. in diameter at the outlet, reducing to 9 in. in the manifolds, with 2-in. laterals extending from the manifolds on 6-in. centers. The main collectors, manifolds and laterals are tapped on approximately 6-in. centers for the insertion of brass strainers of the umbrella type.

The filtering medium consists of 17 in. of gravel placed around and above the strainer system, in even layers, varying in size from 2 in. at the bottom to $\frac{1}{16}$ in. at the top, and 24 in. of sand having an effective size of 0.35 to 0.45 m.m. and a uniformity coefficient of 1.6 to 1.7.

Filtered-Water Reservoir—The filtered-water reservoir, which occupies the site of the former settling basin, is an all-concrete structure 360x810 ft. with a maximum depth of water of 16 ft. 9 in. The depth of the reservoir was limited by the elevation of existing pumping engines and other structural details of the two main pumping stations. Both floor and roof of the reservoir are of flat-slab construction, with three-way reinforcement carried from reinforced-concrete columns on 20-ft. centers forming equilateral triangles. The roof is covered with 24 in. of earth and will be seeded or sodded to form an addition to the park area; it is to be utilized for tennis courts and other recreational purposes. To conform to the general character of the surrounding grounds the ventilators will be surmounted by ornamental flowering urns.

When full the reservoir will contain 37 m.g. It will serve as a balancing factor to meet the fluctuating conditions of consumption without disturbing the prevailing rate of filtration.

General Construction—Owing to the unstable nature of the soil every portion of the filter structure, including the filtered-water reservoir, had to be supported on a pile foundation. Under the filter and coagulation basins, where the bottom was above normal river level, Raymond concrete piles were used but wooden piles were used under the filtered-water reservoir as they will always be submerged. There were 15,380 concrete piles driven for the filter plant and 14,019 wooden piles under the reservoir. The calculated pile loadings varied from 15 to 20 tons.

Bottoms of coagulation basins and filter beds are beam and flat-slab construction, the beams as well as wall footings bearing directly on piles. The base area of the whole plant is built on the ground, with the pile heads projecting up into the concrete from 6 to 12 in. No dependence was placed on the bearing value of the soil, as the entire weight of structures and contents was calculated to be carried by the piling.

Quantities—The contract for the filter substructure involved 11,000 cu.yd. of excavation, 50,000 cu.yd. of concrete, 2,200 tons of reinforcing steel, 96 tons of structural steel and 770 tons of cast-iron pipe and specials. The contract for the filtered-water reservoir comprised 43,600 cu.yd. of excavation, 32,400 cu.yd. of concrete, 1,500 tons of reinforcing steel, 48 tons of miscellaneous iron and steel and eight 60 to 64-in. gates.

All hydraulic gate valves and cast-iron piping and specials for filter connections, all cast-iron wash-water troughs and cast-iron manifolds and laterals for strainer systems were purchased and installed by the water department.

Costs—The total cost of the filtration plant, including the filtered-water reservoir but excluding the pumping station, is approximately $4,480,000; and of this amount more than $1,530,000 was expended for pile foundations, an item which normally would not have to be considered. Assuming the capacity of the plant at 320 m.g.d., and taking the full cost, including pile foundations, the result is a cost of $14,000 per million gallons capacity; or with pile foundations cost deducted, would be $9,200.

The writer acknowledges the valuable assistance given by Frank H. Stephenson, principal assistant engineer, in working out details of the filtration plans, and by Henry A. Hagen, assistant engineer for details of an architectural nature.

Southampton's New Floating Dock

Southampton's ability to cope with an over-growing volume of ocean-going tonnage will shortly be increased by the provision of a giant floating dock, according to the British Commercial Association. The new dock is of the double-sided self-docking sectional box type, consisting of pontoon and two parallel walls divided transversely into seven sections. It will have a lifting capacity of 60,000 tons. Its over-all length of 960 ft. will make it capable of receiving the largest war or mercantile vessel yet built or contemplated. The first plates were laid on the blocks at the firm's Walker Shipyard on Nov. 22, 1922, and the first section was launched from the Armstrong Yard on March 22, this year. Messrs. Sir W. G. Armstrong, Whitworth, are the builders.

Trunk Sewer Under Construction at Portland, Oregon

By W. P. Hardesty

Civil Engineer, Portland, Ore.

THERE is now being completed at Portland the second section of a sewer project that will total 7.4 miles of sewer ranging from 36 to 78 in. in diameter. The difficulty of draining the district served, the circuitous route required and the use of a long tunnel are some of the features of the undertaking.

The Willamette River is the natural discharge for sewage in Portland, but in the extreme southeast part of the city is a district of such topography that the logical direction of trunk sewer discharge is away from the river for nearly two miles. The trunk sewer for the drainage of this district is in two sections. The first section, or Foster Road Sewer, has a length of 2.2 miles and cost about $334,000. It falls southeasterly, mostly away from the main city and the river. The second section, or Lents trunk sewer, connects with the first section and runs in a general westerly direction for its length of 5.2 miles to its discharge into the Williamette River. This second section is now under construction.

Only about one-third of the route traversed is served directly by the Lents sewer. Much of it lies outside of the city limits, as much as 1¼ miles in one stretch. Advantage was taken of this condition to place the sewer at a comparatively shallow depth and to space the manholes far apart, which lightened the cost considerably.

Construction—The sewer is of reinforced concrete, mostly of horse-shoe section, top and sides 7 to 9 in. thick, bottom or invert paved with paving brick laid flat. This brick floor will facilitate repairing when abrasion shall have made it necessary.

The variation in section of the sewer, mainly to fit the size to different grade rates available, is made with only two widths. The height of the vertical walls is alone varied, using the same invert and arch, and this results in much economy of form construction and is decidedly more convenient for the contractor. Thus, with a 61-in. width the clear height varies from 53 to 74 in., while in the tunnel the width is 56 in., with a height of 71 in.

At the westerly end of the sewer the topography is such that the broad Sellwood ridge is tunneled through for a distance of 4,420 ft., to the outlet into the Willamette River. The tunnel has been driven from the two ends and from two intermediate shafts. The material is mostly gravel and boulders, with some cemented gravel and conglomerates in which blasting has been done. The unit prices for driving the tunnel in earth and in rock are $18.50 and $21.50 per lin. ft., respectively, including timber lining. The contract price for the monolithic sewer ranges from $13.40 to $16.90 per lin. ft. Trench excavation is $2 per cu.yd. in earth and $5 in solid rock.

The contract for the Lents trunk sewer was awarded to J. F. Shea at an estimated cost of $693,110. Construction was started in September, 1922, and is expected to be finished about the close of 1923. The work is in charge of O. Laurgaard, city engineer, and O. E. Stanley, assistant engineer.

Building Additional Siphons of Catskill Aqueduct

Original Single Line of Concrete-Covered and Mortar-Lined Riveted Steel Siphons Being Paralleled with Two More Lines to Give 500-M.G.D. Capacity

By Thaddeus Merriman
Chief Engineer, Board of Water Supply, New York City

CONSTRUCTION work is now in active progress on the large concrete-covered mortar-lined steel-pipe siphons at fourteen locations along the Catskill aqueduct between New York City and the Ashokan reservoir under three contracts awarded Nov. 23, 1921, by the Board of Water Supply of the City of New York (see Table I).

During the original construction of the aqueduct from 1907 to 1917 the tunnels and cut-and-cover sections were built to the full capacity of not less than 500 m.g.d., but at these fourteen locations crossing the narrower valleys the design provided for three parallel steel pipes, only one of which was installed. The work in hand is the placing of the two additional pipes at each location to bring the aqueduct to full capacity, which will be required when the additional supply is available from the Schoharie development, now also in progress.

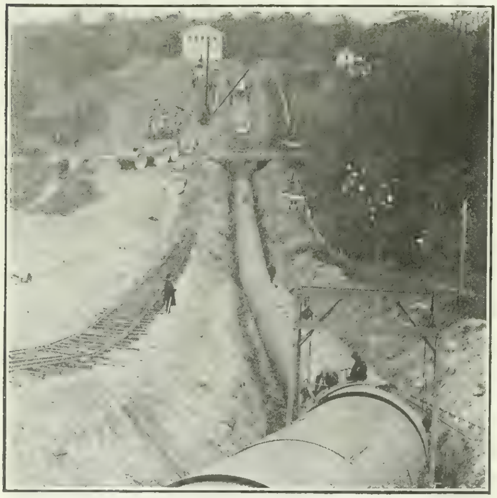


FIG. 1—LAYING 11¼-FT. STEEL PIPE FOR FORT HILL SIPHON

The siphon in service is under the construction track; the third siphon will be laid at left of the first one. Note cradles and see line cut for detail.

The single pipes originally laid have had sufficient capacity under forced conditions to convey the supply available from the Ashokan reservoir up to this time. These pipes, covered with concrete and lined with mortar, have fulfilled every requirement and the success of this type of construction has been entirely demonstrated. An examination in September, 1921, after a service of seven years, of the mortar lining in the interior of the 11¼-ft. Bryn Mawr siphon, which is over a mile long, and of shorter siphons, showed that the lining was in perfect condition and had afforded complete protection for the steel. The methods used in constructing the first siphons were therefore adopted for those now being placed.

The steel-pipe line, as laid, riveted and calked, is itself made watertight. The outside concrete envelope serves two purposes: (1) It holds the steel pipe in its true deformed service shape and (2) it protects the pipe from corrosion. The function of the mortar lining is principally to protect the steel from corrosion, but by smoothing up the interior the carrying capacity is increased about 25 per cent over that which would obtain in an unlined riveted pipe. Reports of experience from many places and examinations of many steel-pipe lines having failed to show that there was to be had any coating which would efficiently protect the steel of the pipe shell, reliance was placed on the protective action of portland cement on steel to secure a steel-pipe type of construction reasonably comparable in durability with the masonry portions of the aqueduct.

The protective action of the mortar lining is in large part due to the alkalinity of the cement with which the lining is made, and it may be said that as long as this alkalinity remains there will be no corrosion of the steel. This has been shown in the old cement-lined sheet-steel and iron pipes which were in vogue many years ago. Failure of these lines never occurred due to corrosion from the inside, but in nearly every case from the outside, where the acid conditions of the soil hastened the neutralization of the alkalinity in the mortar envelope.

The mortar lining itself is not watertight (very few substances are absolutely so) but it is of such density that water passes through it very slowly. Hence the dissolved oxygen carried by the water reaches the steel in very limited quantities, and such corrosive action as there will be when the alkalinity has been neutralized will proceed very slowly, since oxygen is necessary to the completion of the corrosion cycle. Practically all paint and dipped coatings tend to act as osmotic membranes and so, by the establishment of acid-alkali cells, tend not only to hasten corrosion but also to accelerate their own destruction.

At each end of each siphon there is a concrete chamber which forms the connection with the adjacent cut-and-cover or tunnel portion of the aqueduct. In each chamber, sluice-gates for controlling the flow of water into the several pipes were planned to be installed but, from the experience of several years' operation, sluice-gates are being put in only at those points which experience indicates to be desirable for operational purposes. The chambers, with their superstructures, were built under former contracts and the present work is being done between the throat castings previously placed at the chamber outlets.

A comparison of the cost of the present work, which represents the prices of November, 1921, with those of 1910-11, indicates an increase of about 46 per cent. The price for steel pipe includes the laying, testing and making tight. All pipe of ½-in. or thicker plates and,

TABLE I—DIMENSIONS OF CATSKILL AQUEDUCT PIPE SIPHONS

Item	Siphon	Length, Ft.	Thickness of Plate, In., and Kind of Joint	Max. Head, Ft.	Diam. of Pipe Shell Ft. and In.	Cost per Ft. for Pipe Alone
	Contract 209, West of Hudson River: Rice & Ganey, Inc., New York City					
7	Esopus	4,215	$\frac{7}{16}$, lap joints	107	8 4	$25 00
7	Tongore	1,150	$\frac{7}{16}$, lap joints	72	8 4	25 00
8	Tongore	240	$\frac{9}{16}$, long. butt joints		8 4	35 00
9	Washington Square.	6,550	$\frac{7}{16}$, lap joints	90	8 10	27 00
		12,155				
	Contract 210, East of Hudson River to Kensico Reservoir: Frederick Snare Corporation, New York City					
10	Foundry Brook.....	6,980	$\frac{7}{16}$, lap joints	192	8 6	34 00
11	Foundry Brook.....	570	$\frac{1}{2}$, lap joints		8 6	38 20
7	Indian Brook.......	1,210	$\frac{7}{16}$, lap joints	70	7 4	35 00
10	Sprout Brook.......	3,530	$\frac{7}{16}$, lap joints	234	8– 6	34 00
11	Sprout Brook.......	910	$\frac{1}{2}$, lap joints	...	8– 6	38.20
10	Peekskill...........	6,360	$\frac{7}{16}$, lap joints	340	8– 6	34 00
11	Peekskill...........	785	$\frac{1}{2}$, lap joints	...	8– 6	38.20
12	Peekskill...........	4,950	$\frac{1}{2}$, long. butt joints	...	8– 6	38.20
13	Peekskill	1,235	$\frac{9}{16}$, long. butt joints		8 6	41 30
9	Hunters Brook.....	2,975	$\frac{7}{16}$, lap joints	110	8 4	34 00
9	Turkey Mountain...	3,010	$\frac{7}{16}$, lap joints	92	8– 4	34.00
8	Harlem Railroad....	1,380	$\frac{7}{16}$, lap joints	60	7–10	34.00
		33,895				
	Contract 211, Kensico Reservoir to Hill View Reservoir: Thomas Crimmins Contracting Co., New York City					
7	Kensico........ ...	3,240	$\frac{7}{16}$, lap joints	50	11 3	34 00
7	Elmsford...........	2,980	$\frac{7}{16}$, lap joints	68	11–3	34.00
7	Fort Hill...........	2,530	$\frac{7}{16}$, lap joints	72	11–3	34.00
7	Bryn Mawr.... ...	5,090	$\frac{7}{16}$, lap joints	214	11 3	34 00
8	Bryn Mawr.... ...	470	$\frac{1}{2}$, lap joints		11 3	40 00
9	Bryn Mawr.........	4,555	$\frac{1}{2}$, long. butt joints	...	11–3	45.00
10	Bryn Mawr.........	1,085	$\frac{9}{16}$, long. butt joints	...	11–3	48.00
		19,950				

Recapitulation

Contract	Diameter of Shell, Ft. and In.	Lin.Ft.	Estimated Cost	Estimated Cost per Foot Completed Works
209	8–4 to 8–10	12,155	$999,325	$82.21
210	7–4 to 8– 6	33,895	2,978,103	87.86
211	11–3	19,950	2,275,360	114.53

at certain places, pipe of $\frac{9}{16}$-in. plate, have double-riveted circular joints.

Steel for the plates is made by the basic open-hearth process and fulfills the requirements for "flange steel" as given in the Standard Specifications for Boiler and Firebox Steel for Locomotives, serial designation A30-18 of the American Society for Testing Materials, and for rivets as given in the Standard Specifications for Boiler Rivet Steel, A31-14 A.S.T.M. All specimens and records are furnished and analyses and tests made as therein provided. These tests are made or records furnished the Board's inspector at the rolling mill and duplicate check samples as required are tested and analyzed in the laboratory of the Board of Water Supply.

An identifying number is stamped on each plate so that only accepted plates go to the fabricating plant. The plates for Contract 209 are rolled at the 140-in. mill of the Carnegie Steel Co., Homestead, Pa., and fabricated by the American Bridge Co., at Ambridge, Pa. For Contract 210 the plates are rolled at the 110-in. mill of the Bethlehem Steel Co., Sparrows Point, Md., and fabricated by the Merchant Shipbuilding Corporation, Chester, Pa. For Contract 211 the plates are from the 110-in. mill of the Bethlehem Steel Co., Sparrows Point, Md., and fabricated by the New York Engineering Co., Yonkers, N. Y. The total weight of steel under these contracts is 20,000 tons.

On Contract 211 the 11¼-ft. pipe is being fabricated in a plant located near the work, thus enabling delivery to be made by truck. This size is so large as to require special precautions for rail delivery, which under present conditions of traffic congestion would be difficult.

The pipes are made with alternate inside and outside courses, the nominal diameter being measured as the inside diameter of the inside course. Each course is made to lay 7½ ft. and is formed of not more than two plates and usually of one. The edges of all plates are bevel sheared, and plates ½ in. or more thick are bevel planed; all joints are calked both inside and outside. At the junction of the circular and longitudinal joints the plates are reduced to a fine edge, through which two rivets of the circular joint are driven; the material for the butt-straps is cut from across the width of full-sized plates and not in a direction parallel to their length. The work is carefully and accurately laid out and all rivet holes spaced with precision. On Contract 211 all holes are drilled to template, several plates being drilled at a time. On Contracts 209 and 210 all holes are punched in automatic gang punches. In the thicker plates the holes are sub-punched and reamed to final size.

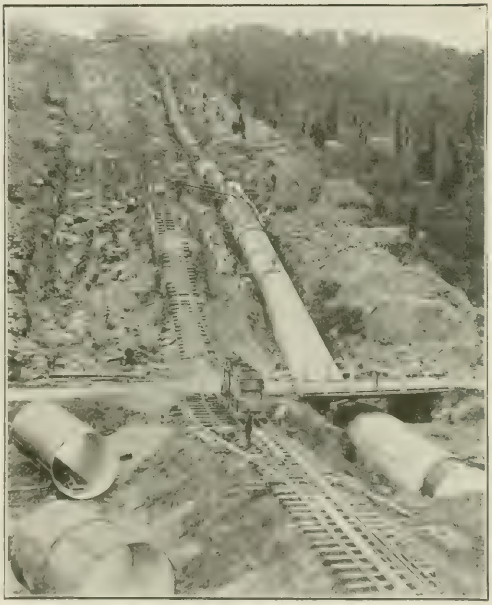
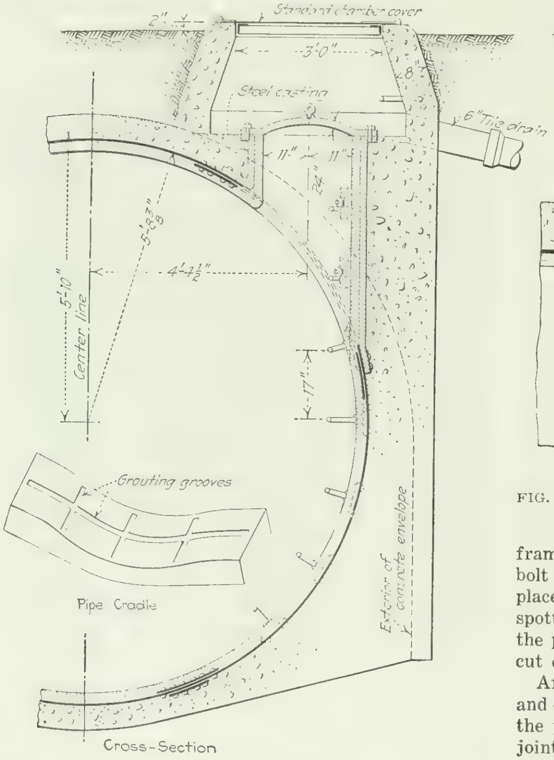


FIG. 2—CONSTRUCTING TWO ADDITIONAL SPROUT BROOK SIPHONS

Concreting east line in progress; excavations for west line under way. Note two- and three-length sections of steel pipe in foreground.

All riveting on the shop seams is done by hydraulic or compressed-air riveters. In the field the riveting is being done with compressed-air hand hammers. All of the steel plates are pickled by dipping into a bath of dilute sulphuric acid. This bath is maintained at a strength of approximately 5 per cent by volume of oil of vitriol, and at a temperature of 125 deg. F. After sufficient time in the pickle to thoroughly remove mill scale, the plates are taken from the bath, washed and immediately dipped into a warm alkaline bath of strength sufficient to neutralize the remaining acid.

For shipment to the field two courses are usually riveted together, forming a section 15 ft. long; on Contract 210 many sections of three courses each have been made. To protect the pipe sections from the effects of weather exposure, the interior surfaces are covered with a heavy coat consisting of 50 gal. of heavy lime whitewash, 20 lb. of glue dissolved in water and 50 lb. of portland cement. The exterior surfaces of the pipes are sprayed with a thin coating of boiled linseed oil. Both of these coatings are of a temporary nature and serve only to reduce the labor of cleaning the surfaces before the concrete and mortar are placed. The whitewash coating is removed by brushing and scraping before the mortar lining is put in, while the linseed-oil film is both rubbed off by the mechanical abrasion during the pouring of the concrete and dissolved by the alkalinity of the concrete.



The first field operation is the removal of top soil, which is stored for surface dressing. The trench is excavated to subgrade and concrete cradles are built at grade 7½ ft. c. to c., one at the center of each pipe course. The cradles are 6-in. minimum thickness of concrete, 2 ft. in length of trench and nearly full trench width (see Table II for dimensions). The surface is formed to a curve, the radius of which is slightly greater than the nominal pipe curvature. A 1x1-in. grout channel is formed in the surface with three cross channels.

TABLE II—DIMENSIONS OF CONCRETE CRADLES

Nominal Diameter of Steel Pipe, Ft. and In.	Chord of Cradle, Ft. and In.	Radius of Steel Pipe, Ft. and In.	Radius of Cradle, Ft. and In.
7–4	5–7	3–8	4–2½
7–10	5–9	3–11	4–4½
8–4	6–0	4–2	4–7½
8–6	6–1	4–3	4–8⅞
8–10	6–5	4–5	5–3
11–3	9–2½	5–7½	7–0

Manhole and blowoff connections are made of cast steel and all blowoff valves and other valves immediately adjacent to the pipe are of solid manganese bronze. Because of the severe buckling and tearing strains which the large thin-shelled pipes undergo when being first filled with water, heavy reinforcing collars and plates are provided. The steel castings are of material conforming to the standard specifications of the A.S.T.M. for Class B, Steel Castings, serial designation A27-16, but the sulphur is held so as not to exceed 0.05 per cent. Contact surfaces of flanges of manhole frames and covers are faced. Bearing surfaces for all bolt heads and nuts are spot faced. The castings are placed in position against the pipe and rivet holes spotted and drilled. After they have been riveted to the pipe, required apertures through the pipe plate are cut out and the joints calked.

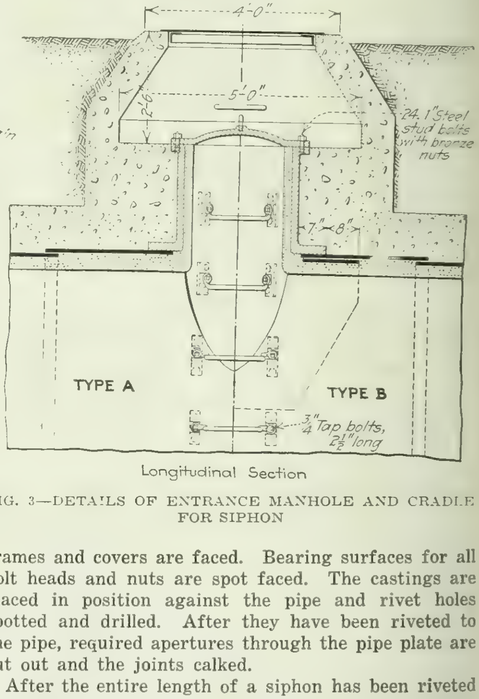


FIG. 3—DETAILS OF ENTRANCE MANHOLE AND CRADLE FOR SIPHON

After the entire length of a siphon has been riveted and calked up to the closure outside the siphon chamber, the pipe is put under full hydrostatic pressure; moist joints calked and leaky rivets marked for replacement. The pipe is then emptied, replacements are made and the pipe is again filled and the full head of water maintained during the placing of the concrete envelope. In a number of cases intermediate bulkheads were used

The concrete envelope has a minimum thickness of 6 in. at the crown, increasing to about 8 or 10 in. on the horizontal diameter, where the outside limit of concrete drops vertically to the subgrade. Concrete is placed in most cases from a traveling concrete plant which is shifted along on the central pipe already in service, and the concrete chuted directly from the mixer into the forms. The plant is served by gasoline locomotives hauling trainloads of six 1-yd. batches of materials. A Koehring paver is used at one location. About 70 lin.ft. of envelope are placed per day and the maximum poured was 140 ft. in 8 hr. The concrete mix is 1 cement: 1.5 sand: 3.8 gravel or broken stone varying to 1:2:4, the proportions being by volume, the mix being varied so as always to secure a cement factor of 1.5 barrels per cubic yard of concrete. A number of strength tests have been made on the concrete and these tests point to the advisability of specifying strengths, as has been done in many contracts for highway work. Upon the completion of the concrete cover, and after it has attained sufficient strength to resist the stresses incident to the unwatering, the structure is ready for the mortar lining. The function of the concrete covering is twofold: (1) It serves to prevent corrosion; (2), and most important, it holds the steel shell very nearly to the shape which it will have when in service. The outer concrete, therefore, makes possible the use of the thin interior mortar lining which of itself could not resist the stresses due to the distortions resulting from the change in conditions from a pipe empty to one full and under pressure.

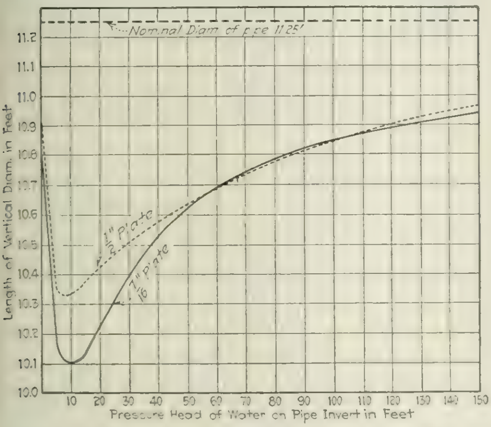


FIG. 4—CHANGES IN VERTICAL DIAMETER OF UNPROTECTED 11¼-FT. STEEL PIPE

The mortar lining is 2 in. thick measured from the inside of the inner course of pipe. It also extends into the manhole castings and the blowoff elbows. The lining consists of portland cement and sand mixed in ordered proportions, 1 part cement to from 1 to 2 parts sand if the mortar is poured into forms. The mix now in use is 1 cement to 1½ sand by volume. The water content is regulated so as to secure a mixture which will flow readily but yet which will have a minimum water content.

The lining is placed by pouring the grout mortar into the space between the pipe shell and an interior form through 2½-in. holes provided in the steel shells at the uphill end of each outside course. These grout-hole openings are closed so as to be watertight after the lining has been completed by threaded cast-steel plugs. These holes are reinforced by plates riveted on and calked, except for holes 2 in. or less in diameter in 7/16-in. plate.

During the progress of the work a number of measurements and observations have been made, the results of which are of general interest. Changes in length due to temperature variations were observed as shown by Table III.

TABLE III—TEMPERATURE CHANGE IN LENGTH

Pipe Diameter, Ft. and In.	Length, Ft.	Temperature Change, Deg. F.*	Expansion, In. Observed	Expansion, In. Theoretical
8–10	3,078	15	3	3½
8–10	3,078	20	4–5	4
8–10	3,078	25	6–7	6
8–10	3,078	30	7	7¼
8–6	807	19	1¾	1¼
8–6	807	30	2½	2
8–6	1,292	15	1¼	1[illegible]
8.6	1,292	24	2⅝	2¾
8–6	1,292	33	3⅜	3[illegible]

* Mean of atmospheric temperatures inside and outside the pipe. † The theoretical expansion was computed with a coefficient of 0 0000072.

These steel pipes, due to their changes in length with temperature, always tend to creep in the direction of least resistance. In one case there was a movement of 15 in., and in another case a length of 540 ft., laid on a slope of 19 deg., moved downhill 8 in. and was held in position only by the adoption of special measures. Nearly all movement of this nature may be avoided by laying upward both ways from the valley bottom.

As the pipes are laid in the trench they flatten down, due to their own weight. Then as they are gradually filled with water the flattening increases until they are just about full. Above this point, as the pressure increases the flattening decreases, but the pipe never assumes a truly round form. The accompanying diagram shows the average results of a number of observations on the natural deformations of the 11¼-ft. diameter pipe with plate thicknesses of 7/16 and ½ inch.

The work in the field is being supervised for the Board of Water Supply by Charles M. Clark, department engineer; Howard P. Barnes and Cornelius J. O'Connor are the division engineers. The designs are prepared in Headquarters Department, of which Walter E. Spear is department engineer. Fred F. Moore is designing engineer and L. Bernard Stebbins is assistant to the chief engineer.

Sprinkler Heads in Automatic Fire Protection Systems Need Care

By C. C. Brown

California & Hawaiian Sugar Co., Crockett, Calif.

A RECENT test of 5,000 sprinkler heads of various ages and makes in the fire-protection system of a large Western industrial plant showed an interesting variety of conditions. Some heads had remained effective and ready for service for twenty-five years, but many not so old had deteriorated so as to be inoperative or had developed leaks. After a series of tests on heads taken out of service it was decided that heads in locations exposed to salt air or to deposits from manufacturing processes should be dipped in a suitable protective solution before installation and should thereafter be inspected every few months.

Some of the heads had suffered mechanical injury that bent or jammed the parts and in others solder holding the release bars had come loose, but most defects were due to leaks and the resultant formation of corrosive deposits. Cleaning these corroded heads only increased the leakage. Leaky heads were therefore all replaced.

Where corrosion was found to be due to external causes the heads were cleaned and before replacement were dipped in a protective solution made of 2 parts boiled linseed oil, 3 parts resin and 7 parts paraffine, all ingredients being measured by weight. This solution was melted together at a temperature of about 190 deg. F. and clean new heads were dipped into it quickly. The covering dries quickly and affords a corrosion-proof coating effective for many months.

Water Filtration Plant for Omaha Metropolitan District

High Consumption Overtaxes Settling Basins—Filter Building on Separate Footing—Stools in Underdrains Save Gravel

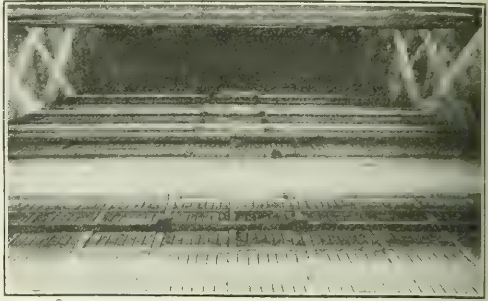
By F. P. Larmon
Chief Engineer, Metropolitan Utilities District, Omaha, Neb.

NOVEL concrete stools in the underdrain system of the new Omaha (Neb.) water filtration plant make every 2 sq.ft. a miniature isolated system fed by four ½-in. openings. Non-occurrence of gravel in the vicinity of Omaha and high freight rates to bring it in were another factor leading to the use of the stools. Other points in this latest of filter plants on which construction is being rushed include an extra wide pipe gallery for easy access to the piping and the construction of the filter house separate from the filters.

The present water plant was built in 1881 and up to this time the water, which is taken from the Missouri River, has been treated by sedimentation through a series of seven basins. The latest basin, which was built two years ago, was designed at that time for use as a clear-water basin for the new filter plant. In 1922 the pumpage reached 35 m.g.d. and the river water had such a high turbidity that it was impossible to furnish satisfactory water by plain sedimentation. On Sept. 6, 1922, the board of directors of the Metropolitan Utilities District authorized the construction of a filter plant having an initial capacity of 50 m.g.d. and so designed that it can be extended later to 100-m.g.d. capacity. Work on the plans began immediately, and nine days after authorization construction was started. By January the main building had been inclosed, the head house carried up to the tank floor and work was well under way for the interior conduits and filter beds.

GENERAL VIEW OF PLANT

After careful investigation it was decided to follow closely the lines of the Chain-of-Rocks filter plant at St. Louis and put in twelve filter beds of 1,400 sq.ft. effective area. These beds are rated at 4 m.g.d. each, although it is expected that, on account of the large settling basins, this rate may be increased 25 per cent. The ultimate plan calls for the head house in the center, with twelve beds extending to the south and twelve beds of the future addition extending to the north. The head house and conduits are designed for the ultimate 100-m.g.d. requirements. The building is designed with a concrete frame, columns and roof. The side walls are to be of light gray brick with steel sash and wire-glass windows. The present structure is 130 x 242 ft. in plan.



CONCRETE BLOCKS AND STOOLS FOR FILTER UNDERDRAINS SYSTEM

Slots in top of stools distribute wash water evenly to underside of the 8-in. gravel layer supporting the sand bed.

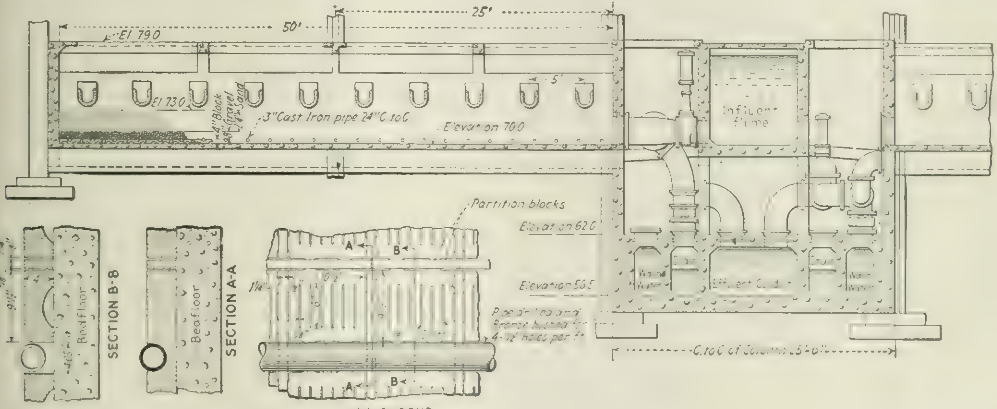
On account of the necessity of early completion of this plant, it was decided to construct the building and the filter apparatus entirely separate, putting up the building first and carrying the supporting columns on separate foundations, later installing the beds between the columns. The wisdom of this arrangement was proved by the fact that it was necessary on account of soil conditions to put in the column foundations at different depths. Erection of the building first meant the saving of three months' time and will put part of the plant in operation in the early summer.

The present sedimentation basins extend in a row from north to south and a conduit will be constructed to the west of these basins, so arranged that the water for the filter plant can be taken from any one of the first six basins. This arrangement will give the plant great flexibility and permit the shutting down of any one basin for cleaning or for repairs without interference with the operation of the others or of the filter plant.

The Pipe Gallery—This extends through the center of the building and is 23 ft. wide in the clear. The conduits are of concrete. On the lower level is the effluent conduit with drains for carrying off the wash water located on each side, and the conduits for delivering the wash water to the bed on the outside. The top of these conduits forms a floor the whole width between the beds, the only obstruction being the control piping, which is arranged with a view of making it compact and also easy of access. Seven feet above the effluent conduit is the bottom of the influent flume, the top of which will furnish the floor of the main corridor. From the influent flume a 24-in. line leads to each bed and is controlled by a hydraulically-operated valve. The waste-water piping is taken from the side of the influent line and leads diagonally down to the drain. Filtered water is taken from the two halves of each bed by a 20-in. pipe, joined in the center to a 24-in. pipe which leads through a rate controller and then down into the top of the effluent conduit. The wash-water connection is situated directly under the junction of the two 20-in. lines. A 6-in. re-wash connection is also provided.

The Filter Beds—These are 50 ft. long and 33 ft. wide, divided through the center by an open conduit for the distribution of the inflowing water and for the collection of the wash water. The collecting troughs will be of concrete and of horse-shoe section with a rounded top edge.

Under the center of each half of the bed is a closed concrete conduit for collecting the filtered water. In the top of this conduit, 2 ft. c. to c., are special cast-iron tees from each side of which lead 3-in. pipes forming the collection system. These collecting pipes are drilled four holes to the foot and fitted with ½-in. brass bushings. Between the pipes will be laid a concrete filter bottom recently brought out by the International Filter Co., consisting of concrete stools and partition blocks so arranged that each 2 sq.ft. of filter bed will be fed by four ½-in. holes, the water passing through the holes in the distributing pipes and under the concrete stools, then up through the slotted top. The partition blocks are so arranged that the water must pass up through or alongside of each concrete stool but cannot flow into the adjacent compartments. It is believed that this type of filter bottom will give satisfactory results and practically eliminate the formation of mud balls. On top of these concrete stools will be spread 8 in. of gravel graded from 1-in. down. Over the gravel will be spread 24 in. of sand. Experiments have shown that washed sand from the Platte River can be used without any preparation and after two or three washings and a light scraping will give a well graded and satisfactory filtering medium. On account of the lack of any gravel in this vicinity the cost due to freight is high. The thin gravel layer permitted and the wide spacing obtainable by the use of these stools will make this bottom much cheaper than the usual bottom obtained by placing the piping on 6-in. centers and using 12 to 18 in. of gravel.



SECTION OF PIPE GALLERY AND ONE FILTER

Wash-Water Tanks—On the second floor of the head house will be placed the concrete wash-water tanks, with ample capacity to wash three beds without refilling. A large high-pressure supply main passes near the filter house so that it is possible to use a centrifugal pump driven by a water turbine for filling the wash-water tanks from the effluent conduit.

Operating Tables—The material will be gray Tennessee marble, with a green marble base, a departure from the usual custom being to make the front a solid marble panel and to place the manifolds and four-way valves below the main floor instead of within the tables. This will eliminate the possibility of any leakage from these valves or manifolds onto the main corridor and also put them in a place easy of access for repairs or adjustment.

Heat and light will be taken from the main pumping station, which is located 500 ft. north of the filter plant.

By the middle of May the main building had been erected, the head house and wash-water tanks completed and three of the filters put into service. By June 1 three more will be ready. All work on the plans and construction has been done by the department of engineering and construction of the Omaha Metropolitan Utilities District under the general direction of the writer.

European Railway International Relations

With the purpose of improving the confused conditions of international railway traffic in Europe due to the hard feelings and many frontier changes following the World War, an International Railway Commission was organized at Paris in October, at a conference of representatives of about twenty-six countries. The meetings were held at the house of the French Society of Civil Engineers and were presided over by Mr. Mange, general maanger of the Paris & Orleans Ry. Mr. Mange was later elected president of the permanent organization, with Mr. Leverve as general secretary. The official name is the International Railway Union, with offices at Paris. Membership is limited to railways having not less than 628 miles of standard-gage track in Europe or connected with European lines. It is expected that Japan and China may be admitted when the Trans-Siberian Railway is reopened. Smaller lines and narrow-gage lines may be admitted if of sufficient importance in regard to international traffic. The number of votes of delegates varies with the mileage which they represent. Certain transport undertakings, railways or otherwise, not eligible for membership but having international traffic relations with member railways, may become "adherent administrations." Meetings are to be held every five years. A board of management to administer the affairs of the organization will be composed of twelve member railways, who will appoint a chairman and three vice-chairmen to handle ordinary business matters. Decisions may be made when seven members of the board are present. Five committees have been appointed to deal with special subjects as follows: (1) Passenger traffic; (2) freight traffic; (3) reciprocal accounts and exchange; (4) interchange of rolling stock; (5) technical affairs.

Right Method of Paying for Water for Fire Protection

Municipal as Well as Private Works Should Get Cost of Service from Taxpayers—Hartford Figures Illustrate Some Points

By Caleb Mills Saville
Manager and Chief Engineer, Water-Works, Hartford, Conn.

In considering the value of the fire-protection service furnished a municipality by its own water department the question is often raised as to whether there should be any payment. Arguments, more or less specious, are made to the effect that the cost of this service should be included in the water rates or disguised in any way that will prevent its appearance as an item in the budget on which the tax levy is to be based. The consensus of public utility rulings considers a municipal water department as a separate entity, distinct from other functions of government and required to finance its own operations. Accepting this construction it readily follows that it is essential that a water-works system, whether owned by the municipality or privately, receive adequate return for value furnished. It is then important to determine the facts on which to base a method for proper and reasonable return for the service furnished.

Among the ways for meeting payment for fire protection service are: (1) A unit charge per hydrant in service. This is perhaps the most common method, although it has little or no rational basis in fact, because the number of hydrants is no measure of the amount of money invested in the water-works for fire-protection purposes. (2) A unit charge per capita of population is sometimes made. This also is illogical, because there is no direct connection linking population, property value, and water department expenditure for fire protection. (3) The method most approved by public utility commissions in rate making decisions is a composite charge consisting of a unit charge per hydrant for maintenance and depreciation, plus another unit charge for pipe capacity and other costs of excess service per linear foot of pipe in service.

The total amount which a city should pay to its water department for fire-protection service may be obtained as follows: (1) Ascertain the proportion which the extra cost of the water-supply system, due to its fire-protection service, bears to the total cost of the works. (2) Determine the annual amount necessary to operate the works, including interest and sinking fund payments, and of this total allocate that portion to fire protection which the extra cost due to fire-protection features is to the total cost of running the works. To find these proportions accurately for any individual water system requires much expenditure of time and money.

Fortunately there are on record many rate cases where these determinations have been made and ratios can be established for the average case which are sufficiently accurate for general use or for a preliminary estimate. These studies show that the smaller the town the larger the proportional charge for fire protection. For example, for a town of 10,000 inhabitants, 60 per cent of the total cost of the works is found to be for fire protection, while for a city of 300,000 only about 13 per cent of the total cost is thus allocated. In the case of the Hackensack Water Co., before the New Jersey Public Utility Commission in 1917, the proportion of the gross charges for water service chargeable to fire protection was found to be 12.5 per cent. In the case of the Queens County Water Co., New York, before the commissioner of Water Supply, Gas and Electricity (1915), the total value of the works was found to be $2,000,000, of which 23.2 per cent was attributed to fire protection. It was also found that 15 per cent of the operating expenses were incurred on this account.

The only bearing that the number of hydrants has in the making up of the fire-protection cost is in the annual charge for maintenance and depreciation of these appurtenances. The method of placing a per capita charge for fire-protection service of the water department, while less in evidence than the hydrant charge, is also illogical and probably an accompaniment of the nearly obsolete fixture charge for water supply. It appears just as reasonable to charge a per capita rate for household service regardless of the amount used as to charge for fire protection regardless of property defended.

Generally speaking Hartford is much better served with hydrants than many larger cities. This condition, however, is reflected, among others, in the lower rates for insurance enjoyed in Hartford, which is one of the very few cities placed in "Class A" by the National Board of Fire Underwriters.

In Hartford, during the working season of 1922, the cost of hydrant installation and replacement, including 20 per cent overhead charges, was:

21 new hydrants installed on new mains at an average cost of $165 each, range, $117 to $208.
15 new hydrants installed on old mains at an average cost of $250 each; range, $158 to $273.
29 hydrants replaced with new ones because of obsolescence at an average cost of $2[illegible] each; range, $104 to $258.
The 36 new installations averaged about $200 each.

The effect of the increased cost of labor and materials on hydrant installation cost in Hartford, using 1910 as a base, is shown by the accompanying diagram.

TABLE I.—TENTATIVE DISTRIBUTION OF HYDRANT WORK COSTS BETWEEN CITY DEPARTMENTS

	Total Cost per Year	Street Department			Fire Department			Water Department		
		Portion of Total	Amount	Per Hydrant	Portion of Total	Amount	Per Hydrant	Portion of Total	Amount	Per Hydrant
Inspection regular	$2.200	⅗	$1,320	$0.75	⅕	$440	$0.25	⅕	$ 440	$0.25
Inspection special	3,700	none	none	none	all	3,700	2.15	none	none	none
Repairs	2,100	⅗	1,260	0.75	⅕	420	0.25	⅕	420	0.25
Depreciation and obsolescence	8,000	⅛ *	1,000	0.60	⅞	7,000	4.10	none	none	none
	$16,000		$3,580	$2.10		$11,560	$6.75		$860	$0.50

*⅛ Depreciation ⅛, on basis of 400 hydrants used by Street Department and their life shortened to 25 years as compared with 40 years life for remainder.

Total of 31 hydrants were replaced because of depreciation or obsolescence during 1921. The average for the last five years has been 33 per year, with 1712 hydrants in service as of Jan. 1, 1923.

Total number of hydrants repaired from March 1, 1921, to Jan. 1, 1922, and their use so far as it has been possible to distribute it
Total hydrant repair jobs 257
Of the hydrants repaired
34 were used during the year by Fire Dept.
75 were used during the year by Street Dept.
20 were used during the year by both Fire and Street Depts.
66 were used during the year by Water Dept. for commercial purposes..
62 for which there is no record of use.

257 total hydrants repaired.

While the total cost of hydrant maintenance is available from department records, it is impracticable to make a close division of this cost among the principal city departments using them without knowing how much of this cost is due to surreptitious use by unauthorized persons. The accompanying table gives a tentative allocation of the total maintenance cost which, while derived from observation and inquiry, is thought to be sufficiently close to actual facts to warrant its use as a basis for hydrant charge.

TABLE II—RELATION BETWEEN WATER RENTS AND PROPERTY VALUES AT HARTFORD

Classification	Amount Paid for Water per Year	Assessed Valuation of Property	Amount Paid for Water per Year per $1 000 Valuation
I —Laundries			
1	$1,376 94	$63,400	$21 70
2	1,183 44	9,300	127.00
3	702 72	34,700	20.20
4	1,462.44	29,400	49.70
5	1,529.46	29,700	51.40
Totals and average	$6,255.00	$166,500	$37.55
II—Apartment houses			
1..	$243.00	$117,100	$2.08
2...	254.76	124,000	2.05
3...	1,206.48	419,800	2.87
4...	177.96	104,500	1.71
5...	267.36	126,800	2.10
6..	288 48	127,500	2.35
Totals and average	$2,438.04	$1,019,700	$2.39
III—Manufacturing plants			
1	$5,264.22	$2,442,700	$2.16
2	1,665.66	1,098,500	1.15
3	2,191.20	2,122,900	1.03
4	981.72	298,500	3.29
5	1,414.68	853,500	1.66
Totals and average	$11,517.48	$6,816,100	$1.69
IV—Department stores			
1	$1,774.80	$2,038,100	$0.87
2...........	2,101.20	2,341,000	0.90
Totals and average	$3,876.00	$4,379,100	$0.89
V—Office buildings			
1...........	$533 16	$1,200,000	$0.45
2	422 71	941,000	0 45
3	1,539.19	2,587,500	0.59
4...........	57.36	348,000	0.16
5	1,182 00	1,331,400	0 89
6	1,218.69	3,106,000	0.39
Totals and average	$4,953 11	$9,513 900	$0 52
Grand totals and average	$29,039.63	$21,895,300	$1.33

How the excess investment for fire protection shall be paid for is the question that has bothered many public service commissions. Stripped of the varying camouflage that has been built up from time to time for ulterior purposes the matter may be resolved into at least two distinct issues as to payment for this service: (1) Shall consumers bear the burden by means of increased water rates? (2) Shall property be assessed in proportion to value received?

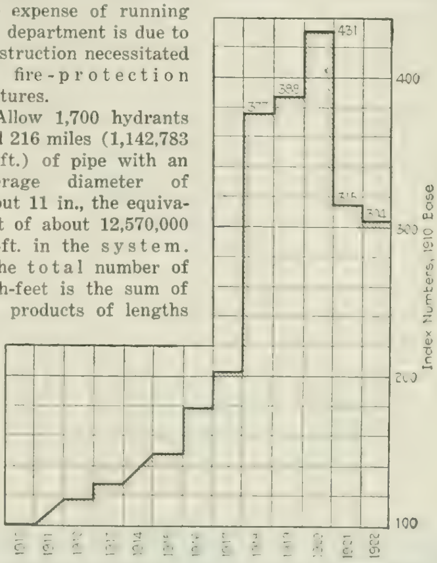
The most equitable method for defraying the cost of fire-protection benefit is its inclusion in the general tax laid against property. While the actual rate increase would be small if the cost of fire protection were placed on consumers, because of being so widely distributed, yet its imposition has by public utility commissions been held unfair, inequitable and discriminatory. The fallacy and inequality of putting the cost of fire protection on private consumers is evident when it is considered that oftentimes high-value buildings use so little water that their contribution to the cost of fire protection, based on rate payments, would be negligible compared with the amounts paid by low-value buildings using large quantities of water. This is shown by Table II, based on Hartford Water Department records.

To study the effect of the two methods of fire protection, assume a city with the following conditions:

Grand list (taxable property) $300,000,000, with a tax rate of 20 mills to provide for a budget for all municipal purposes except the water department, which must finance itself from its income from water sold.

Assume also that the income necessary properly to care for operating expenses, maintenance, depreciation, interest and sinking fund is $720,000; and that a careful analysis of conditions shows that 12.5 per cent of the expense of running the department is due to construction necessitated by fire-protection features.

Allow 1,700 hydrants and 216 miles (1,142,783 lin.ft.) of pipe with an average diameter of about 11 in., the equivalent of about 12,570,000 in.-ft. in the system. (The total number of inch-feet is the sum of the products of lengths of the different sizes of pipe by their respective diameters in inches.



INDEX NUMBERS FOR COST OF HYDRANT INSTALLATIONS AT HARTFORD, CONN., 1910-22

Income to be derived for fire protective service $90,000. If this amount is to be obtained from water rates it means an increase of 12.5 per cent in water rates. If applied to the subtotals in Table II, the increase is similar, ranging from 0.7c. to 53.7c. per $100 valuation, depending on the character of the premises served. If the amount is to be obtained from the tax levy, it means an increase of 1.5 per cent or about three-tenths of one mill ($0.0003) and places a uniform rate on all property of 3c. per $100 property.

This cost of fire-protection service furnished by the water department through installations made solely for that purpose may properly be compared with the cost of ordinary fire insurance, which for the class of property listed in Table II would cost from 10c. to 15c. per $100 value insured.

An approved method of charging for the service is: [illegible]

[illegible]

[illegible]

[illegible]

A summary of the most logical method for dealing with the allocation of the cost of fire-protection service provided by the water system is well set forth in the following excerpts from decisions of public utility commissions:

The cost of standing ready at all times to furnish public fire protection should be borne entirely by the city and paid for from the general tax levy, while the cost of supplying potable water for general consumption should be borne by the individual consumers.—*Re* Kenosha Wis. Pub. Utility Rept., 1918, D, p. 751.

The fire costs are largely fixed. These costs should be met by charges based on the proportion of plant and system required for fire protection exclusive of hydrants, and an additional charge (for maintenance, depreciation and replacement—C.M.S.) for each hydrant. The first element of this charge is proportional to the inch-feet of main in the piping system.—*Re* Hackensack Water Co., N. J. Pub. Utility Comm. April 28, 1917, p. 35.

Aeration Experiments for Removal of Carbonic Acid

Various Types of Apparatus Tested on Memphis Artesian Water Supply—Multiple-Tray Coke Scrubber Adopted

By Wellington Donaldson
Of Fuller & McClintock, Engineers, New York City

AN INVESTIGATION of the water supply at Memphis, Tenn., by Fuller & McClintock in the winter of 1921-22 resulted (as reported in *Engineering News-Record*, Oct. 5, 1922, p. 566) in a recommendation to continue the use of ground water but to install purification facilties for removing the dissolved iron and free carbonic acid (carbon dioxide) present in the water in objectionable amounts. Recommendations for complete new works included the use of air-lift for pumping the wells. One of several factors favoring the air-lift is the fact that the ground water contains about 110 p.p.m. of free carbonic acid (expressed as CO_2) of which amount the air-lift removes incidentally 75 to 80 per cent, as determined at numerous installations in the city. The remaining 25 to 30 p.p.m., though not uncommon in public supplies, was regarded as undesirable in view of the low hardness of 40-60 p.p.m. of the well water and its marked "aggressiveness" which has made necessary the adoption of all-lead or brass plumbing in the city. To eliminate the corrosive effects of the water, it was considered important to further reduce the carbonic acid to a residual of 10 p.p.m. or less by some form of aeration, followed by a small dose of lime if complete removal should be found desirable.

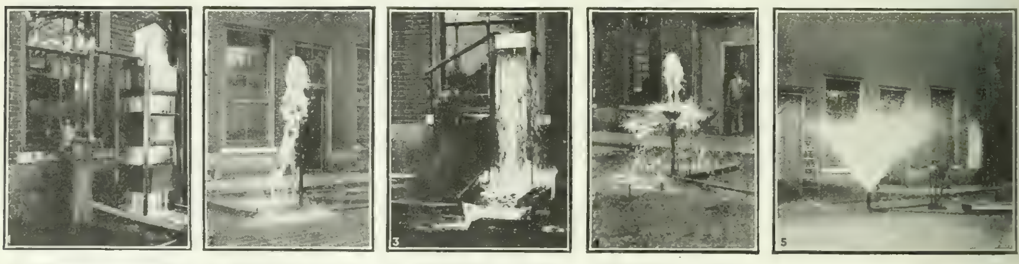
A comparison of aerating devices used in connection with typical ground-water or iron-removal plants indicates wide diversity in design and quite variable efficiency as regards removal of carbonic acid. In some installations, as for instance at Lowell, Mass., the degree of oxygen saturation rather than the amount of carbonic acid is the controlling factor. In most installations, however, it is evident that the maximum removal of carbonic acid was desired. The meagerness of reliable data on the efficiency of aerating devices for decarbonation is probably due to the readiness of the dissolved gas to escape from drawn samples, making undependable any determination not made on the ground with special precautions against loss in sampling and analysis.

The reported performances in decarbonation by some typical ground-water installations are given in the accompanying table.

TABLE I—REMOVAL OF FREE CARBONIC ACID BY AERATION

Locality	Type of Aerator	CO_2 in P P M Raw	 Aerated
Middleboro, Mass.	Spray over 10 ft. coke bed	41	4
Superior, Wis.	Stack of 4 perforated trays	12	4
Shelby, Ohio	Stack of 3 coke trays	48	16
Xenia, Ohio	Stack of 3 coke trays	30	10
Far Rockaway, N. Y.	Single large riser pipe	30	12
Rockaway Park, N. Y.	11 wooden steps	55	31
Long Beach, N. Y.	Spray nozzles	38	11
Lowell, Mass.	2 in. riser pipes and 10-ft. coke bed	23	13
Virginia Beach, Va.	Spray nozzles	125	20
Excelsior Sps., Mo.	Multiple spilling pans	73	30

With a view of determining for the Memphis conditions what type of aerator would give the desired reduction in CO_2 with minimum head loss and floor space, outdoor experiments were conducted, at the Central Ave. pumping station, which is equipped with air-lift and furnishes normally one-fourth of the supply of about 13 m.g.d. This water contains from 25 to 32 p.p.m. CO_2 as against an average of 110 p.p.m. in the main Auction Ave. station supply.



FIGS. 1 TO 5—AERATION DEVICES FOR DECARBONATION EXPERIMENTS AT MEMPHIS, TENN.
1. Triple-tray coke scrubber with 2-in. meter on supply pipe. 2. Metal pan with perforated bottom. 3. Simple 2-in. pipe discharging 106 gal. per min. 4. Riser pipe, splash table, discharging 64 g.p.m. 5. Spraco nozzle, discharging 72 g.p.m.

In all of the experiments herein described the rate of applied water, or "loading," was measured by taking meter readings at intervals of exactly 5, 10 or 15 minutes. A ⅝-in. Lambert meter used in the first experiments was replaced by a ¾-in. Trident and later by a 2-in. Crest as the flows increased. The CO_2 determinations were made in the usual manner by titration with N/22 sodium carbonate and phenolphthalein indicator. Titrations were made on the spot in intervals between meter readings.

Exp. 1: Multiple Coke Trays—The experience of certain deferrization plants in Germany and this country with beds or towers of crushed stone and coke suggested the possibility of good CO_2 removal with relatively high loadings of applied water, when using the device unsubmerged. The character of material used for such "scrubbers," whether stone or coke, was not considered

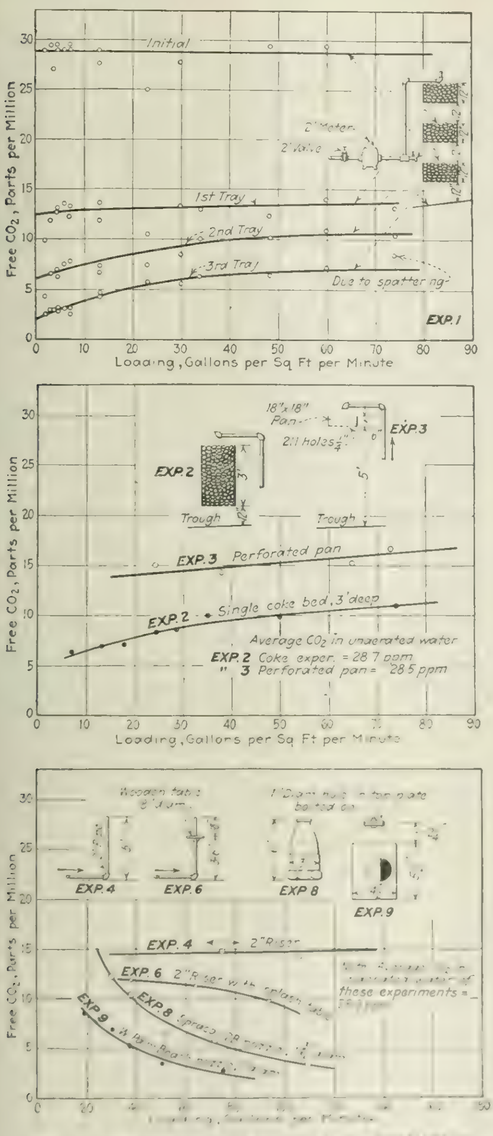


FIG. 6—EXPERIMENTS IN WATER DE-AERATION

essential provided the material was inert to the water. Limestone, dolomite, marble, etc., were barred on account of their solubility in the presence of free CO_2, which would result in an undesirable increase in temporary hardness of the aerated water. Coke, on account of its inert properties, light weight and availability, was selected for the Memphis experiments. At the outset it was thought that an arrangement allowing free access of air and free egress for the liberated gases would be more efficient than a single tower open only at top and bottom. Accordingly the apparatus pictured in Fig. 1 was set up, after the manner of the Shelby, Ohio, design, described by Burgess (*Jour. Am. W. W. Assoc.*, 1921, p. 193). It consisted of three superimposed trays, each 20x20 in. in plan by 12 in. deep. The trays were supported 12 in. apart, the bottom tray being 12 in. above the floor, which was a shallow wooden trough covered with composition roofing to collect the water. The bottom of each tray was covered with ½-in. mesh wire or hardware cloth to support the crushed material, which consisted of clean cupola or coke-oven coke, broken to sizes between 1½ in. and 3 in. The metered water supply was delivered at the top of the trays through an upturned elbow, short nipple and increaser, giving a slight spouting effect. For the higher flows it was necessary to place a pan over the discharge to eliminate spouting and the aerating effect of the jet itself. The experimental results are shown in graphical form by the curve entitled Exp. 1, where each plotted point represents the average of not less than two consistent observations.

It is evident that the first tray has done better than 50 per cent of the work, but each additional tray has served to materially bring down the CO_2 content. The flatness of the curves with increased loadings is noteworthy.

Exp. 2: Single Coke Bed—To determine the comparative merits of multiple coke trays and of a single deep coke bed the trays used in Exp. 1 were stacked one above the other without disturbing the contents, thus making a coke bed 3 ft. deep, open top and bottom. The results shown by the curve, Exp. 2, indicate that the 3-ft. solid bed had an efficiency equal only to the first two trays of Exp. 1.

Exp. 3: Perforated Pan—This apparatus, pictured in Fig. 2, consisted of a square galvanized-iron pan 18x18 in. in plan by 6 in. deep with 211 holes ¼ in. in diameter punched in the bottom, the pan being supported 5 ft. above the trough or floor. Results shown as by the curve, Exp. 3, indicate an efficiency of about 45 per cent for this device, with little variation with different loadings.

Exp. 4: Simple Riser Pipe—This experiment employed a vertical 2-in. riser pipe with the top 5 ft. above the floor, as pictured in Fig. 3. The results plotted as Exp. 4 are quite similar to those of Exp. 3 using the perforated tray.

Exp. 5: Inspirator Effect—The same arrangement was used as in Exp. 4 except that the outer shell of a conical nozzle was clamped in position over the top of the riser pipe, causing air to be drawn in and mixed with the jet, on the principle of the ejector pump. In operation the entrained air could be easily observed as pistons traveling with the jet, causing a decided scattering at the crest. This set-up showed an increased efficiency of about 12 per cent over the plain riser with the same amount of water flowing. Doubtless a well designed nozzle, instead of an improvisation, using the inspirator principle could be made quite effective.

Exp. 6: Riser With Splash-Table—This set-up was the same as Exp. 4 except that an 18-in. circular wooden platform was affixed to the riser pipe at a distance of 18 in. below the top, thus providing an intermediate step for the water in its fall as pictured in Fig. 4. From the curve marked Exp. 6 it is evident that the use of a platform or splash-board increases materially the efficiency of the riser pipe. Following the same reasoning it is to be expected that additional steps or platforms would result in still better efficiency, although experiments were not continued to determine further effects.

Exp. 7: Riffle Board—The exposure of water by allowing it to run over an inclined surface in a thin film should allow ready aeration and escape of CO_2. A large aerator of this type was built over one of the settling basins some years ago at Suffolk, Va., for the purpose of reducing CO_2 in a lake supply, but was found not to have a very high efficiency. An elaboration of the "riffle board" idea is found in the plants at Newport, R. I., Chester, Pa., Norristown, Pa., New Brunswick, N. J., and several other places which utilize a sloped surface studded with cast-iron deflectors. All of these supplies handle surface water however.

At Memphis there happened to be handy at the Central Ave. station an inclined concrete walkway or approach 10 ft. wide by 28 ft. long with a drop of about 2 ft. in the length. The well water was applied as evenly as possible to the top of the incline and allowed to flow down the concrete surface which was grooved transversely. The results were as follows: Initial CO_2, 28 p.p.m.; aerated CO_2, 15 p.p.m.; efficiency, 46 per cent.

Exp. 8: Spray Nozzle—A "Spraco" No. 12-B nozzle was arranged to deliver vertically as pictured in Fig. 5. Results are shown as curve Exp. 8. Nozzles of this general type, employing internal deflecting vanes, are used in a number of water-works, but chiefly for odor and taste removal, as on the Catskill water supply, New York City, and at Lynchburg, Va. At Virginia Beach, Va., they are used on ground water for aeration and decarbonation.

Exp. 9: West Palm Beach Nozzle—The nozzle used in Exp. 9 differs from the Spraco nozzle in not having internal deflecting vanes. The spray effect is produced by the water entering the nozzle in a tangential direction at the periphery of the cylindrical shell. Nozzles of this type are in use at the iron-removal plants at West Palm Beach, Fla., and Long Beach, N. Y. Results are shown by the curve, Exp. 9. In comparing these results with those of Exp. 8, account must be taken of the difference in diameters of nozzle openings.

Exp. 10—At the conclusion of the Central Ave. experiments with the air-lift water the triple coke tray apparatus used in Exp. 1 was set up at the Auction Ave. station, without disturbing the contents. In doing this it was desired to note the performance of the coke scrubber when handling water of high carbonic acid content.

Accomplishments of the three-tray scrubber on water of 101 p.p.m. CO_2 content, when handling 50 gal. per square foot per minute, were found about the same as that of typical air-lifts. In other words, it would take an additional three trays to reduce the CO_2 to the figure obtained by the Central Ave. experiments, using the same apparatus.

Conclusions—The writer's conclusions from the foregoing experiments are summarized as follows:

1. The spray nozzle was found most effective of several devices used for removing CO_2 from water by aeration. Objections to the spray nozzle are (a) the area and head required; (b) the opportunities of contamination of open spray ponds of considerable area by dust and soot; (c) probable nuisance to adjoining property from wind carriage of spray, even where substantial louvres are provided.

2. From the standpoint of heavy loading, with minimum floor space and head utilized, the multiple coke scrubber is believed to have merits over the other devices tested. The efficiency in carbonic acid removal is not equal to the spray nozzle, but is sufficient for practical purposes in dealing with moderate content. The superior efficiency of the coke scrubbers compared with other splashing devices, such as perforated pans or riser pipes, utilizing the same head, is apparently due to air being drawn with the water through the coke and thus assisting materially in sweeping out the CO_2 gas.

3. Even distribution of water over a coke scrubber is very important. Short circuiting along the inside walls of the trays, or by outside spattering, interferes materially with efficiency and should be carefully provided against.

4. The coke scrubber may be used on waters of high carbonic acid content by adding other trays to the stack and increasing the head requirements accordingly, but if the total head requirement exceeds 12 to 15 ft. the spray nozzle may be the better solution.

5. With a CO_2 content of 100 p.p.m. or over it is doubtful if any scrubbing or splashing device can compete successfully with a good type of spray nozzle, on the basis of equal head utilized, though other considerations mentioned may govern.

Design Adopted for Memphis—The aerating equipment for the new 18-m.g.d. purification works now actively under construction at Memphis will be of the multiple-tray coke scrubber type. There will be 40 units about 2 x 7 ft. in plan, made up of four superimposed trays of coke 10 in. deep, spaced 9 in. vertically. The arrangement of units and trays will allow free circulation of air. Uniform distribution of water to the top tray will be by a trough having a perforated bottom. A loading of 30 gal. per square foot per minute was used in the design.

Road Crossing Accidents on Pennsylvania R.R.

That 97 per cent of automobile drivers are reasonably careful and that the deaths and injuries which occur on streets and highways and particularly at railroad crossings are due to gross or criminal carelessness of the other 3 per cent is the conclusion presented in a report by the insurance department of the Pennsylvania R.R. system, this report being based on checks of more than 100,000 drivers at crossings during a period of four months. Of 682 crossing accidents during that period, 607 were due to motor vehicles, five to streetcars and 31 to horse-drawn vehicles. Further, 487 of the accidents occurred in broad daylight and 195 at night, while about 50 per cent involved passenger trains and 50 per cent freight trains and switch engineers. Of all these trains about 60 per cent were running at speeds lower than 20 m.p.h. Some of the figures of the report are summarized in the accompanying table:

	No. of Accident	Deaths	Injuries
Automobiles	428	59	94
Motor trucks	175	12	37
Buses	4	..	
Attempt to cross ahead of train	..	7	17
Disregard of crossing bell	.	14	7
Disregard of watchman	49	5	22
Due to defective automobile brakes	16	..	
Intoxicated drivers	7	3	3
Automobiles stalled on tracks	61	6	12
Automobiles running through gates	280		
Automobiles running into side of train	70	14	22

Railway Water Treatment Plants and Their Operation

Successful Results Depend on Proportioning of Chemicals to Suit Character of Water and Its Frequent Changes

By Fred D. Yeaton
Assistant Engineer of Water Service, C., M. & St. P. Ry.

In the treatment of water for locomotive boiler supply the proper quality of chemicals and the proportioning of the solutions to suit different waters are apt to be overlooked, since the plant attendants are largely pump men and the engineers having supervision of the plants often have little chemical knowledge. Simple tests and care in operation are necessary for efficient service and such service can be secured if the work is in charge of an experienced water-service engineer. Greater attention is now being given to railway water supply, since increased capacities and higher steam-pressures of modern locomotives have resulted in demands for increased supply and better quality of water. Furthermore, it is being more widely recognized that the quality of water has an important bearing on the operating service and repair cost of the locomotives.

Under these conditions increasing responsibility is being placed upon the railway engineers in the selection of suitable treatment for the varying character of water encountered and especially in having this treatment carried out properly by the non-technical men charged with the operation of water supply and treatment plants.

In railway water service the principal chemicals employed are lime and soda ash for softening hard water, and sulphate of alumina and sulphate of iron as coagulants for turbid water. Some other chemicals are available for water softening, but lime and soda ash have the advantage of combining efficiency with low cost. All chemicals should be purchased under careful specifications as to quality and with due regard to requirements for proportioning.

Lime—Both quicklime and slaked or hydrated lime are used, but the latter seems to be coming into more general use, as it does not require to be slaked at the treating plant and does not deteriorate by storage for about a year. Quicklime slakes by absorbing moisture from the air and at the same time it absorbs carbonic acid which renders the lime useless for water softening. Lime made from magnesium calcium limestone should not be used, as the magnesium is of no value in treating water and only increases the amount of sludge to be handled.

In water softening, the lime is used to remove the carbonic acid and cause precipitation of the hard scale-making carbonates. It is applied as milk of lime, containing about one part of lime to ten parts of water, by weight.

Soda Ash—This material is divided commercially into "light" and "dense," only the former of which should be used in water treatment. Its purpose is to replace the scale-making limestone sulphates by non-scaling sodium sulphate. Soda ash is the base of most of the anti-scale boiler compounds which are used by many railways. For this use it is either added to the water in the tender or placed directly in the boiler through the washout holes after the boiler has been cleaned.

Sulphate of Alumina—This material (often erroneously termed "alum") is a very effective coagulant for highly turbid waters from reservoirs and streams. It dissolves very readily in hot water, a precipitate being formed which must be allowed to settle before the solution is used. The best sulphate of alumina contains about 17 per cent of water-soluble aluminum oxide, which should be 3 per cent or more in excess of the amount theoretically required to combine with the sulphuric acid in the water.

Sulphate of Iron—This ferrous sulphate when used in conjunction with lime is a good coagulant for turbid alkaline waters, such as those of the Missouri basin. The best form, known as "sugar of iron," is partly dehydrated. Several railroads have used ferrous sulphate successfully for removal of the last three grains of calcium carbonate from boiler waters in order to eliminate clogging of the injectors and branch pipes of the locomotives.

Proportioning Water Treatment Solutions—The amounts of lime and soda ash for water softening should be determined and added accurately according to the scale-producing elements which are to be removed. Well waters do not vary much in hardness from day to day, but waters from lakes, reservoirs and streams may change in character frequently. For instance, the water of several rivers of South Dakota often varies in 24 hours by as much as 10 to 20 grains of encrusting solids per gallon.

Treated water tested recently showed 14 grains hard and it was found that a sample of the raw water had been sent to a chemist several hundred miles away. The instructions as to treatment were being followed, but in the meantime the character of the water had changed materially.

Close control of the operation of a treating plant is necessary for successful results. Failure of many such plants may be traced to loose and careless methods. Not only does the raw water change, as noted above, but devices for proportioning chemicals get out of order and the quality of chemicals also varies considerably. These variations can be detected only by careful supervision of each plant.

The amounts of lime and soda ash required for any given water may be obtained in several ways. The method of water analysis given usually in text books involves too much time and care for regular use at the treating plant or by traveling inspectors employed by the railway.

A small and cheap but effective field testing outfit may be made, containing standard soap and acid solutions, methyl orange and phenolphthalein indicator solutions, and sufficient limewater for trial treatments. There will be also several small droppers, bottles, filter paper, funnel and 5 and 60-cc. graduates. The necessary knowledge of chemistry, the methods of operation for the use of such an outfit and the treating methods to be followed from these results can be taught to any fairly intelligent pump retainer or pump man. But the treatment to be used on an engine division or for any particular water requires considerable experience with water treatment and locomotive service. It can best be directed by someone who has had experience as a water-service engineer.

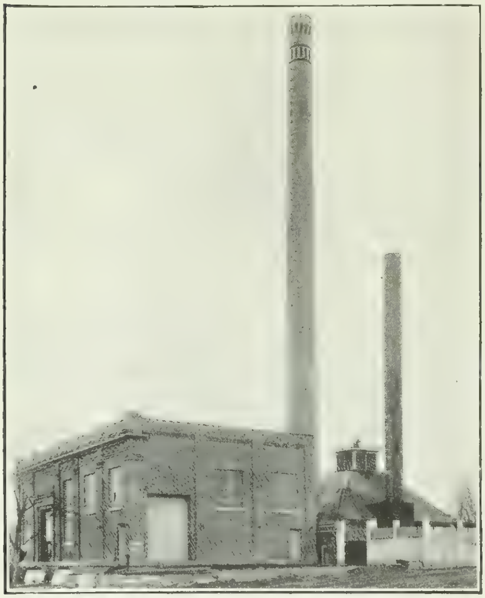
Overhauling Outgrown Water-Works at Fort Smith, Ark.

Gas-Burning Boilers Put on High Efficiency Basis—Centrifugal Pumps Chosen on Previous Eight Years Experience

By Wynkoop Kiersted, Jr.

Assistant Engineer, Kiersted & Stringfellow, Consulting Engineers, Kansas City, Mo.

Extensions to the overtaxed water-works plant at Fort Smith, Ark., include four new filters, boilers, a chimney, high- and low-lift pumps, dry chemical feeders and a general overhauling of the old pumping machinery. Before the improvements great difficulty was experienced in keeping the city supplied with water of even inferior quality. The four 1-m.g.d. filters were overworked; coagulant was crudely applied through neglect of proper upkeep; the pumping machinery was overtaxed and greatly deteriorated and the 25-year-old plain-tube boilers were extravagantly fired.



FORT SMITH WATER-WORKS PUMPING STATION
Old boiler house and steel stack in rear at right are to be removed. New boiler house is extension of old pump house at left.

Boilers—Two 300-hp. water-tube boilers with forged steel sectional headers proportioned for 200 lb. pressure were selected as the best and cheapest for this installation. Provision was made for superheaters later on. Gas burners designed for natural gas were installed in the fire doors of the boiler fronts and the space below the level of the burners filled with sand paved with firebrick. A combustion space of 1 cu ft. per boiler horsepower was thus allowed. Later if it becomes necessary to operate the boilers at a higher rate the burners may be placed in the ash-pit doors and the sand removed to afford greater combustion space.

As aids to economy and certainty of operation an open-type feed-water heater and two boiler-feed pumps of the simplex, direct-acting type were installed. The 8-in. front and 6-in. rear steam headers are equipped with extra heavy steel valves, flanges and fittings while the piping is extra heavy with lap joints. All live-steam pipes, boiler heads and feed-water heaters are covered with double standard thickness magnesia covering and the feed-water and auxiliary exhaust pipes with single thickness of magnesia.

The new 150-ft. reinforced-concrete chimney has a top inside diameter of 5 ft. and is built on a foundation extending to rock about 26 ft. below the surface. The proportions are sufficient to permit a future change to coal as a fuel.

In line with the class of workmanship required and materials employed to obtain a high degree of steam boiler efficiency, openings in the setting were carefully filled and thermometers, draft gages and draft regulators were provided for fire control. Flue-gas analyses are made at the plant periodically and under operating conditions show the CO_2 as 80 per cent of theoretical perfect combustion of natural gas, free oxygen 2 per cent and carbon monoxide not present. This high boiler efficiency is facilitated by the constant load.

Pumping Installation—In the existing plant were a duplex direct-acting triple-expansion high-lift unit and two turbine-driven centrifugal low-lift pumps, each of 5-m.g.d. capacity.

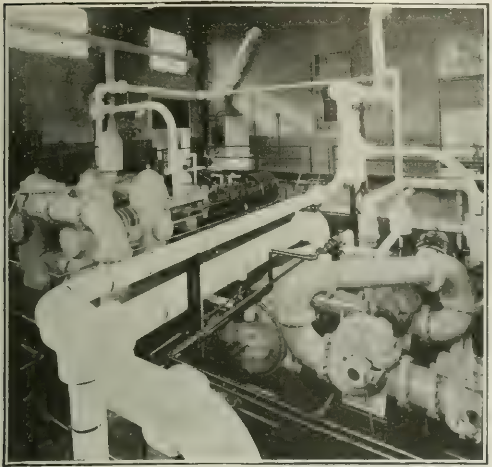
Before preparing specifications for the turbine-driven centrifugal pumping units informal proposals were obtained on a cross-compound rotative pumping engine of the opposed type and a direct-acting triple-expansion unit. The great cost of the former type of engine and the misfit in the available space, eliminated it from further consideration. The triple-expansion direct-acting unit was not accepted on account of serious objections to that type of engine which developed during the eight years use of the existing unit. The most serious of those objections are as follows: High cost of condenser, air pump and valve repairs, and renewals; large oil consumption; presence of oil in the condensate; overreach of plunger and occasional heavy hammer when the pumps are delivering water into the distribution system with surplus pumpage going to the distribution reservoir; station duty running considerably below the original test duty of 98 million; audible pump pulsations communicated to residences through the plumbing, and pounding of check valves on the reservoir lines of pipe.

These objections were further supported by the fact that the direct-triple unit would cost about 28 per cent more than the turbine-centrifugal unit and would be a misfit in the available space. Moreover, evidence showed that the station economy of the turbine unit would exceed that of the triple unit and that it would fit the available space with room to spare.

Eight years of satisfactory use of the two turbine-driven centrifugal units for low-lift work and the restricted available space of 15 ft. square necessarily confined consideration to this particular type of unit for low-lift work.

Results thus far seem to confirm previous conclusions. In the new installation the turbines of both the high-lift and the low-lift units exhaust into the same condenser. The test duty of the low-lift unit was 97,000,000 ft.-lb., exclusive of auxiliaries, and of the high-lift unit 110,000,000 ft.-lb. per 1,000 lb. of steam including auxiliaries.

During the month of February, 1922, when the two



NEW 8-M.G.D. HIGH LIFT IN FOREGROUND AND OLD TRIPLE EXPANSION UNIT BEYOND
Water end of both units painted light color. All steam lines heavily covered to prevent heat losses.

new units were in operation constantly, the fuel cost (natural gas) was $809—equal to a fuel cost of $8.24 per m.g. of water output. In March the new machinery was shut down for painting. During that month the old pumps scored a station fuel cost of $1,052 and a water output cost of $10.80 per m.g. In both months the high-lift water pressure was 80 lb. and the low-lift in February about 50 ft. but 4 or 5 ft. less in March. Both turbine units during February worked at 55 to 60 per cent of their rated capacity, while the triple unit and the old turbine units worked at 70 to 80 per cent of rating.

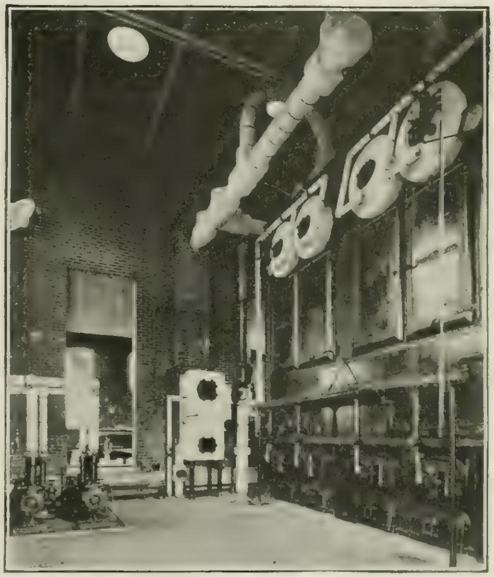
The high-lift pumping unit consists of a Terry turbine geared to two Lea-Courtenay pumps in series. The low-lift unit is of the same make and design except that there is but one pump. The Beeson Machinery Co., of Kansas City, Mo., was the contractor for the machinery installation.

The double-stage steam-ejector principle of maintaining a vacuum of 29 to 29.5 in. of mercury in the condenser has been particularly satisfactory. Likewise a single steam jet has successfully primed the condenser and pumps as well as relieved the river suction and river pumps of air. Heretofore air in the river suction at low water of the river, when the combined static and friction lift was 17 ft., caused considerable annoyance. The discharge from both the two-stage jet and the suction jet goes into a hot well outside the building.

Coagulation—A bronze motor-driven centrifugal pump supplies a constant head (6-in.) orifice box for the alum feed. The quantity of solution remains the same but the strength of solution is varied to suit the changing turbidity and pumpage.

A dry lime-feed machine is located over a mixing chamber 10 x 12 ft. in plan and 10 ft. deep, divided by a vertical baffle into two compartments. One compartment receives water from the river pumps while the other discharges through a pipe in the bottom into the adjoining settling basin. The dry lime drops into a water-flushed hopper and thence is conducted through 8 ft. of 2½-in. pipe to the opening of the influent pipe. The water in weiring over the vertical baffle receives the alum solution. The mixing of the coagulants with the raw water is effected by the weir drop and water swirl in passing through the chamber.

The alkalinity of the Poteau River water varies from a little over 20 during freshets to 80 or 90 p.p.m. at low water. The hydrogen-ion concentration in a few tests varied from a pH value of 5.8 to 7.0. In this condition a turbidity of 600 to 2,000 p.p.m. is readily flocked and reduced to such a condition by filtration that small objects can be seen in the bottom of the clear-water well through 25 ft. or more of water.



NEW BOILERS SHOWING GAS BURNER INSTALLATION

This condition does not prevail indefinitely. Backwater from the Arkansas River, sometimes containing alkali and always of high turbidity, introduces complications which speedily disorganize the ordinary procedure of coagulation and modify results materially. Even the Poteau River water unaffected by Arkansas River backflow responds to the coagulation process.

Wynkoop Kiersted, consulting engineer, Kansas City, Mo., planned and supervised the construction of the extensions to the Fort Smith water-works in 1913 as well as those described. The author acted as resident engineer during the recent construction and during the installation and testing of the pumping machinery. The cost of the extensions was $177,000—$23,000 less than the estimate.

F. A. E. S. Urges Reforestation

The Reforestation Committee of the F. A. E. S. is promoting a nation-wide effort to unite all agencies for elimination of waste within the industry, for reduction of waste of basic materials, and for conservation of and reforestation for future supply. "The virgin forests of the United States have been reduced to 40 per cent of the original," according to Executive Secretary L. W. Wallace, "and the time is rapidly approaching when the supply of merchantable timber will play an important role in the economic and social aspects of the nation."

From Job and Office

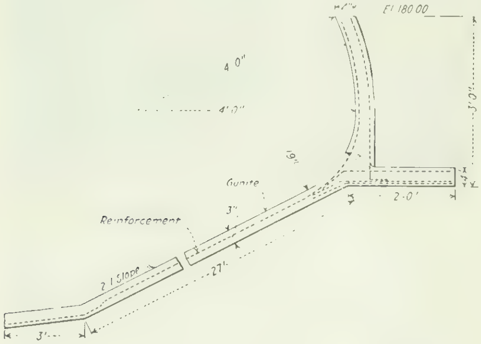
Hints That Cut Cost and Time *For the Contractor and the Engineer*

Reservoir Embankment Protected by Gunite Reinforced Slab

By A. S. Holway
Chief Engineer, Water Department, Oklahoma City, Okla.

In 1919 Oklahoma City completed a new 5,000,000,000-gal. water-supply reservoir in the bed of the North Canadian River. The water was turned in through the feed gates, but was never allowed to reach the crest of the spillway because the banks of the reservoir, which are made up of a very light silty soil, were being washed away so rapidly by the waves that it was necessary to lower the water level at once to save the reservoir.

Because of the large amount of silt carried during floods, the river was bypassed around the reservoir by means of a canal separated from the reservoir by an embankment with an 18-ft. crown. Originally the slope on the bypass side was 1 on 2½ and on the reservoir side 1 on 5. A portion of this embankment was one of the sections which was most rapidly attacked by the waves. The other section endangered by the action of the water was the south shore of the lake for a distance of approximately 6,000 ft. west of the main dam where the shore line was particularly vulnerable because it is paralleled by a drainage ditch lower than the reservoir water level.



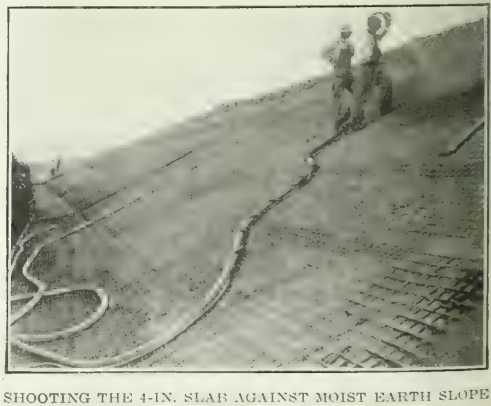
COMBINED WALL AND SLAB FOR SLOPE PROTECTION

Following a comprehensive study, it was decided that a combined wall and slab of reinforced gunite would most nearly meet all the requirements.

As constructed, the protection work consists of a 3-in. slab on a 1 to 2 slope, 27 ft., measured along the slope, surmounted by a 3-ft. cantilever wall with a curved face. The slab is extended 3 ft. on the bottom on a 1 to 10 slope. A heel 4 in. thick extends behind the wall from the point where the wall and slab join. Normally the water level will vary from 7 to 12 ft. below the top of the wall. The slab is reinforced with electrically-welded steel wire fabric consisting of No. 4½ wires, 4 in. c. to c. each way. This gives a sectional area of 0.11 sq.in. in each direction. Expansion butt joints filled with a bituminous filler are located 100 ft. apart. Directly under the joints a slab 30 in. wide was placed and separated from the main slab with tar paper. The specifications called for a 1:3 cement and sand mixture, with the voids in the sand varying from 30 to 35 per cent. As the protection is 10,800 ft. in length and the amount of work at any one point was extremely small, the contractor adopted a plant layout to meet these conditions, consisting of five compressors, driven by 2,300-volt motors. Two cement guns were used on the wall and three on the slab.

RESULT OF WAVE ACTION ON BYPASS EMBANKMENT

The slab was shot directly on the carefully graded slope after the ground was thoroughly wet. Great care was taken to lift the wire reinforcement up into the gunite as it was placed. Numerous test sections cut from the finished slab showed invariably that the reinforcement is almost exactly in the center of the slab.



SHOOTING THE 4-IN. SLAB AGAINST MOIST EARTH SLOPE
Reinforcement was raised to center of slab. Air was piped from central plant maximum of 3,000 ft.

Both wood and steel forms were used for the wall but the wood proved to be more satisfactory. After 24 hours the forms were removed. The method of shooting into the forms concentrated the sand pockets on the face of the wall. These pockets were all dug out with picks and chisels and the wall was then flashed with approximately ½ in. of gunite.

The quantities involved and the prices bid were as follows: 45,000 cu.yd. of excavation at 45c.; 33,000 sq.yd. of trimming at 10c.; 297,000 sq.ft. of slab at 37.1c.; 10,850 ft. of top wall at $4. Work was started in June, 1922, and completed in October.

The Pratt Thompson Construction Co. of Kansas City, Mo., was the contractor for the work, which was designed and constructed under the supervision of the writer, with C. E. Bretz as assistant engineer.

Laying 48-Inch Water Main in Detroit

DOWNTOWN pipe-laying in Detroit is carried on expeditiously by use of a trenching machine for the excavation, rarely more than three or four blocks being opened at a time. In the picture herewith is shown, in Elizabeth St., a portion of a 5-mile, 48-in. feeder from the pumping station to Sixth St. Except for 2,200 ft. of hammer-weld pipe with bump riveted joints the line is lock-bar pipe. As this particular section was yellow clay the 10-ft. trench stood up well, but at crossings under street car tracks it was carried in three-ring brick culverts with concrete inverts.

PIPE LAYING OPERATIONS CONFINED TO THREE BLOCKS

Following pavement breaking is a trench machine [illegible] a trench 10 ft. deep for 48-in. main, [illegible] with earth. Actual laying follows trenching machine closely in same block.

As fast as existing lead services were severed by the trenching machine, they were connected up with rubber hose and left in that condition until backfilling was under way, when they were replaced with lead pipe. Where telephone conduits interfered, the cables were cut, new cables spliced in and looped over the pipe. Manholes were then built over the pipe at these points.

Field joints were left uncovered until the pipe had been subjected to 100-lb. test pressure. All leaks were then carefully calked and the joints coated with a special paint before backfilling.

This pipeline extension was laid by the Gillespie Contracting Co. under the general direction of George H. Fenkell, superintendent and general manager, Detroit Department of Water Supply.

"A Cold Weather Fight and Warm Weather Sedative": a Scenario

By Louis L. Tribus

Tribus & Massa, Engineers, New York City

Place: *Within 1,000 miles of New York City.*
Season: *Late winter.*
Temperature: *Zero, or lower.*
Water Supply: *Gravity.*
Age of System: *Between 25 and 30 years.*
Dramatis Personae: *Chairman of a Water Board, Anxious Citizens and a Consulting Engineer.*

SNUGLY settled by the fireside on a cold winter's evening, reading (the *Engineering News-Record*, of course), the consulting engineer is jarred from his comfort by the persistent tinkle of the telephone bell. At the other long-distance end a much perturbed official voice tells of a most distressing condition of affairs; a town largely out of water, and *no apparent cause;* the consulting engineer is wanted at once to relieve the distress. (Note the confidence in an engineer.)

There is no train until morning, but early in its chill air the engineer is on his way. At conference on arrival, information is given that for days previous shortage was increasingly felt, yet a careful inspection of the long gravity pipe line had not shown any leak; the impounding reservoir was full, therefore something serious must have happened to the intake, or some choking on the line.

The engineer asks as many, or more, questions as a six-year-old, and inspects everything that can be seen; also telephones for a diver.

With the engineer's arrival the temperature begins to moderate, and water begins to reach higher levels.

The diver arrives. He finds the conical intake screens partly choked, and wedged tight, from many years of neglect. He removes a couple of buckets full of sediment and rust, relieving the strong suction created by the water drawn through the limited screen area, and puts the screen once more into fair working order. The water carries but little sediment, so that screens are more for fish elimination than for filtering.

As the weather moderates greatly, the water in the town rises again to the high levels, and the clearing of the screen is given the credit.

* * *

AS WATER-WORKS' readers will surmise, the real facts of the case were that draft to prevent freezing of plumbing, on the lower levels, used up all the pipeline capacity, so that little was left for the higher levels.

The engineer having, as outlined, relieved the pressing situation, with aid of Old Sol and South winds, continued to make full flowage and use studies, fully verifying his surmise.

The main pipe line had been planned nearly 30 years before to serve a purely residential population, and had capacity for reasonable increase. The population growth had not quite materialized, but special and unexpected commercial needs had developed.

Facilities had not been adequately provided for getting the full value of an equalized 24-hr. flow, which naturally the engineer recommended, as well as certain other changes in the way of betterment. In the event of similar temperature conditions, even with equalized supply, the likelihood is still imminent of cold weather shortage, and the writer so reported to the town, but they have as yet taken no steps to protect themselves.

From Job and Office

Hints that Cut Cost and Time

Designing Filtration Plants Graphically

By P. B. Streander
Chief Engineer, Roberts Filter Manufacturing Co., Darby, Pa.

In DESIGNING a water filtration plant, certain units or parts are common to all plants such as subsidence or coagulating basins, filter units, sand strainers, laterals, wash troughs, piping, sterilization, pumping, etc., the proper determination or proportioning of which takes considerable time. Among the charts devised to reduce this time, none is so rapidly constructed nor so easily read as the charts of the alignment or nomographic type, examples of which as utilized by the writer are given below. These charts are based on the use of three or more logarithmic scales, parallel or inclined, depending on the form of equation used.

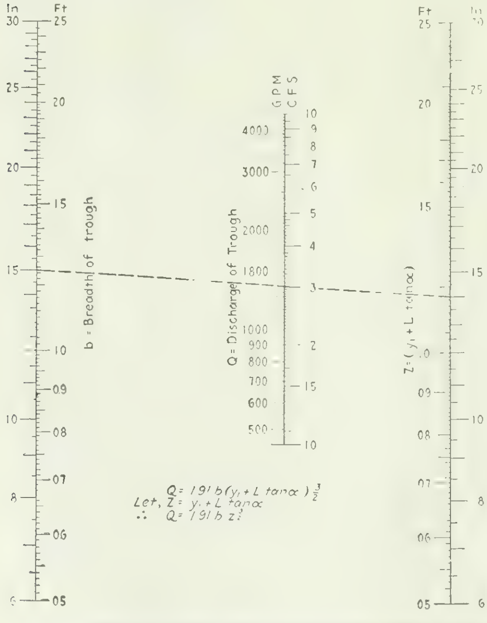


FIG. 1—SQUARE WASH-WATER TROUGH CAPACITIES

Having the total discharge capacity of the trough in gallons per minute or cubic feet per second on scale 3, project from this point to breadth of trough assumed on scale 1 and obtain the value of Z on scale 2. The dimensions of B and Z are for rectangular shape troughs. For shapes of troughs not rectangular application of the above chart can be made by assuming a rectangular section of equivalent area. The value of Y_2 or the depth of water at the discharge end of the trough applies to a case where the discharge is into a chamber in which the water level is at or near the level of the water in the lower end of the trough. In case of free fall the actual value will be less owing to the weir action.

Wash Troughs—The spacing of wash-water troughs should be such that the farthest horizontal travel of the water will not exceed 3½ ft. as a maximum. The size of the wash trough is of considerable moment for if this is made too small, it will be impossible to wash the filter bed properly. An approximate formula for calculating the discharge capacity of wash-water troughs has been derived by C. N. Miller and is explained more fully in the appendix of J. W. Ellm's book on "Water Purification." This formula has been used by the writer with very good results and is as follows, using the notations of

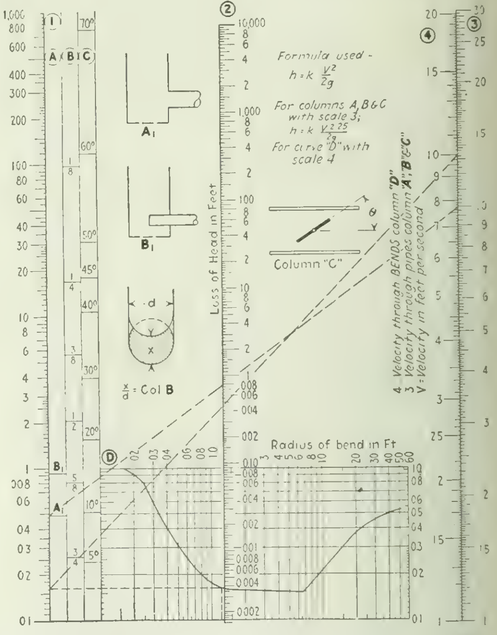


FIG. 2—LOSS OF HEAD AT ENTRY, BENDS AND VALVES

To obtain entry loss of head, connect the velocity through the pipe scale 3 with the constant K (depending on type opening) projected to scale 1 and read the loss of head on scale 2. To obtain the loss through bends, first determine the value of constant K by projecting the vertical line corresponding to the radius of the bend until it intersects with the curve shown. From this point project horizontally to the left to scale 1 and connect this point with the velocity through the bend on scale 4 obtaining the loss on scale 2. For losses through partially closed valves determine the fractional opening of the valve and on column B project to scale 1 and proceed as before. For partially closed butterfly valves proceed same as for gate valves.

Q = Total quantity of water received in trough in cubic feet per second.
B = Width of trough.
Y_1 = Depth at shallow end of trough.
Y_2 Depth at discharge end of trough = $\frac{2}{3}Z$.
L = Length of trough.
A = Slope of bottom of trough.
$Q = 1.91\, B(Y_1 + L \text{ tang. } A)^{\frac{3}{2}}$ and letting
$Z = (Y_1 + L \text{ tang. } A)$

then

$$Q = 1.91\, BZ^{\frac{3}{2}}$$

Fig. 1 gives this formula in chart form.

From Job and Office

For Contractor and Engineer

Pipe Losses—Fig. 2 gives losses due to bends in pipe, entry loss and loss through valves, etc. On this chart all losses have been computed in terms of $H = K\frac{V^2}{2G}$ where K is a constant depending on the construction of the pipe entrance indicated in column A for entry head loss, on how much a valve is closed in column B (not ordinarily used) and the degrees which a butterfly valve in column C is closed (used only where this loss is required as on the butterfly valve to subsidence basin) and upon the radius of the pipe column D for losses through bends. The loss through bends has been based on the formula $H = \frac{V^{2.25}}{2G}$ prepared by W. E. Fuller (*Journal* New England Water Works Association, December, 1913). It is more convenient to handle than the Weisbach formula.

Pumping Equipment—The pumping equipment in most modern filtration plants is usually of the high-speed centrifugal type having as prime movers, electric motors or steam turbines. Fig. 3 is an alignment chart for quickly obtaining the horsepower required for quantities ranging from 40 to 10,000 gal. per minute and heads of from 1 to 1,000 ft. Alongside of the gallons-per-minute column are listed the sizes of pumps required for capacities shown. The maximum pump capacities are to be used if the total head exceeds 45 ft. and suction head not to exceed 15 ft. If the total head is less than 45 ft. use the smaller capacities.

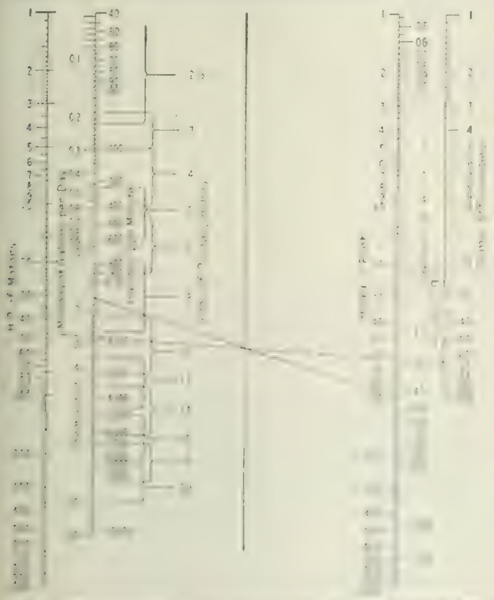


FIG. [illegible] CENTRIFUGAL PUMP [illegible]

[illegible]

Lubrication Saves $2,500 Replacement of Water-Main Valve

By Wm. W. Brush

Deputy Chief Engineer, Department of Water Supply, Gas and Electricity, New York City.

FRICTION is a great consumer of energy, and yet how frequently do we see failure to apply to both human beings and inanimate machines that which will lubricate contacts where friction exists, thus largely eliminating it. Valves on water mains, especially the larger ones, are expensive machines, but virtually no provision is made for their lubrication after installation. This condition leads to hard operating valves, requiring several men on a cross-bar, even within a year of their installation.

A case in point is a 48-in. valve on Fifth avenue at 29th St., New York City, on a main through which Croton water flows from about 8 p.m. to 5.30 a.m., the flow then being shut off until evening. This valve is operated twice daily by hand. In the late summer of 1922 it was reported that the valve must be replaced, as it could not be kept in good operating condition. To replace the valve was estimated to cost $2,500.

As the difficulty appeared to be excessive friction on the thrust bearing, an oil cup was installed and piped to this bearing to furnish it with a constant supply of oil. A continuous slow drip from the oil cup could not be secured during the cold weather, due to the congealing of the oil, and the stop cock on the oil cup was opened to allow freer flow. As a result, it was necessary to supply new oil frequently. The application of the oil in this manner caused the valve to operate easily.

A substitute for the oil cup, in the form of an oil pipe carried to a point just below the underside of the manhole cover, is to be installed, and a small amount of oil will be daily discharged into this pipe, thus lubricating the thrust bearing.

Aeration of Water Immediately After Alum Dose Saves Soda

By Malcolm Pirnie

of Hazen & Whipple, Civil Engineers, New York City

ABOUT two months ago the writer had an opportunity to study the treatment of the Dan River water at Danville, Va., with Richard Messer, chief engineer of the Virginia State Board of Health, and Lynn H. Enslow, sanitary engineer. The records of the filtration plant showed that soda was used with alum to get coagulation about nine months in the year, and this suggested that we might reduce the acidity of the water by aeration immediately after the alum dose.

We found upon experiment that the water would not coagulate within a reasonable time with any dose of alum from 1 to 10 gr. per gallon. With an alum dose of 1½ gr. and soda dose of 1.13 gr., a good immediate floc was obtained. This was also true for an alum dose of 2 gr. and soda dose of 1.5 grains. However, upon standing for several hours the coagulation was not so good as that first obtained and better coagulation was observed in the samples containing lower relative doses of soda.

A sample of water was therefore dosed with alum at the rate of 2 gr. per gallon and with soda at the rate of 0.8 gr. per gallon. Half of it was aerated immediately by pouring slowly from one beaker to another. The aeration caused the immediate formation of an excellent floc which was the equivalent of that obtained when 1½ gr. per gallon of soda were used without aeration. With the aeration, however, there was no deterioration in the sample upon standing several hours. The unaerated portion of the sample dosed with 2 gr. of alum and 0.8 gr. of soda did not show a precipitate inside of two hours, but would precipitate upon standing overnight. The difference in these results was due to the difference in the amount of free CO_2 present in the water. Driving off the CO_2 by aeration made immediate coagulation possible with but half the amount of soda that was required to produce similar coagulation without aeration.

For the information of those who may be interested in the pH of the water, the following results are given:

	pH
Raw water	7.35
Sample dosed not aerated	6.60
Sample dosed and aerated	7.20

All samples that showed good coagulation whether immediate or after standing overnight had a pH between 7.1 and 7.2. Samples dosed with higher amounts of soda which gave an immediate good floc had a pH of 7.1 and later as the floc went partly back into a milky state the pH was found to be higher in the neighborhood of 7.4 to 7.5.

These experiments indicate that a considerable saving in the amount of soda required can be made by aeration immediately after the dose is applied.

A Departure in Water-Works Intakes

By C. M. Daily
Engineer-in-Charge Supply and Purifying Section,
Division of Water-Works, St. Louis, Mo.

If the water commissioner of St. Louis, Mo., followed precedent in building an intake for the Missouri River plant, his selection would be a tower intake located in the main channel where the turmoil of water around the tower would be a prolific source of trouble from sand carried into the ports during high water and from ice during the periods of flowing ice in winter.

From Job and Office

Hints that Cut Cost and Time

When a sandbar is passing a tower, the sand does not roll along the bottom but is picked up by the swirls caused by the tower and carried past in suspension, the ports in use receiving their share of the sand and gravel which deposit along the tunnel leading to the wet well. The new tunnel has been cleaned twice since it was put in service in 1916, the sand averaging about 4 ft. in depth over its entire length each time it was cleaned. When floating ice strikes a tower the cakes are broken into small fragments which are carried by the mixing action of eddies into even the lower ports of the intake.

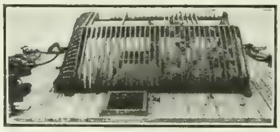


FIG. 1—DAMAGED SCREEN TOWER WATER INTAKE

Undisputable proof of the eddies caused by tower intake is shown by Fig. 1, which is a view of a damaged screen taken from one of the ports of the new tower at Chain of Rocks last November, in which gravel and boulders weighing as much as one pound are lodged between the bars. This screen was in place four years and its bottom was 9 ft. above the river bed. The boulders were lifted by the swift eddies caused by the tower.

Experience with the two tower intakes in the Mississippi River at Chain of Rocks has led to the adoption of a shore intake (Fig. 2) for the Missouri River plant where the current of the river will be directed and maintained by suitable dike work and where the water will pass smoothly, free from eddies or swirls. It is expected that there will be but little trouble from either sand or flowing ice.

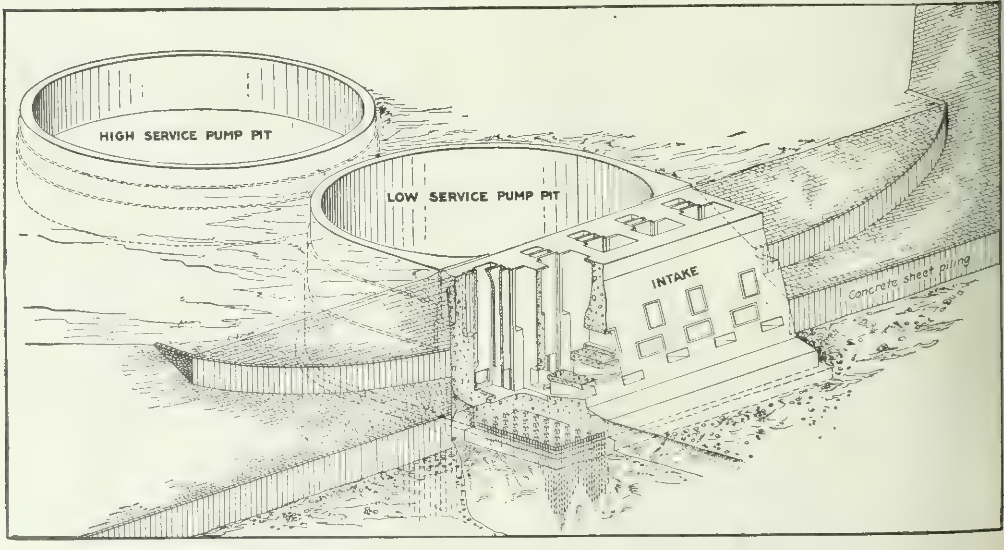


FIG. 2—ISOMETRIC VIEW OF NEW SHORE INTAKE AND PUMP PITS, ST. LOUIS WATER-WORKS

From Job and Office

For Contractor and Engineer

Worn-Out Ford Running Gears Used as Trailers at Philadelphia

BY D. A. MCCRUDDEN

Assistant to Chief of Water Bureau, Philadelphia, Pa.

RUNNING gears of otherwise worn-out Ford cars are used by the Philadelphia Water Bureau as trailers to carry diaphragm pumps and also (separately) as tool wagons and boxes.

The diaphragm pump (Fig. 1) is a standard gasoline-driven outfit, formerly mounted by the manufacturers on a low truck with small iron wheels and no springs. The weight was about 800 lb. and the running gear was adaptable only for movements at the site of the work. Loading and unloading for long distance transportation required several men and not infrequently resulted in damage to the pump. The unprotected gasoline engine was not efficient in wet weather. Mounted on a Ford running gear, as shown by the accompanying view, the pump equipment is complete with tool boxes, suction hose and proper housing for the engine. The equipment can be handled as a trailer by a Ford one-ton truck.

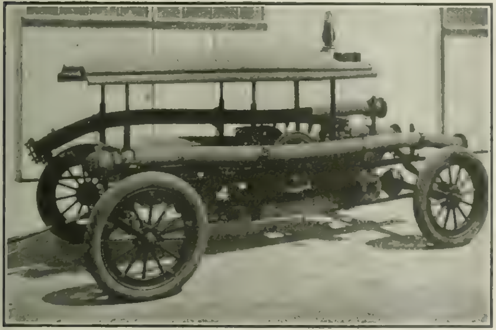


FIG. 1—TRAILER-MOUNTED PUMP FOR REPAIRS

The trailer tool wagon (Fig. 2) weighs 950 lb. and carries about 500 lb. of tools and equipment, including boots and clothing which the men leave overnight at the job. New tires are not used on the trailer, as it is often left unprotected overnight. When left on the job the wheels are locked.

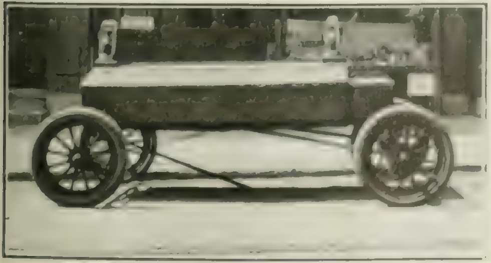


FIG. 2—TRAILER TOOL BOX

One truck, used by the foreman for transportation, is capable of serving from three to five of these trailer wagons, the truck carrying certain special equipment and being always available to bring additional equipment to any job in case of necessity.

Experience seems to indicate that 6 trucks and 22 trailer tool wagons will do the work of 22 horse-drawn vehicles.

Oxyacetylene Welding Outfits Most Useful of Butte's Equipment

BY EUGENE CARROLL

Vice-President and Manager, Butte, Mont., Water Co.

THE MOST useful equipments we maintain in the operation of the plant of the Butte Water Co. are the oxyacetylene outfits for welding and cutting. We keep three complete outfits ready for service at all times, consisting of generator and cutting and welding tools. One outfit is kept at our city shop and is extremely useful in the repair of automobiles and various other parts of our equipment, and also for cutouts in pipe 12 in. or more in diameter. Another outfit is kept at our South Fork reservoir, twenty miles from Butte, at which point there is about three miles of welded-steel pipe with welded joints and about three miles of steel-riveted pipe. The third outfit is kept at our Big Hole pumping station, thirty miles from town, where there is also considerable steel pipe, both welded and riveted.

The generators are kept mounted on skids, enabling us to place them quickly on a truck and deliver them to any point where they may be required for repair work. In our Big Hole pipe line, which was constructed in 1899, we used riveted steel pipe for the heavy pressures. This pipe is beginning to disintegrate, and the cost of repairing would be very great were we required to put on riveted patches at all breaks. Up to the present time the breaks have been longitudinal cracks in the pipe, varying from one to three feet in length and occurring usually near the edge of the steel on the lap joint. With the welding outfit, repairing this kind of a leak is a very simple matter.

The Fable of the Hank o' Lead and the Candle

BY M. L. WORRELL

Engineer and Manager, Water Department, Vicksburg, Miss.

ONE DAY while away out on "the job," riding behind a nigger who was driving a grey mule, we chanced across a valve leaking through a stuffing-box. Looking around for something to pack it with I found nothing, or at least nothing but a hank of lead-wool, which material had just been put on the market. We had a small piece of plumber's candle which was set afire and furnished the necessary lubricant, and mixing this with the hank o' lead we packed the valve, made a good job, and a lasting one. Since then, after "think-tanking" a bit, we have used it numerous times on different similar jobs with absolute satisfaction. And on each pumping station job, where metallic packing was used, lead-wool has taken its place at less than one-fifteenth the cost and with just as much satisfaction otherwise. If the work of valve-packing on water-gates is thoroughly done, it will never have to be repeated; my word for this.

Chamber of Commerce Meeting of Interest to Engineers

Annual Meeting of National Body of Business Men Devoted Mainly to Transportation and Immigration—General Study of Transportation Now Under Way—Hoover Optimistic on Immediate Future

MATTERS of concern to engineers were the principal topics of discussion at the eleventh annual meeting of the Chamber of Commerce of the United States which nearly 5,000 business men attended at New York City in the week of May 8-11. Transportation was the principal subject under consideration, but some little time in the sectional meetings was devoted to another subject of interest to engineers, namely, immigration. The Chamber is fostering an extended investigation into the subject of transportation and the committees which have it under consideration made preliminary reports, which indicate that the whole subject, including the details of railway organization and its relation to the government and the inter-relation of highway, waterway and railway transportation, will be thoroughly reported on by next fall.

In addresses to the meeting both Herbert Hoover, Secretary of Commerce, and Julius Barnes, the president of the Chamber, voiced a real optimism as to the immediate business future in this country. Mr. Hoover especially called attention to the differences in our present economic position as compared with the situation prior to the collapse of 1920 and showed how great is the production capacity of this country, mentioning how our efficiency of production has increased in recent years, and from this he deduced that we can afford to have tremendously increased production and consumption figures because the standards of living of the people as a whole have been raised. While he advised a certain amount of caution in going into the future, he felt that there was no need of any hysterical retrenchment.

Immigration Policies—The Immigration Committee of the Chamber recommended that the present 3 per cent limitation of immigration be retained, but that to this 3 per cent there be added 2 per cent on a selective basis, this 2 per cent to give opportunity to test the practicability of proposals for selection "so meeting the desires of those who wish a selective basis to replace the restrictive while not affording ground for alarm to those who fear an innovation." The committee stated the selective requirements to be: Meeting a minimum physical, mental, and moral test, and a demonstrated need for immigrants of a particular kind. In his speech, Congressman Johnson, chairman of the House Committee on Immigration, stated definitely that he did not believe that there would be any let-down in the restrictions imposed in a new law. Rather, he thought the restrictions would be tightened by the next Congress and the chances were that a bill would go through which would set the basis of immigration as 2 per cent of the nationals in this country in 1890, with a possible 1 per cent addition for the blood relatives of those already in this country. He stated that there were international difficulties in the way of examination abroad which made it almost impossible to put it in force, but that there was a possibility of registration abroad sufficiently in advance so that some weeding out of applicants could be made in time to select the immigrants before they embarked from the other side.

Allen T. Burns, of the Carnegie Corporation, presented some interesting figures on immigration and citizenship, which seem to disprove some of the older held ideas regarding the source of the best material in this country. He showed that the immigrants who become naturalized quickest are those from such countries as Turkey, Ireland, and Russia, where home governmental conditions are not stable; whereas those from England, Germany, and Sweden are the slowest in taking out their papers. Those in the first group take from eight to ten years and those in the latter from twelve to thirteen. On this basis, he said that it is not altogether safe to throw the standard of selection back to 1890 in the hope of getting the Northern races, because these do not necessarily become citizens any quicker than the Southern races.

Transportation—Realizing that the tremendous expansion in the transportation requirements of the country demand a program of development which will not only take advantage of the best that is in all the existing means of transportation but will also point out the most desirable lines of future development, the Chamber at its meeting last year began a comprehensive study of the present transportation situation from which it hopes to evolve a plan which it can present to the country as a working basis for all future legislation. Assured that it represents the desire on the part of the great majority of the people to stimulate rather than suppress private enterprise, the Chamber took private ownership of the railroads and barge lines as the basis of its transportation program. It then appointed committees to study the problems arising under the following heads: railroad consolidation, government relations, relative rates, motor transport, waterways, and the co-ordination of rail, water, and motor transportation. This year most of these committees submitted interim reports. When the final reports of all the committees are submitted the Chamber proposes to construct a general committee which will fit the separate recommendations into a comprehensive whole.

Obviously the railways will be the chief subject of concern in such a comprehensive transportation system but the potential value of the waterways in handling slow-moving bulk freight and the adaptability of motor vehicles to the rapid movement of small units of freight make it necessary to determine what their proper relation to the railways shall be and to what extent they can be used to advantage in carrying part of the freight now handled by the railways. To do this properly requires a study not only of the existing rate structure for each class of transportation to see that its basis is correct, but also a study to determine the proper distribution of the interline rates when the three classes are co-ordinated. The question of rates leads to a study of the financing of the railroads and of the best method of consolidating them into several large systems as required in the transportation act of 1920. The question of co-ordinating the three major classes of transportation so that they will be supplementary rather than competitive leads to a study of how far such co-ordination can go under one system before the system will become monopolistic.

Railway Consolidation—The committee on railroad consolidations reports that from the facts which it has been able to obtain it is of the opinion that the popular belief that the chief advantage to be gained from consolidating the railroads into several large systems will result in great economies of administration and operation is, in a large degree, illusory. It is, in reality, of subsidiary importance to the rate adjustments that will be possible under the consolidation, and to the freer flow of traffic that will result from the improvement in the interchange and from the greater flexibility of the car supply. The committee also believes that, contrary to the opinion expressed in many quarters, the consolidation can be so accomplished as to maintain and even enhance the competition in service required by the Transportation Act. The second phase of the committee's report is a study of the measures which will be necessary after the plan of consolidation has been adopted in order to avoid injustice to the present owners of railroad securities due to the consolidation, and finally the consideration as to whether any compulsion will be necessary to effect the consolidation. The committee is of the opinion that the financial arrangements for the protection of the security holders can be settled without difficulty, and that there are no insurmountable obstacles in the way of voluntary consolidation.

The committee on government relations reports that before it can draw any conclusions on a subject concerning which there are such widely divergent views it feels that it should first assemble all the pertinent data and study them to the end that its report will be as nearly unanimous as possible. With this object in view the committee is collecting data regarding the past and probable future traffic, an enumeration and portrayal of the facilities and the financial resources necessary to adequately develop the railways. It is also studying the Transportation Act of 1920 to determine whether it has had a fair test, and to suggest additions or changes in its provisions which the committee may, in the course of its study, find to be desirable.

Waterways—The committee on the development of the waterways and the co-ordination of the rail and water service reports that it is of the opinion that the waterways should only be used to supplement the railways as the railways must continue to be the back-bone of our transportation system. It is also exploring all the existing sources of data to determine what railway facilities can be replaced by water-borne facilities. When this question is answered the committee will take up a study of the rates, both for water transportation alone and for the joint services. This will of course include a study of the fundamental question of the relative cost of the two classes of transportation. Among its broad duties the committee includes consideration of methods of stimulating the greater use of the waterways of the country.

Motor Transport—The committee on the relation of highway and motor transport to other transportation agencies reports that it is of the opinion that its report should cover the conditions underlying the motor, rail, and waterway transportation. That consequently it has organized into three groups to consider: (1) the field of motor use outside the terminal area, (2) the field of motor use inside the terminal area, and (3) the legal aspect of highway carriers in relation to other carriers. The chairman will also look into the matter of the use of gasoline motor cars on the railroads. Each of these sub-committees has made progress in getting at the basic facts. One fact which they have already brought out is that the motor interests of the country are opposed to the use of motor cars for long hauls.

C. A. Newton, Congressman from Missouri, spoke on the co-ordination of transportation facilities. As Mr. Newton is a member of the Rivers and Harbors Board of Congress he devoted the most of his speech to waterways. He outlined in detail the present condition of the railways of the country, pointing out their inability to handle the traffic that is now offered, and then showed that in view of the fact that our traffic, expressed in ton-miles, doubles every ten years we would soon lose sight of the question of rates in our demand for greatly increased facilities. To offset this he considers that the railways, waterways, and highways must be developed to their fullest capacity and used as one great transportation system. But before such a transportation system can be developed two things must be accomplished, First: the projects for the completion of our inland waterways must be completed, and second: the abuses in railroad rates which have in the past stifled competition on the water routes must be abolished so that investments in river equipment will be stimulated and our waterways will be carrying their full share of the country's commerce.

Charles H. Markham, president of the Illinois Central R.R., followed Mr. Newton, speaking on the same subject but from the point of view of a railroad man. He pointed out that the expenditure of great sums of money by the government on waterways and highways was in effect a subsidy to the competitors of the railroads. That in determining the true economies to be derived from highway and waterway transportation due consideration must be given to the cost of building and maintaining these routes. In addition, legislation should be equalized. At present the railroads are burdened with all kinds of restrictive regulations while motor and water traffic have almost none. He also feels that the public are beginning to realize that the prosperity of the country is intimately related to the prosperity of the railroads, and that the reaction against further restrictive legislation which will surely follow will in the end assure to the railroads sufficient income and new capital to develop as the country grows.

Resolutions—The formal resolutions adopted by the Chamber had for high spots a declaration in favor of a general international economic conference and a world court of justice, the loosening of immigration restrictions by adding a selected 2 per cent to the present 3 per cent restricted quota (practically the recommendation of the committee on immigration), the endorsement of the principle that the state should continue to regulate public utilities instead of delegating power to local authorities, and general clauses favoring private operation of government-owned ships, open shop in coal mine operation, improvement of waterways, development of a system of flood control and reclamation of waste lands. Inasmuch as the transportation question is still under discussion for the final report next fall, the resolutions committee did not undertake any specific recommendations.

Professional Work and Internal Problems Before American Association of Engineers

Effective Work for Professional Betterment Comes to the Front—Principles of Conduct Adopted—A New License Law—Other Work in Progress—Serious Internal Problems—Benham Becomes President

Engineering News-Record Staff Correspondence

WITH country-wide representation of delegates from its various chapters, and one representative from as far away as Hawaii, the American Association of Engineers had a notable meeting at Norfolk last week, its ninth annual convention. Some 200 were in attendance. Important national committee work of constructive character bearing on difficult phases of professional betterment was reported, and found approval by the convention. With this achievement the association demonstrated in substantial manner that it can do useful work.

A code of rules of good professional conduct was formulated. A new license law was drafted. An active start was made toward the study of consulting engineering practices. The study of compensation of engineers in public employ was carried forward. Effective action in aid of good national legislation in the interests of the public generally and of engineers was reported upon. A good beginning was made toward outlining the political functions of the association and its members. Useful work was added to what had previously been accomplished in the study of the standing of technical colleges.

But the convention also became involved in a tangle of organizational troubles and disputes which not only brought to light a threatening lack of harmony and various disruptive tendencies but also absorbed a good part of the time and energy of the convention. Constitution tinkering was indulged in extensively, as at previous conventions of the association. A determined effort was made to oust the secretary, on shadowy grounds, the only tangible element of which was that, in the view of some persons, the secretary must be held responsible for the decline of membership of the association. Proposals were offered to change the entire structure of the organization. At the bottom of much of this discussion was the familiar money problem. The actual outcome of the discussions on these business matters, as expressed in various resolutions adopted, appears to represent only a partial and temporary settlement of the questions at issue.

In the following review of the convention doings, the constructive work will be considered first.

Professional Work

Principles of Conduct—Basing on the 40 or more decisions heretofore rendered by the Practice committee in cases of questionable professional conduct presented to it, the committee during the past year compiled a code of principles of sound professional conduct. The principles are in four groups, relating separately to the engineer's relations to the public, to clients or employers, to employees, and to other engineers. They form probably the first definite guiding code of conduct that has been available to engineers. After consideration by the Resolutions committee of the convention, they were adopted as the principles of the association, with the exception of five of the original principles, which were referred back for restudy and revision.

Consulting Engineering Practices—Work on this difficult subject has been divided into several parts, the important ones being rules of practice, standard fees, private work by public employees, effect of Reclamation Service and federal and state highway work upon the field of private engineering, and certain miscellaneous questions such as engineering guarantees and competitive bidding practices. The most definite results so far have been obtained on private work by public employees, on which subject a large mass of material and views has been collected, the conclusions from which are not yet ready. The committee has also begun a study of free engineering service offered in manufacturers' advertisements, and expects to formulate a policy on this subject.

Occupational Specifications—With extensive governmental aid the committee on classification of engineering positions undertook a precise statement of the minimum qualifications of highway engineers in various services, as reported in *Engineering News-Record* of April 26 and May 3, pp. 744 and 793. This work was carried out largely by Prof. A. B. McDaniel. It is to be continued, unless present hopes for the necessary financial support of the work are defeated.

Public Salaries—No attempt was made during the past year to modify the public service salary schedules heretofore drawn up and recommended by the association, but the committee asked that these schedules be reaffirmed and further efforts made to insure their adoption. Other phases of public employ, such as short and insecure tenure of office, civil service classification, permanent staff organization, and the need of more publicity for the value of good engineering of public works, were reported upon by the committee and will be the subjects of further work.

New License Law—The legislative committee during the year prepared a revised draft of a license law on the basis of reports of experience with license administration in various states. Just prior to the convention this draft was further revised by a special committee composed largely of members of state examining boards. Discussion at the convention showed that there are various points in license laws that will continue to give rise to difference of opinion, and that probably local requirements and preferences will dictate certain differences in the laws of different states. However, the revised bill was adopted by the convention and ordered to be published, after editorial correction and full annotation, the latter to indicate what variations in the several provisions may need to be considered. The bill contains suitable administrative provisions, requires a license for practicing or offering to practice engineering, includes a grandfather clause, and provides as completely for reciprocity as is considered practicable at present.

Political Policies—In the report of the committee on political policies the proper limits of the political activity of the association or its chapters were outlined, and emphasis was placed on the importance of the individual engineer's taking his full part as a citizen in politics. Revised drafts of these principles, formulated by the committee on resolutions, were adopted by the convention. Several other political questions were studied by the committee, including the question whether an engineer in public employ should make contributions for political purposes when called upon, and whether it is ever defensible to support a layman running for the office of county engineer. From the divergent views expressed by the members of the committee on these questions it was evident that moral sentiment on such points is not everywhere crystallized, and that more thinking needs to be done before useful results are obtained.

Railroad Work—Following the abandonment of its appearance before the Railway Labor Board as official representative of professional engineers in railroad employ, the association organized a railroad advisory committee. This committee is working by direct conference with railway executives. It has been able to show some degree of success, but is still in an organizational stage of its work. Sharp difference of opinion within the association as to the right way to deal with the railroad engineers' problem became evident in the course of the meeting.

The Title "Engineer"—Abuse of the term engineer was brought to the attention of the association by the Qualifications committee. No method of dealing with the difficulty was suggested in the report, but recognizing the importance of the subject the convention adopted a resolution asking the organization of a joint committee of engineering societies to deal with the subject.

Efforts at Co-operation—The consistent policy of the association to co-operate with other engineering bodies in questions of joint interest has had little opportunity for application heretofore, apparently because of the unresponsiveness of other societies. Nevertheless, the Norfolk convention recognized the present peculiar conditions in professional circles which call for more active co-operation between societies, and adopted a resolution reaffirming the association's readiness at all times to co-operate in questions of joint interest. A specific recommendation in favor of a joint committee has been noted just above.

Federal Work—Effective work by the association's Washington office in guiding and urging legislation and appointment matters was reported. It included successful efforts in support of the classification act, which lays the foundation for an orderly and equitable arrangement of technical positions in the federal service all over the country, the civil service retirement act, and related matters. Co-ordinate with this activity, the association's federal advisory committee has also worked effectively on legislative and other federal matters. Work in both departments is to be continued actively during the year.

Classification of Schools—With the primary purpose of facilitating the consideration of applications for membership, the Education committee during the past year largely expanded its study of the qualifications and standing of engineering schools throughout the country, begun in the previous year. From the findings so far reported—which, however, are subject to further analysis of the data—it is likely that conclusions of direct value in the improvement of technical schools will develop.

BUSINESS DISCUSSIONS

Quoting from President Johnson's address: "Much important work of the association is accomplished through its national committees. Including standing and special committees, there are eighteen in all, and few organizations have developed a higher degree of effective committee work. First of all the A.A.E. is a national organization, and only by the fact that it is such an organization is it possible to accomplish even those things which may have but a local interest. And while it is true our association functions in many ways through chapters, nevertheless they would be impotent were they not part of a national organization. I believe all of us realize the mistake that was made at the Buffalo convention, which tended towards decentralization. One of the chief problems before the Salt Lake convention was to remedy the results of too hasty action made at the previous convention." Mr. Johnson also referred to the decline of membership in the last year, attributing it to the unsound growth which resulted from the "drives" of a few years ago, following the war period. In these passages, the address pointed toward some of the chief business problems discussed at the convention, which also concerned itself with two other problems, publication and finances.

Publishing Troubles—With the help of a 75c. allotment from membership dues to *Professional Engineer*, the association's monthly showed a slight apparent surplus for the year, with receipts and expenditures about $20,000 each. But the experiences of various chapters in publishing their local bulletins convinced many members that the paper can be made much better in character and very profitable. One member told of the methods by which local merchants have been "induced" to place advertising in his local publication, and claimed that similar methods of genteel persuasion should prove successful in securing national advertising. Half a dozen publishing resolutions were presented, none of which, however, got through the Resolutions committees. Final action took the form of a commendation of the journal qualified by a recommendation to the board of directors to improve it and endeavor to increase its financial success. It should be added that since last fall the work of editing the journal has been carried on by the secretary of the association, in addition to his other duties.

A prominent feature of the discussion was the manifest unwillingness of some of the members to leave essential managerial matters in the hands of the board of directors, based on an implied lack of faith in the wisdom and ability of the board. This same spirit ran through all the other business discussions. It came out again in resolutions to require the Board to publish a membership roster, reimbursing itself by making a charge for the roster.

The Financial Problem—In spite of a 20 per cent reduction in income during the year just closed, which reduction is attributable to loss of membership, a small operating profit was shown—as against a considerable deficit in each of the preceding two years—as the result of close economy. Expenditures were reduced nearly $60,000, half of this being represented by smaller payments to the chapters and half by economies in the national organization. But the irksomeness of this close economy, the desire by the chapters to have more money for their local work, and the constant pressure to enlarge national activities and to take up new ones, for which the money is lacking, combine to make the financial problem of the association its central source of worry.

The income of about $175,000 per year is by all considered to be insufficient, and meanwhile the membership is in part clamoring for reduction of dues. The treasurer reported that the figures "show conclusively that our association is face to face with a crisis that must be wisely met if it is to survive as a going concern." One phase of the situation is the constant friction between chapters and central headquarters, as suggested in the statement, "Experience has shown that some chapters are altogether too optimistic as to their expected income, and this has resulted in their expenses being greater than their income, resulting in past-due obligations and general disappointment, including actual hostility to national headquarters without any reasonable foundation."

Another phase of the financial problem is reflected in radically divergent ideas between various members as to the ownership of moneys collected. A case was reported involving a chapter which decided to disband; having a considerable sum of money in its treasury left from the share of the dues assigned to it for its local work, the chapter simply distributed this money to the members of the disbanding chapter. Prosecution of the persons involved was begun but by vote of the board at the convention was dropped.

A flood of resolutions to reduce the dues was presented to the convention, partly with the argument that the individual member cannot afford to pay $15, and partly on the ground that the returns are not worth this sum. After extended discussion, however, these proposals were rejected, a roll-call vote on one phase of the subject being 6,636 in favor of leaving the present dues unchanged, against 1,601 for a reduction. A proposal authorizing chapters to fix their own local dues was similarly defeated. In general, the conviction became evident that the financial salvation of the association lies in plugging ahead on the present basis, making sure every dollar spent is turned to good account.

Employment Service—Much discussion of the employment service now conducted by the central headquarters and independently by the larger chapters led to no definite result. But the discussion was marked by the determined demand of many members that the fees now charged for engagements obtained through the service be abolished. Employment service is the principal return which the association offers its member for his dues, it was claimed, and if a fee is charged the chief value of the organization is lost. A supplementary view was expressed in comparisons made by one or two delegates of the national and their own local employment service, which were unfavorable to the former, and assertions by men of the far West that the present national service benefits mainly the men in the Chicago territory. However, it developed that only a few of the Class A chapters are handling their employment service in business-like manner or to good effect, and practically no co-ordination of the local with the national work has been accomplished.

The outcome of all the discussion was (1) defeat of the proposals for free employment service, and (2) demonstration of the vital importance of the service to the association's membership.

Membership—Nearly 10,000 members were lost during 1922. Since the beginning of 1920 the membership figures (for Jan. 1) were 13,000, 24,500, 23,500, 15,000. The loss in membership was explained variously by different parties: It is the secretary's fault; it is largely a loss of railroad members, who became dissatisfied with the absence of promotional railway activity after the association had brought about increases in pay for railway men several years ago; it is due to the ineffective handling of national affairs and the throttling of local affairs by a grant of too little money and exercise of too much guardianship by the central organization, etc. That the quality of the membership is high was shown by the character of the men in attendance at the convention. Nevertheless, the loss of membership is of vital importance, if only because it increases the financial difficulties of the organization. It was decided to enter upon active efforts to rebuild and increase the membership.

Chapter Activities—Various reports on the activities of the local chapters indicated a somewhat unsatisfactory condition, in that some chapters are functioning well and arousing active local interest, while others are not. Many of the chapters have accomplished distinctly good results in connection with local legislation, appointments and improvements. In general, it would appear that the chapters have not yet found a real field of work, useful to the community and stimulating to their own membership. As the chapter work has more direct bearing on the members' interest in the organization than the national committee work or publications, the weakness of chapter activities probably has some causal relation to the loss of membership.

There was a great deal of discussion on the subject of the chapters, many delegates taking the view that they ought to be helped more by encouragement and suggestion on the part of the national organization. It was decided that a special effort should be made to assist, advise and encourage the chapters, through enlargement of the functions of the Chapter Activities committee, and probably also through the appointment of a traveling secretary to advise and encourage the chapters and exchange information on effective local working methods.

Decentralization—The chapter grumbling was the chief motive of further efforts at decentralizing the association. Two years ago, at the Buffalo convention, the first strong effort at decentralization was successful, barely stopping short of making the chapters completely independent units, loosely bound into a federation with clerical headquarters. The grant of local autonomy and a large share of the membership due funds to the chapters was not successful enough to prevent a partial return to the original condition at the next convention. But the preference for freedom from central government has remained strong enough with a minority of the membership to lead to persistent, well-organized efforts at Norfolk to tear down the entire organizational structure of the association and substitute one based on local and occupational-group independence. The supporters of this movement held that with more money the local chapter is bound to be successful, while the opponents pointed to the demonstrated lack of success of many chapters and the vital importance of the national committee work and other central activities. The efforts in the main were decisively outvoted, although some phases of the proposed reconstruction were referred to the board of directors for consideration.

A matter possibly connected with the chapter problem is the complaint made by one or two committees of apathy on the part of committee members and those to whom inquiries for data were sent. Another committee reported that its work was retarded by an acrimonious spirit of discussion, a further indication that local differences of view are strong and interest in nation-wide problems is affected by more than one difficulty.

Special Activities Demanded—A prominent feature of the reconstruction proposals presented to the convention was the various demands for activities in favor of special occupational groups of engineers. It was definitely proposed that the association be split up in such a way as to segregate from the dues certain sums to be applied in the interest of practicing engineers, engineers in teaching service, railway engineers, and so on. The movement was sponsored mainly by railway engineers, or those who claimed to speak for them. The argument is that since the increases of pay procured for them by the association's efforts several years ago, nothing further has been done for railway engineers, and that every member, and every class of members, expects and should receive full value or more for the dues paid. This value, it is claimed, should be measurable directly in terms of the class benefits received by each occupational class.

One expression of this movement was a radical reconstruction proposal submitted by the Chicago Chapter, under which a Railway Men's Technical Council would be organized within the association but quite independent of it in most respects, to represent professional railway engineers under the Esch-Cummins law. Apparently it would function without much regard to either the chapters or the central headquarters. This body would be supported by allotment of a large share of the dues of railway members of the association. The proposal was defeated, though even after full discussion no approach toward harmonizing of the opposing views was evident, and the vote was strictly factional.

Fight on Secretary—Much of the convention's time and energy were taken up by bitter quarreling over the secretary, C. E. Drayer. Representatives of a number of chapters came instructed to use every means to bring about the secretary's dismissal or resignation. Circular correspondence with all the chapters was initiated on this point by the Chicago Chapter a number of weeks ago. A number of chapters supported the movement, all generally blaming the loss of membership and straitened financial condition of the organization on the secretary, in so far as grounds for the fight were brought out at all. The matter was finally disposed of after the board of directors had strongly affirmed its faith and confidence in the secretary and charged that the criticisms and the opposition, such as they were, directed themselves against the board, whose executive agent the secretary had been. A vote of 5,300 to 2,100 upheld the position of the board.

New Officers—Webster L. Benham, consulting engineer, Kansas City, was elected president for the coming year, winning in a close contest over Robert I. Randolph, of Chicago, and Frank T. Payne, of New Orleans. The new vice-presidents are: Dean G. M. Butler, Tucson, and Morris Bien, assistant director of the Reclamation Service, Washington. The following were elected directors: W. H. Marsh, H. C. Ferry, J. C. Nagle, J. C. Kaulfuss, D. W. Patton, W. R. Harris, M. Z. Balph, and Philip Sellers.

On urgent invitation from the San Francisco chapter, the 1924 convention was allotted to that city.

Disastrous Maine Floods Due to Heavy Snow Storage

Record High Water in Several Streams Follow Rain on Deep Lie of Snow—Earth Dam Fails on Union River

By George C. Danforth
Chief Engineer, Maine Water Power Commission, Augusta, Me.

HIGH WATER and floods in most of the rivers of Maine during the first part of May caused considerable damage. In April the opinion was generally expressed that the absence of frost in the ground and the empty storage basins would prevent any serious high water during the spring runoff. Snow surveys made during the latter part of March on the Kennebec, Penobscot and Androscoggin headwaters, however, enabled the writer to give information to the press on April 1 that floods of considerable magnitude were to be expected on rivers from the eastern state boundary to as far west as the Androscoggin basin. These surveys showed about 50 per cent more water on the ground than in any recent year except on the Androscoggin where the amount was less than that in the spring of 1922.

TABLE SHOWING SNOW AND HYDROLOGIC CONDITIONS ON MAINE RIVERS—APRIL, 1923

	Andros. Above Rumford 2,090 sq.mi.	Kennebec Above Waterville 4,270 sq.mi.	Penobscot Above W. Enfield 6,600 sq.mi.
Average depth snow, inches 1922	40	18	24
Average depth snow, inches 1923	39	36	46
Water on ground, inches 1922	9.1	6.4	6.2
Water on ground, inches 1923	8.2	9.5	9.8
Water on ground, [illegible] 1923	39.57	93.97	149.59
Water on ground less available [illegible]	9.92	62.67	75.86
[illegible] sec. ft. for 10 days	11,500	72,800	87,800
Maximum recorded flow [illegible] day	55,200	127,000	76,300
Maximum recorded flow [illegible] hour		[illegible]	88,700
Maximum recorded flow [illegible] date	Apr. 15, 1895	[illegible] 1901	[illegible] 1909
Maximum daily flow per sq. mi.	26.4	[illegible]	[illegible]
Maximum hourly flow per sq. mi.		[illegible]	13.4
Maximum daily flow 1923	33,800	120,000	152,000
Maximum daily flow per sq. mi.	16.2	28.1	23.0
Maximum hourly flow 1923		[illegible]	[illegible]
Maximum hourly flow, per sq. mi.		32.0	23.3

Data for the Androscoggin [illegible] Walter H. Sawyer [illegible]

The largest dam affected by the flood was that at Graham Lake on the Union River, which was completed in December, 1922, by the Bar Harbor and Union River Power Co., and which failed on May 2. This is located about five miles above their Ambursen type dam at Ellsworth (see *Engineering News*, May 23, 1907).

The following data concerning this dam are of interest:

[illegible]

[illegible]

[illegible]

Type: Earth filled. Upstream slope, 3:1; downstream slope, 2:1. Concrete core on steel sheetpiling about 20 ft. upstream from center line of dam, El. 107.
Storage (20 ft. in elevation): 7 b.cu.ft.
Spillway: None. Controlled by gates.
Log sluices: 2 at El. 89.0 and 97.0, 8 ft. wide, concrete.
Gates: 3 steel Fainter gates, 15,000 sec.-ft. capacity; sills at 83.0.
Elevation of high water: 105.

The plans show a 15-ft. apron below the gates. It is believed that this distance was extended somewhat during construction. The material underlying this section was "stiff yellow clay" and "hard clay and gravel." This was excavated to hardpan, and sheet-steel piling was driven.

Officials of the company report that on April 29 the water stood at 103 in the reservoir. On April 30 it had risen to 104 and the gates were opened discharging 20,000 sec.-ft. for 48 hours while the elevation in the reservoir went to 107. The partial failure occurred at about 8 p.m. on May 2, when material under the gate section started to wash out. The excavation increased rapidly taking out part of the gate section and about 30 ft. of the earth fill east of the gates. Considerable of the stored water was released causing an additional rise of about 20 in. at Ellsworth. The dam there was uninjured although the power plant was flooded.

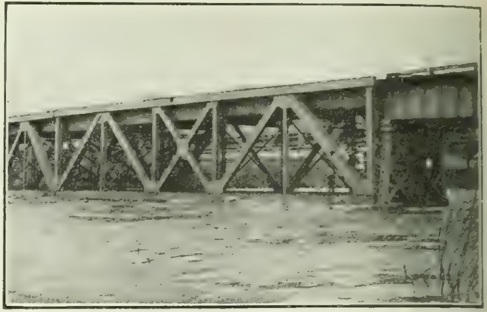
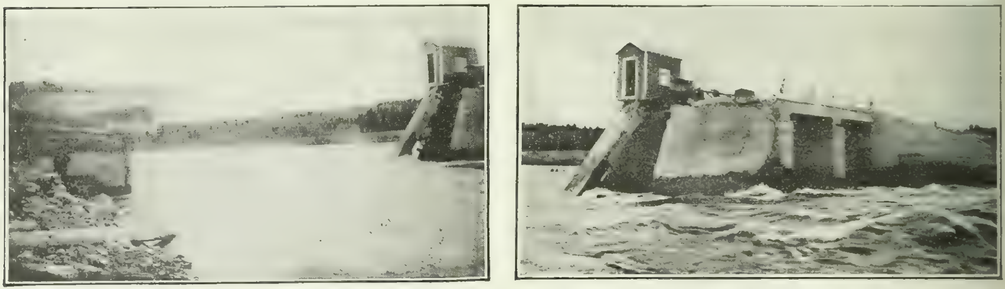


FIG. 3—MAINE CENTRAL R.R. BRIDGE, KENNEBEC RIVER WATER 18 FT. ABOVE NORMAL



FIGS. 1 AND 2—GRAHAM LAKE DAM, AN EARTH FILL WITH CONCRETE COREWALL AND GATE SECTION, ON UNION RIVER, ME. FAILED MAY 2, 1913

The highest previously recorded flow at the gaging station on the west branch of the Union River (discontinued 1919) was 2,160 sec.-ft. on the area of 140 square miles (15.4 sec.-ft. per square mile) on March 21, 1913. Estimates of the flow here during the recent flood based on an extension of the rating table and local reports concerning flow outside the main channel place this discharge at 7,000 sec.-ft. or 50 sec.-ft. per square mile. Applied to the 452 square miles at the dam this would give a discharge there of 22,500 sec.-ft., a figure which may be in error owing to the inadequate data available.

Had the rains of April 28-29 occurred three or four weeks earlier the maximum runoff would have been greater than any previously recorded and the results would have been disastrous. Not only would the amount of water have been greater but ice and log jams would have seriously complicated the situation. Between April 1 and 28 there occurred only 1.37 in. of rainfall and continued cold weather with sun and wind made conditions far less serious than might otherwise have been the case. The rain of the night of April 28-29 (3.25 in. at Augusta) and the night of 29-30 (1.15 in. at Augusta) was widespread over the state, taking off nearly all the snow and resulting in property damages estimated at between three and four million dollars, particularly on the Kennebec, Penobscot, Union and St. Croix watersheds. Many bridges were washed out and railway, trolley and highway transportation was entirely discontinued over a considerable part of the state.

Maximum discharges at a few of our river gaging stations were as follows (preliminary and subject to revision):

	Area Sq.Mi.	Discharge Sec.-Ft.
St. John River at Van Buren	8,270	134,000
Piscataquis River at Foxcroft	286	15,200
East Branch Penobscot River at Grindstone	1,070	30,900
Kennebec River at The Forks	1,570	20,900

Water was 13.5 ft. over the dam at Waterville and 11.5 on the dam at Augusta and was in the ash pits of the steam station of the Central Maine Power Co. near Gardiner. Industrial and hydro-electric plants were in general either flooded out or rendered ineffective by elimination of head on account of extreme backwater.

Some comments might be made concerning the proposed legislative franchise for the Dead River storage reservoir which was vetoed by Governor Baxter during the recent session of the Legislature. When passed over his veto a referendum was invoked by the Governor. The proposed reservoir of ten billion cubic feet capacity would have eliminated the runoff of 500 square miles of area contributing directly to the flood conditions and would have materially lessened the damages on the Kennebec basin. It would also have supplied sufficient storage to enable industries on the river to maintain their low water power at more than present plant capacity.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Engineers in Railway Service

Sir—Referring to letter signed "Railway Engineer" published in *Engineering News-Record* of April 19, 1923, p. 720, I beg leave to reply to the statements expressed, in the name of the large number of loyal engineers in the railway service.

It is true that engineering employees are transferred from time to time in the interests of the service. In its very nature a railroad's business covers large areas of country and its plant requires attention in its various locations. Men are used in one locality as much as possible, but it is necessary for a man who desires to rise in the railroad world to become acquainted with his railroad's property; this cannot be done very fully without moving. Transfers often mean increased pay and opportunity, and free transportation for the engineer and his family is furnished and generally for his effects as well.

Railway salaries I think average up with any other line of engineering rates of pay, continuity of service and all things considered. They are generally insufficient in all lines.

It has been my observation that most engineering department employees considered their work broadening and not narrow and that the many varieties of work encountered and satisfactorily performed well fitted them for other than railroad work. The large number of successful engineers with railroad experience all over the country tends to show that railroad engineering is instructive.

The charge as to advancement of relatives, etc., is from my observation particularly objectionable. The railroad officers of this country, to an extent I think not shown by any other business, have risen from the ranks step by step, being the products of successive selections of the most fit material in the different grades which they have occupied. A railway organization more truly represents the American ideals of self achievement than any other business of which I know. A railroad officer achieves success only by getting his work done properly, usually under the spur of competition. To have that work done well it is necessary that the best men available be selected to do it or he himself fails. Self protection if nothing else would require selection of competent men for positions of responsibility and not friends and relatives.

The "Bullying and insulting tactics of many railroad executives and their encouragement of such methods" does not deserve much notice, as in any large business conducted in an orderly way a certain discipline must be maintained, but it sits lightly on those who do their work well. The atmosphere of the average organization is exceedingly pleasant and the *esprit de corps* is remarkable.

It can be stated as a fact that there is no royal road to high position in the railroad service and the aspirant for position must bear the heat and burden of the day, but for well prepared, able young men of character there is an opportunity for exercise of ability with the accompanying rewards for success and an immense satisfaction in a connection with a properly functioning transportation system.

JOHN LANSDALE, Valuation Engineer,
Houston, Texas, Southern Pacific Lines.
April 25, 1923

[It is refreshing to get an impression of this kind from an engineer who has worked up in the railroad service from the position of a rodman, and who feels that the frequent moves that railroad men are called upon to make are, in the long run, worth the price.

The principle underlying what Mr. Lansdale says about the need of such moves is obviously correct but the method of making them, which is still in vogue on most railroads, is not above question. If a man's services to a company are of such a character that he deserves advancement, then it would seem that he should be consulted before the final decision to move him is made, rather than keep him in the dark until time to make the change and then order him to make it at once. Such a sudden change often puts him or his family to great inconvenience.

Undoubtedly on some of the great railroads of this country "bullying and insulting" of junior officials and men is a thing of the past. Unfortunately that is not true on all our railroads. It still exists to a surprising degree on one of the largest systems on this continent, starting with the vice-presidents and spreading down through the whole organization. Discipline can be, and is, maintained without such tactics.—EDITOR.]

How Can We Stop Duplication of Orders?

Sir—Regarding the editorial in *Engineering News-Record*, April 26, I wish to advise that our policy in placing orders has been to cover fully the jobs which we have on hand and not to prospect on propositions in the future. If a contractor wishes to protect himself to take care of a rise in the market I think there should be some manner in which he should protect the manufacturer so that the manufacturer would not be a victim of loss in case there should be a fall in the market or in case of cancellation of orders.

At this particular time when the building trades are so busy the placing of promiscuous orders is very serious and a procedure which should be stopped, because the contractor with a bona fide order and a contract to fulfill is sometimes made the loser on account of the fact that a less responsible contractor might cover himself for quantities which he may think he will need.

Pittsburgh, May 8. J. B. KELLY,
Mellon-Stuart Co., Contracting Engineers.

Sir—We are very much in sympathy with your apprehensions with respect to the rising cost of materials and the shortage of labor, and we are with you very much in the movement to establish conditions on a more sound, stable and continuing basis. We are at every opportunity advocating this with our bankers and prospective building owners.

We do not find, in so far as contractors are concerned in this locality, however, a duplication of orders on manufacturers. They are only buying what they require for specific work. I have analyzed this pretty thoroughly and believe that this statement covers the situation in this district accurately. We do not believe that dealers are altogether frank in some of the statements that are being made, at least so far as some sections of the country are concerned, but we believe that with the proper attitude on their part, cancellation could only be had on a basis of reimbursement that would be satisfactory to them.

It is possible that there are equipment dealers taking advantage of the situation in placing orders with their manufacturing connections for more than they have any idea of using, in the hope of getting what they expect to use and cancelling the remainder of their order. This is a vicious practice and should be abandoned, but we believe it could be well handled at the source.

We are glad to have this opportunity to discuss this matter by correspondence, and we firmly believe that we will not have difficulty in this section in the respects mentioned. If the manufacturers will establish a closer connection between themselves and the users of materials and equipment, they will find they have eliminated a great many of the troubles they are now experiencing.

In our opinion there are entirely too many agents and middlemen representing manufacturers and we think this is one of the important elements in the rising costs. We do not hesitate to make the statement that, in so far as our business is concerned, the agent, unless he carries a stock on hand, is a liability in a transaction rather than an asset to us. You will find on close analysis that the difficulty is not with the buyer, who is capable of handling properly the enterprise in hand; very likely it is not with the manufacturer so much; more likely will it be found with the distributor who takes no chances whatever and represents a profit entirely incommensurate with the service rendered. Wherever it is possible we buy direct from the manufacturer, and we have no complaints to make against those with whom we are regularly doing business.

H. W. BAUM,
President, H. W. Baum Co., Engineers and Contractors.

Salt Lake City,
May 8.

Sir—I have read the editorial in *Engineering News-Record* of April 26, with reference to the protection of building material and the duplication of orders. It is difficult for me to realize that such a practice is as prevalent as you say it is, for I have always felt that a material contract was as binding upon the buyer as upon the seller. There is no question in my mind that the obligation arising out of such a contract is mutual, and should not be subject to cancellation except for a cause, and by mutual consent of both parties to the contract.

C. S. LAMBIE,
President, The C. S. Lambie Co., Engineers and Builders.

Denver, May 8.

Roadway Widths and Traffic

Sir—The paper by O. L. Kipp, construction engineer, State Highway Department of Minnesota, in your issue of April 19, 1923, p. 699, is interesting. The economics of highway design is a subject that is of great importance and one to which, quite generally, too little attention has been given.

Mr. Kipp's paper presents the matter clearly and in terse form, but some of his assumptions and, therefore, some of his conclusions seem doubtful. His ideas as to the value of reducing distance and grades are by no means conclusive and it is extremely doubtful if a problem involving the many variables to be considered in highway traffic can be reduced to such a mathematical analysis; but the point in his paper to which special attention should be called is his discussion of roadway widths. He makes the assumption that if a roadway width of 30 ft. gives one hundred per cent traffic capacity, a width of 24 ft. has fifty per cent and a width of 20 ft. has twenty-five per cent capacity.

At any point and time, a roadway will have one, two, three or more vehicles in a line transverse to the roadway, and the capacity of the highway is determined by the lines of travel it will accommodate. A roadway 18 ft. or 20 ft. wide is adequate for two lines of traffic and since, in the majority of cases, there is a marked preponderance of travel in one direction, at a particular time, there is usually an opportunity for the faster moving vehicles to pass the slower ones without interfering with travel in the opposite direction. This fact makes the usual highway width of 18 to 20 ft. capable of carrying a larger percentage of traffic, per unit of width, than any other. It is difficult to see how a roadway 24 ft. wide will accommodate more traffic than one 20 ft. wide, since it is evident that a width of 24 ft. will not sustain three lines of traffic; or, if it is contended that it will, certainly 30 ft. will not sustain four lines. The only advantage a 30-ft. roadway has over a 20-ft. roadway, so far as traffic capacity is concerned, is that the 30-ft. roadway provides a lane through which high-speed traffic can more readily pass slowly moving vehicles, and this advantage of a 24-ft. roadway over a 20-ft. roadway is of very much less importance. Therefore, Mr. Kipp's assumption that a 24-ft. roadway has only 50 per cent of the capacity of a 30-ft. roadway, and that a 20-ft. roadway has only 50 per cent of the capacity of a 24-ft. roadway, is evidently incorrect and the conclusions based upon these assumptions are equally incorrect. Speaking generally, the assumptions made in the paper seem preconceived to sustain the argument for wide, direct highways paved with concrete.

It is conceded that many highways should be paved with concrete and that they should be wide and direct, but the mileage of such highways is very small compared with that mileage which can be made entirely adequate without the expenditures which Mr. Kipp's suggestions would entail and without the terrific traffic costs which he would charge to a less expensive type of construction.

A highway should be designed for the traffic it is to carry, just as a bridge or other structure, and expenditures for refinements should be made only after it is thoroughly demonstrated that they will result in an adequate return in traffic facility. It is feared that reasoning along the lines of Mr. Kipp's paper will not secure this result. In many places in this county, an extravagant expenditure of money in road construction has caused a reversal of sentiment that makes it difficult to proceed with any road program even though it be conservative and well within traffic needs.

L. R. ASH,
Consulting Engineer.

Kansas City, Mo., May 3, 1923.

More on Concrete Rock Borers

Sir—The report of Dr. Kofoid and Mr. Miller on the finding of rock borers in concrete at San Pedro, Calif. (*Engineering News-Record*, March 15, 1923, p. 499) may have over-emphasized the economic importance of these animals as indicated in the communication of Mr. Squire and in your editorial (*Engineering News-Record*, April 5, p. 608) but it must be remembered that these animals belong to the same group as the teredo and that with the increase in the amount of concrete subject to attack, they may increase in activity as the teredo undoubtedly has.

A report of an attack by the same animals has recently been received from Panama. The French dock at La Boca was built in 1898 on cylinder piers 5 m. in diameter. These piers were constructed in steel caissons 5 mm. thick, the steel being left in place, and it is thought that the concrete was of the same quality as other structures now in good condition, built by the French at the same time in the immediate vicinity on shore. This dock was condemned about two years ago and at an inspection made by engineers and a biologist belonging to the canal force on Nov. 15, 1922, it was found that the steel caissons had corroded through, or been destroyed by abrasion in a number of places.

At each point where the casing had been destroyed, it was found that there was a heavy attack of borers of several species and that the concrete was badly disintegrated. Whether the borers or the disintegration caused the first damage is not known, but the borers undoubtedly accelerated the action.

The general disintegration of concrete in sea water is caused by the action of the sulphates in the water on the free lime of the cement and the increased area offered to this attack as the result of the boring by animals undoubtedly increases the rate of dissolution of the concrete. There seems so far to be no evidence to prove that the borers will or will not attack undamaged concrete of maximum density, but the evidences of destruction from two ports so widely separated as La Boca and San Pedro certainly indicate such possibilities that it is unsafe to disregard the warning of Dr. Kofoid and Mr. Miller.

As stated in the editorial, however, the disintegration of concrete in salt water offers a problem of much greater importance, one which our committee is studying very carefully and one which deserves much more consideration than it has received from engineers in general. As in the case of the marine borers, the engineer must make more intelligent use of the work of the pure scientist than he has generally done if he is to build enduring structures.

WILLIAM G. ATWOOD.
Director, Committee on Marine Piling Investigations of the National Research Council.

New York City,
April 16, 1923.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The City of Columbus, Ohio Will Pave 25 miles of streets in 1923, if the projected program is carried out. This is more than any year since 1908, when 26.7 miles were paved. The total for the past ten years was 120 miles.

The State of California Requires the Services of a large number of engineers and draftsmen to carry out an extensive program of the California State Highway Commission and other engineering divisions of the state government. Requests for information should be addressed to the California Civil Service Commission, Forum Bldg., Sacramento.

Philadelphia is to Have a New Grain Elevator, built by the Reading R.R. Co. at Port Richmond, and costing over $3,000,000. The capacity will be 2,500,000 bu. and provision is to be made for increasing it to 3,500,000 in the future. With the addition which the Pennsylvania R.R. Co. is making to its elevators at Girard Point, the port of Philadelphia will have a working capacity of 6,000,000 bushel.

Award of a Contract Has been made by the Ford Motor Co. to Stone & Webster, Inc., Boston, for the building of a 10,000-hp. hydro-electric power plant on the Menominee River, near Iron Mountain, Mich. Other contracts to Stone & Webster are a hydro-electric and steam power plant and manufacturing buildings at High Dam at St. Paul, Minn., and hydro-electric power plants at Green Island, N. Y., and Flat Rock, Mich., the last two being recently completed for the Ford Motor Co.

Suit Has Been Filed in the Superior Court against the city of Tacoma, Wash., Ira S. Davisson, commissioner of light and water, and B. E. Torpen, engineer employed on the Lake Cushman power project, by Benjamin H. Petley, who claims that he should have the position held by Mr. Torpen. The complainant asserts that Commissioner Davisson, disregarding the civil service law, appointed Mr. Torpen when Mr. Petley, after taking the civil service examination, was given rank No. 1.

Among the Bills Which Passed the New York legislature at its recent session and now before Governor Smith are the Ryan bill appropriating $300,000 for the construction of a barge canal grain terminal at Troy, the Downing bill appropriating $1,000,000 for emergency repair work to highways of the state, and the Hackett bill authorizing construction of a bridge across the Hudson River at Poughkeepsie and appropriating $200,000 as the 1923 construction expense involved therein.

Motor-Vehicle Registration Now 12,239,114

According to figures just made public by the National Automobile Chamber of Commerce, New York in its annual publication, "Facts and Figures of the Automobile Industry," there were registered during the year 1922 in the United States 12,239,114 automobiles and motor trucks. Automobiles totaled 10,863,389 and trucks 1,375,725. California was the largest user of passenger automobiles, with 822,394, and New York State led in commercial vehicle registration with 185,858.

The gain in total registration for 1922 as compared with 1921 was 1,755,109 vehicles.

During 1922 the motor car output was 2,406,396 vehicles and the motor truck output 252,668.

Northern Canada Power Co. Gets Des Quinze Falls Lease

The right to develop power on the upper series of fifteen rapids on the Quinze River, known as Des Quinze Falls, near the head of Lake Timiskaming, Que., was sold at auction by the Quebec government at the city of Quebec on April 25. The successful bidder was Alexander Fasken of Toronto, on behalf of the Northern Canada Power Co. A lease of the power rights for 60 years was offered at an upset rental price of $8,000 per year and the competition was very keen, rival bidders being the Nesbitt Thomsom Co. of Montreal and the Montreal Engineering Co., Ltd. The lease was finally awarded at an annual rental of $80,100. In addition to this a special tax of 50 cents per hp. is imposed on all electric energy exported from the Province of Quebec. The conditions of the lease require the starting of power development within eight months and the production of 20,000 hp. within a period of four years. The possible development is estimated at between 50,000 and 60,000 hp. The principal markets for the power will be the Porcupine gold field and the new gold area in Quebec. The Northern Canada Power Co. will begin development immediately.

Big Creek-Los Angeles Line Now Carries 220,000 Volts

After preparations extending over many months, on the morning of May 6 the Southern California Edison Co. changed over from 150,000 volts to 220,000 volts on the 240-mile transmission line from Big Creek to Los Angeles. Although other transmission lines have been designed for this voltage, this is understood to be the first system that has actually transmitted power at this voltage.

N. Y. State Reorganization Bill Now Before Governor

One of the thirty-day bills passed at the recent session of the New York Legislature and now in the hands of Governor Smith is Senate Bill 1045, introduced by Senator Walker and known as the Public Works Law. The proposed act establishes the Department of Public Works which shall include the Bureau of Canals, the Bureau of Highways, and the Bureau of Public Buildings. It was originally planned to include the Department of Architecture in the Department of Public Works, but this provision of the act was stricken out before its final passage.

The act, therefore, transfers to the superintendent of public works duties now exercised by the Commission on Boundary Waters Between the United States and Canada, the Commission of Highways, the Interstate Bridge Commission, the trustees of public buildings and the superintendent of public buildings. Terms of these officers are to expire when the law takes effect, unless reappointment is made by continuing as bureau chiefs the heads of existing state departments. The act proposes the establishment of the offices of commissioner of canals and waterways, the commissioner of highways, and the superintendent of public buildings, each to be appointed by the superintendent of public works.

In the event that Governor Smith signs the bill, the act is to take effect July 1, 1923.

Timber Preservation Progress in New Jersey

Tie and timber men from all over the country were enabled to make an unusually complete inspection trip on May 9 and 10 through arrangements made by C. M. Taylor, superintendent of the Port Reading Creosoting Plant. The trip began with an inspection of various installations of treated ties on the Philadelphia Public Service Electric Ry. This was followed by an inspection of experimental ties at Stratford and a trip to Atlantic City. On Thursday the party started at Philadelphia and went to Port Reading, N. J., over the Reading R.R., stopping en route to examine several out-of-face tie installations and experimental sections in which different kinds of tie and different methods of treatment had been used. At the Port Reading Creosoting Plant the plant officials demonstrated the results that they were obtaining in treating various hard and soft wood ties. Sample ties from each class were sawed and split to show the depth and kind of penetration which had been obtained. The tests were of particular interest as the Port Reading Plant is experimenting in the use of a mixture of 30 per cent English creosote and 70 per cent fuel oil for full-cell treatment. This is a distinct departure from the usual practice

Engineering News From the Railroads

Construction Work Has Begun on the Northern Pacific's new 35-mi. line into the Castle Rock country in Montana.

Contracts Have Been Let for the construction of a 35-mile railroad into the Tea Pot Dome Oil fields in Wyoming.

The Minneapolis, St. Paul and Sault Ste. Marie R. R. Co. reports a net income of $995,416 for 1922 as against a deficit of $6,237,672 for 1921.

The Southern Pacific Has Been granted authority by the I.C.C. to begin the construction of a new line 21 mi. long into agricultural territory near Bakersfield, Calif.

The Net Income of the St. Louis-San Francisco R.R. Co. dropped from $3,225,680 for 1921 to 753,013 for 1922. The decrease is largely due to the effect of the shopmen's strike.

One of the Largest Pieces of new railroad construction undertaken in recent years is the construction of a line from Miles City, Mont. to Bucknum, Wyo., a distance of 330 miles.

The Interstate Commerce Commission has placed a tentative valuation of $129,810,913 on the property of the Oregon-Washington Railroad & Navigation Co. The company's own valuation is $156,642,559 while its outstanding stocks and bonds have a par value of $152,840,671.

The Maryland, Delaware & Virginia Ry. has been sold to the E. B. Leaf Co. of Philadelphia. The purchaser will scrap the whole line unless they get a satisfactory bid for all or a portion of it from parties interested in maintaining the railway for the operation of self-contained motor cars.

Additions to the Extensive Freight yards at Mingo Junction, near Steubenville, Ohio, are to be made by the Pennsylvania R.R. at a cost of $514,000, making the total cost of these yards nearly $5,000,000. Besides twenty-three new tracks with capacity for 1,360 cars, there will be a new car repair shop, machine shop, oil and store houses, a 50,000-gal. tank and a caboose yard.

Authority Has Been Given by the Interstate Commerce Commission to the Chicago, Peoria and St. Louis R.R., a line 234 miles long, permission to abandon the whole line. This is the largest railroad in the country to be abandoned, and as it runs through a prosperous country the action has aroused considerable interest in the need of consolidating these small lines with the large railway systems.

The Interstate Commerce Commission has denied the application of the Wenatchee Southern R.R. Co. for authority to build a railroad south from Wenatchee, Wash., to a connection with the Chicago, Milwaukee & St. Paul, and the Oregon-Washington R.R. and Navigation Co. The commission, has, however, granted the company an opportunity to make a second application which will show in detail the need for the new railroad.

Gen. Henry M. Robert Dies

Brig.-Gen. Henry Martyn Robert, U. S. Army, retired, author of Robert's Rules of Order, and former Chief of Engineers, died at Hornell, N. Y., May 11, age 86 years. Gen. Robert was born in Robertville, S. C., May 2, 1837. He entered the U. S. Military Academy in 1853 and upon graduation in 1857 was made assistant professor of natural history and astronomy and acting assistant professor of practical military engineering. A year later he was ordered to Washington territory with a detachment of troops to take command of engineering operations in a campaign against the Indians in Oregon and Washington. After several years' service in the West he was ordered East, just before the outbreak of the Civil War, and at the beginning of hostilities was placed in charge of the construction of a portion of the defenses in the city of Washington. This responsibility proved too heavy a strain, as his health had been undermined seriously by an attack of Panama fever contracted while taking troops to Washington territory via the tropics; he was transferred to Philadelphia for the construction of defences. Later, his health again proving insufficient, he was transferred to New Bedford, Mass., where he continued throughout the war. After the war he was placed in charge of the department of practical military engineering at West Point.

In 1867 he was transferred to San Francisco as chief engineer of the military division of the Pacific. Subsequent transfers placed him in charge of defenses of the Columbia River and the operations of the 13th Lighthouse District, of harbor improvements in Oregon and Washington, of lighthouse construction on Lake Michigan, and harbor improvements on Lake Michigan, Green Bay, and Lake Superior. Later activities were various river and harbor work on Lakes Erie, Ontario, and Champlain, and the St. Lawrence River. The Corps of Engineer activities in the neighborhood of Philadelphia were under his charge for five years. In 1890 he became engineer-commissioner of the District of Columbia and in 1891 was placed in charge of improvements on the Tennessee, Cumberland, and other rivers. Still later he supervised river and harbor work on Long Island Sound and the fortifications of Long Island Sound and New York Harbor.

In 1895, with the rank of colonel, General Robert began the most fruitful period of his engineering career. He was made division engineer of the Southwest Division, which included eleven engineer districts from Pittsburgh to Galveston, with headquarters in New York. He continued in that capacity until April 30, 1901, when he was made Chief of Engineers, U. S. Army, and given the rank of brigadier-general. However, under the operation of the retirement law he held the position for only three days.

Though General Robert will be long remembered as closely connected with engineering operations in many parts of the United States, probably the port and city with which his name will be most connected is that of Galveston, Tex. Following the tidal wave disaster there in 1900 he was appointed chairman of the board of engineers to report on methods of preventing destruction by future tidal waves. The board's studies resulted in a recommendation for a sea wall, which, under modified design, was built and has effectively served the city on two subsequent occasions. After the storm in 1909 General Robert was called in again to report on the repair of the damage and again after the great storm in 1915 he was called upon to recommend still further measures of protection.

A biography in appreciation of General Robert's contributions both as an engineer and as a parliamentarian appeared in *Engineering News-Record*, April 22, 1920, p. 798.

Penn State to Hold Conference on Industry and Engineering

The fourth industrial and engineering conference sponsored by the engineering school of Pennsylvania State College is to be held May 25 and 26. The engineering extension convention is held the two days preceding to outline the educational work carried on in the industries. The purpose of the conference is to bring representatives of Pennsylvania industries employing technical men into closer contact with the college for the study of problems of mutual interest.

Listed in the program are the following subjects for discussion:

"Industrial Research and How Can the College Aid," "What Industry Expects of the College Graduate," "The Department of Labor and Industry and Technical Education," "Engineering Extension, What Is It?" "What Will Be the Demand for Trained Technical Men During the Next Decade," and "How and to What Extent Can the Industries and the Engineering Experiment Station Co-operate in Research,"

Aside from the set program visitors will be given an opportunity of visiting the school of engineering and other branches of the college.

The conference arrangements are being made by R. L. Sackett, dean of the engineering school.

Pennsylvania Holds to Former Position in Shop Crafts Case

The Pennsylvania R.R. Co. will be called before the Railroad Labor Board on May 21 for a hearing to determine if it shall be cited for violation of another decision of the board. This action is to be taken in view of the railroad company's definite refusal to hold another election to select employee representatives in the shop crafts despite the adverse ruling of the Supreme Court. Samuel Rea, president of the road, states, in this connection, that conditions have materially changed since the Labor Board issued its order; that the shop crafts employees have indicated their approval of the former election by the unanimous vote of their 775 elected representatives to retain the present plan of employee representatives; that in effect the Supreme Court decision approved the action of the railroad company; and that under these circumstances the company has no choice but to abide by the employees' decision.

Traffic Association Holds Annual Meeting

Committee Reports Stress Need of Extending, and Unifying Measures of Highway Safety

DEFINITE recommendations to guide the design and construction of highways in the interests of safer traffic were embodied in the committee report submitted by H. Eltinge Breed, consulting highway engineer, New York, at the annual meeting of the National Highway Traffic Association held in New York City, May 10. In addition, nine other progress reports were received from committees on danger signs, mechanical devices, motor-vehicle regulation, truck overloading, grade crossings, transport franchises and clearing houses, and highway financing. The afternoon and the evening sessions of the meeting were presided over, respectively, by Arthur H. Blanchard, of the University of Michigan, president of the association, and David Beecroft, directing editor, Class Journal Co. New York, vice-president. The evening session was featured by an analysis of the national transportation problem by J. Rowland Bibbins, consulting transportation engineer, Washington, D. C., and a statement of policies affecting equitable distribution of highway construction costs by William H. Connell, recently appointed assistant state highway commissioner of Pennsylvania.

SAFETY RECOMMENDATIONS

The figures presented in Mr. Breed's committee report showed that the total registration of motor vehicles in the United States is now more than 12,000,000, that 14,000 deaths from automobile accidents occurred in 1922, and that 90 per cent of the automobiles and trucks operate upon 10 per cent of the nation's highways. To insure traffic safety under these conditions the committee included the following in its recommendations:

Banking on all curves of more than 3 deg., the superelevation to vary from 0 for a 3-deg. curve to 1 in. per foot of width for curves of 20 deg. or sharper; widening curves of more than 4 deg. ½ ft. on the inside for each 1-deg. increase in curvature; painting guide lines on pavements at all vertical or horizontal curves; providing 500 ft. of clear sight at vertical or horizontal curves; making radius of curves not less than 1,000 ft. under special conditions; erecting guard rails on inner edge of all curves of more than 8 deg.; elimination of advertising signs; progressive elimination of grade crossings; widening single-track bridges to double-track width; providing sidewalks along highways in congested areas.

In his report on highway danger signs, G. C. Dillman, deputy state highway commissioner of Michigan, recommended the use of distinctive shapes of sign to indicate various traffic directions. The meeting, however, expressed its preference for indicating danger or caution by descriptive or graphic means.

The color red, according to the report on mechanical devices for traffic regulation by Prof. Louis W. McIntyre, University of Pittsburgh, should not be used for traffic regulation signs, control lights or anything except to indicate danger of the first degree. Position lights, in his opinion, are better than colored lights for traffic control signals. For the relief of traffic congestion in cities, Prof. McIntyre believes that progressively controlled signals are more effective than synchronously controlled signals. The progressive control system would make traffic move in platoons which would not stop until they had traversed the complete length of the main thoroughfare.

In reporting on motor-truck regulation, George H. Pride pointed out that the high speeds made possible by the use of pneumatic tires on trucks originally designed for solid tires called for more powerful braking equipment than ordinarily exists.

The new standard caution plate for motor trucks adopted in January by the Motor Truck Division of the Nation Automobile Chamber of Commerce was described by D. C. Fenner, of the International Motor Co., New York. The new plate provides space for inserting all the weights needed for rating, classification, licensing, operation and regulation of the truck.

Highway financing methods, according to the committee report of William H. Connell, must be adapted in every case to local conditions. As a general principle he stated that original construction cost should be a capital charge, but that the cost of maintenance and of replacement, even when a higher type of surface is substituted for the one originally used, should come out of operating revenue derived from the user of the road. As part of its policy of safety to traffic, Commissioner Connell announced that the Pennsylvania State Highway Department had adopted as standard a wire-cable guard rail at curves, embankments and other danger points, and that this single detail of its program would require the expenditure of $750,000 per year for the next four years.

Ohio Sewer Rates and Maintenance Act Becomes Law

The bill authorizing Ohio cities and villages to charge for the use of sewers and to provide for the proper operation and maintenance of sewerage systems and sewage-works has become a law without the signature of the governor, provided that within 90 days a petition for a referendum vote on the bill is not filed. The bill was enacted substantially as outlined in *Engineering News-Record*, March 15, 1923, p. 509, except that in "home-rule charter" cities the authorities may designate the official or department that shall administer the provisions of the act.

Re-grading Project Under Way on Beacon Hill, Seattle

A contract for sluicing 1,500,000 cu. yd. of material from the ungraded portion of Beacon Hill, Seattle, into tidelands along Ninth Ave. South of Sixth Ave. South, has been entered into by property owners of that district and the Puget Sound Bridge & Dredging Co. The price is 39c. per cu.yd. and the work is to be completed within twenty months. William H. Lewis, former manager of the sluicing department of the company, will be in charge.

This year's officers of the association were re-elected for another term. They are: President, Arthur H. Blanchard, University of Michigan; vice-presidents, David Beecroft, R. C. Hargreaves, L. A. Nares, Charles M. Upham, and Jack F. Witt; secretary, Elmer Thompson; treasurer, George H. Pride.

Mechanical Filtration Plant for Washington, D. C.

INSUFFICIENCY of the Congressional appropriation has made it necessary to postpone until next winter the call for bids for the additional filtration plant for the water supply of Washington, D. C., instead of letting the contract in July, as was intended. The Corps of Engineers, U. S. A., estimates that two years will be required to build the plant. The existing filters, which have been in use for a number of years, are of the slow sand type. The new ones will be rapid or mechanical filters forming a part of the works for an increased supply of water to the District of Columbia. There will be twenty 4 m.g.d. units. Allowing for two units being out of use for cleaning, the new plant will have a working capacity of 70 m.g.d. or slightly more than the existing slow sand filters. The plant will follow the general lines of the one now in use at Baltimore, Md. It is planned to use the surplus water to develop power for the operation of the pumps. For a number of years to come there will be a large surplus of water, from which it will be possible to develop some 1,500 horsepower. A general view of the projected plant is shown above. It was designed by the U. S. Engineer's office, Charles H. Rener, Architect.

Suggest Metropolitan Planning Committee for Chicago

Regional planning for Chicago has been given a start by a call for the appointment of a committee of twenty-one members by the president of the City Club. At least one-half are to reside outside the city limits. Addresses at the recent initial meeting of public officials and interested citizens were made by Samuel Insull, president of the Commonwealth Edison Co., on future power development; Dr. W. H. Evans, former health commissioner, and feature health writer for the *Chicago Tribune*, on health and sanitation; Harry Pearson, mayor of Evanston, on suburban housing; Jacob L. Crane, city planning expert, on the necessity of a plan to prevent haphazard growth; C. H. Wacker, head of the City Plan Commission, on what has already been done; and Prof. Charles E. Merriam, on the governmental obstacles.

Road Contractors Must Finish 1923 Work to Get 1924 Jobs

Contractors building roads for the Indiana Highway Commission must complete their projects on scheduled time this year or they will be regarded as unfit to compete in the bidding for 1924 contracts, according to John D. Williams, director of the commission.

"Indiana is going to have a completed system of main market highways not only connecting all parts of the state, but facilitating interstate and transcontinental traffic by the end of 1925, and the state highway commission does not propose to be delayed by the failure of contractors to complete their work within a specified time," Mr. Williams said.

Under the three-year paving program of the commission, 153 miles of highway will be hard-surfaced this year, 405 miles in 1924 and 400 miles in 1925, Mr. Williams said. Mr. Williams said that in 1922 the paving program proposed for the year was almost entirely completed on time.

Cacapon Dam Under Control of Federal Power Commission

The project of the Cacapon Power Co. on the Cacapon River, near Martinsburg, W. Va., has been found to come within the jurisdiction of the Federal Power Commission. The project involves the erection of a dam 175 ft. in height, which will provide 150,000 acre-ft. of live storage.

The interests behind the Cacapon Power Co. are the same as those behind the Cheat River development. This Cacapon storage will be of great value in taking care of the peak loads on that system and in providing power during periods of minimum rainfall. This is one of the free storage sites relied upon by Major Max Tyler in his plan for the development of Great Falls on the Potomac.

Fire Protection Association Meets in Chicago

Reports of committees on automatic sprinklers, fire pumps, private fire supplies from public mains, hydrants and valves, and a tentative building exits code, were matters of engineering interest at the twenty-seventh annual meeting of the National Fire Protection Association, held in Chicago May 8, 9 and 10. Also, changes in former automatic sprinkler regulations were submitted, together with a section defining outside protection requirements as to layout, size, kind and location of pipes and hydrants, monitors, valves, blow-offs and tests. Tentative regulations were submitted for fire department hose connections for sprinkler and standpipe systems and for steam turbines driving centrifugal fire pumps. The report of the committee on private fire supplies for public mains was largely an analysis of the basis for charges for public service connections.

Much criticism was given from the floor against the committee on safety to life for going into the question only from the standpoint of getting people out of burning structures rather than in paying attention to the structure itself. Slide escapes were decidedly ruled out of the 50-page tentative building exits code submitted.

Engineering Societies

Calendar

Annual Meetings

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; Annual Convention, Ithaca, N. Y., June 20-23.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Detroit, Mich., May 21-25.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29.

The Brooklyn Engineers' Club, at its meeting May 10, elected the following as officers for the ensuing year: Linford S. Stiles, president; Calvin C. Hough, vice-president; Joseph Strachan, secretary; William H. Wharton, treasurer; Philip P. Farley, F. E. Cudworth, J. B. French, W. J. Shea, and Peter B. Bie, directors.

The Providence Engineering Society at its May 15 meeting was addressed by Robert Ridgway, chief engineer of the New York Transit Commission, on features of rapid-transit construction in New York City.

The St. Louis Railway Club at its annual meeting elected the following officers; president, Edward Clemens; vice-presidents, K. B. Hannigan, R. C. White and W. E. Williams; secretary and treasurer, B. W. Frauenthal.

The New Jersey State Highway Department will employ convicts from the state prison at Trenton and the Rahway reformatory on the roads in the vicinity of the two institutions.

American Association of Engineers' Annual Convention, Norfolk, Va., May 7-9.

Personal Notes

Rudolph P. Miller has been reappointed representative of the Federated American Engineering Societies on the National Board for Jurisdictional Awards for the term of office beginning next August.

R. W. Edwards, former general superintendent of transportations of the Missouri, Kansas & Texas R.R., has been appointed district manager of the car service division of the American Railway Association at Toledo, Ohio.

W. E. Copeland is now structural steel designer for Stone & Webster, Inc., Boston, Mass. Until recently he was engaged in the same work with McClintic-Marshall Co., of Pittsburgh.

G. M. Rapp, former structural draftsman of the Bethlehem Steel Bridge Corp., is now with the Delaware River Bridge Joint Commission, engaged as a junior engineer in the design department.

Frank F. Healey has been employed by the Chamber of Commerce of the United States as consulting engineer to its building committee in the design and construction of the new home for the chamber in Washington, D. C. Mr. Healey was recently with L. E. Myers Co., Chicago, Ill.

O. W. Gatchell has been made office engineer in the Carolina headquarters for the Phoenix Utility Co., contractors. Mr. Gatchell formerly was assistant to Frank T. Miller, consulting civil engineer of Greensboro, N. C.

James D. Andrew has recently become associated with the engineering, construction and management firm of Stevens & Wood, Inc., New York City. Mr. Andrew has been placed in charge of the Youngstown, Ohio, office.

S. H. Showell has joined the staff of the Lakewood Engineering Co., manufacturer of construction equipment, as sales engineer. He was formerly superintendent of road construction with Smith & Quynn of Parkersburg, W. Va.

R. M. Strohl, until recently engineer with the Carolina Engineering Co., has become a partner in the general contracting firm of Clague & Strohl, Bowling Green, Ohio.

R. F. Kellogg, for the past four years resident engineer on highway construction with the Bureau of Highways of Idaho, has recently joined the engineering staff of the State Road Commission of West Virginia. He is employed on the construction of the Northwestern Turnpike and is stationed at Gormania.

H. W. Hartmann, until recently superintendent of construction with W. C. Meneely Co., has become the senior partner in the firm of Hartmann-Clark Bros. Co., contractors of Dwight, Ill.

Alexander W. Blyth, for the past three years connected with the Communipaw Co., New York City, as construction manager has resigned and has accepted a position as chief engineer with Louis Chevalier, Inc., contractors and builders, New York City.

Hugh Pattison has been appointed electrical engineer of the Virginian Ry., with offices at Roanoke, Va., and will have charge of the electrification of the 135-mile division crossing the Allegheny mountains. He was formerly electrical engineer of the Illinois Central R.R. in planning the electrification of its Chicago terminal lines.

Dr. Philip B. Woodworth, president of Rose Polytechnic Institute, Terre Haute, Ind., has been granted an indefinite leave of absence, at his request. For two years he has been busy with the design and construction of the new buildings, opened early in 1923 and some weeks ago he suffered injuries in an automobile accident.

James G. Steese, president, Alaska Road Commission, has been appointed in addition chairman and chief engineer of the Alaskan Engineering Commission, operating the Alaska Railroad. John C. Gotwals, chief engineer, Alaska Road Commission, has been appointed vice-chairman in charge of operations.

Samuel Fleischer, of the Fleischer Construction Co., Minneapolis, Minn., is an incorporator for the Marion Holding Co. and the Cecil Holding Co., recently incorporated under the laws of Colorado to do building construction in that state.

Herbert Flagg, chief engineer of the State Department of Public Works, Olympia, Wash., has been appointed a member of the advisory committee of the valuation committee of the National Association of Railway and Utilities Commissioners.

Albert B. Bartlett, a graduate of the University of Missouri, lately assistant state engineer for Wyoming, has been appointed state geologist by Governor Ross.

R. V. Glenn, consulting engineer for Tarrant County, Texas, at Ft. Worth, in charge of highway construction since 1920, has resigned, his resignation to become effective May 1. Mr. Glenn was formerly connected with U. S. Bureau of Public Roads.

R. G. West, construction engineer formerly with James Stewart & Co. New York City, is now with Thomas M. Murray, building contractor of Houston.

E. E. Sands and **R. J. Cummins** have formed the firm of E. E. Sands & R. J. Cummins, Mason Bldg., Houston, Texas, consulting engineers. This firm is engaged in preparing preliminary plans for dock construction at Corpus Christi. Mr. Sands was formerly city engineer of Houston and at present is president of the Texas Section, Am. Soc. C.E. Mr. Cummins is a well known construction engineer.

S. B. Thayer, Son & Co., engineers, organizers and financiers of Wilmington, Del., have moved their office to the Munsey Building, Washington, D. C. This change will not affect offices in other cities maintained by the Thayer company.

John E. McIntyre formerly assistant resident engineer on federal-aid highway work in Shawnee County, Kansas, has accepted a position as assistant state highway engineer, Kansas Highway Commission. Mr. McIntyre is a veteran of the World War having seen service overseas with the [illegible] Engineers.

Major F. R. Schanck, consulting engineer, Chicago, for the Columbia Valley Power Co., New York, is making surveys and engineering investigations preparatory to the construction of two-hydro-electric power plants, totaling 175,000 hp., on the Deschutes River, Ore.

Obituary

W. G. Comber, Assistant Engineer attached to the office of the Chief of Engineers, U. S. Army, died en route to that city recently from Portland, Ore. Mr. Comber had traveled extensively where the Corps of Engineers was executing work, taking charge or planning dredging operations. From 1906 to 1917 he was in Panama as resident engineer in charge of dredging operations on the canal. Mr. Comber was born in England but came to this country when a young man and began engineering as an axeman with one of the Mississippi River Commission's engineering parties.

Rex C. Starr was found dead on May 3 in the Lake Yosemite-LeGrande Canal of the Merced (Calif.) Irrigation District. Mr. Starr was the chief engineer of the Merced Irrigation District which had just completed the canal, a member of the firm of Thebo, Starr & Anderton, construction engineers, San Francisco, and construction engineer for the San Joaquin Light & Power Corp., one of the best known construction engineers of the Pacific Coast, Mr. Starr had been connected with many of the important projects in recent years and with other members of his firm carried on an extensive business in addition to the power company and the irrigation district interests to which he gave a great deal of his personal attention. All of the circumstances concerning Mr. Starr's death are not known, but a note found with his coat and hat on the bank of the canal lead to the belief that he took his own life while suffering from a nervous breakdown.

Donald S. Barton, formerly general manager, Canada General Electric Light Co., Levis, Que., and consulting engineer of the Quebec Railway, Light, Heat & Power Co., died in Quebec April 23. Mr. Barton was born in India and educated in England, and came to Canada in 1900.

James R. Scott, Jr., chief engineer for the Colorado Builders Supply Co., died in Denver, Colo., May 3, aged 37 years. Some years ago Mr. Scott was the designer and in charge of the Colfax-Larimer viaduct in Denver and the Salt Lake City viaduct. He was a graduate of the University of Illinois.

Charles W. Drake, 132 West 70th St., New York City, died May 8 at the age of 72 years. He was formely connected with the Missouri, Kansas & Texas R.R and the Denver & Rio Grande, and secretary of the Rio Grande & Western, but for the last fifteen years had been engaged in manufacturing in New York City.

Chauncey M. David, civil engineer, Denver, Colo., died recently in that city. He was a resident of Denver for more than forty years and built a part of the Denver & Rio Grande R.R. and the Colorado Midland R.R., and later took up the development of oil fields.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Performance Records Need Close Scrutiny

Best Test of Equipment is Cost of Work Over Extended Period

By D. C. Grove
Advertising Manager, Blaw-Knox Co., Pittsburgh

RECORD runs are usually the result of (1) a deliberate setting of the stage by the manufacturer or user of equipment to obtain the greatest efficiency within a specific time; or (2) a more or less accidental gathering together of ideal conditions. Neither of these cases represents a standard performance and the practice does more harm than good because it is apt to mislead not only the purchaser of machinery of a specific make but the purchaser of machinery of the particular type. In other words, misleading performance records may affect the entire trade and so do much to disabuse sales co-operation which has been so effective in promoting American business. If figures were compiled they would show that the cost of energy and brain power required for staging a run, plus the cost of clearing the way from outside interference, plus the drop in efficiency after the run, would be far in excess of any gain.

In some sections of the country, due to local conditions, remarkable speed can be made for a short period. Such speed constitutes what might be termed a record run. At the same time, conditions over which it is possible to exercise no control might prevent a repetition of the feat in another section of the country although similar equipment, same amount of labor and other factors present in the one test were on hand in the other.

Reliability of Figures

There is still another point to take into account when record runs are considered and that is: How reliable are the cost figures? It would probably be found that, in attempting to duplicate the progress, cost elements would creep in which had been either intentionally or accidentally disregarded in the first record and which would entirely change the original figures.

Experienced, practical men take record run figures with more than a grain of salt. The Blaw-Knox Co., for instance, in its Batcherplant, has an admirable machine with which to obtan record-run data. Its mechanism enables trucks or batch-boxes to be filled with premeasured aggregate just as fast as trucks and batch boxes can be run under the hoppers. This company, however, cannot control the movement of trucks and batch boxes so that any record run, based upon the operation of the Batcherplant, must reflect not only upon the efficiency of the plant itself, but upon all of the other elements which the contractor would contribute to accomplish a more than average run. On the other hand, if a contractor using the Batcherplant performed about half an average day's work in a day's time it would not be fair to reflect upon the Batcher-plant, as its mechanism will work just so long and just so fast as the operator can pull the lever.

In the same way we obtain a reaction from record performances of clamshell buckets where we often receive reports that a particular bucket has succeeded in unloading a tremendous number of cars within a certain time. Of course, this reflects favorably upon the bucket but the record itself is due as well to the good features in the crane, the ability of the operator and many other circumstances.

During last year's road building season this company received many instances of records established by Blaw-Knox turntables which helped many contractors establish record runs but they were not alone in making the record run possible. The effectiveness of a turntable, so far as truck speed is concerned, is in direct proportion to the number of trucks used on a job. It is logical that the greater number of trucks used, the more time will be saved by the turntable; therefore, the better the record made by the contractor.

These arguments on the featuring of record runs can be resolved into the one really informative and sensible factor: the *cost* of doing work over a period of time with the use of certain methods and equipment. It is only in rare instances that we find speed so absolutely necessary that cost can be disregarded in order to finish a piece of work within a certain time limit.

It has been the practice of the Blaw-Knox Co. to use in its advertising statements by users of its equipment regarding the services which such equipment has performed. In many of these so-called testimonials it has been impossible to establish a basis of comparison but the figures were presented as offered and in all instances revealed reductions in cost well worthy of note by the readers of the publications. We do not consider such advertisements to be illustrations of record runs but rather the expressions of pleased customers over the increased profits they have been able to obtain, due to the efficiency of our products. No attempt has been made in our advertising to lead the reader to believe that because John Smith saved $800 a month with a turntable, that every contractor buying a turntable will likewise save $800 per month. In this particular advertisement, it was explained that the savings accruing from the use of a turntable were directly proportional to the number of trucks used. Furthermore, such savings were so clean cut in their presentation and so independent of the operation of any other factor on the job that the reader could immediately determine whether or not his contract or his conditions were such as to justify the purchase of the equipment.

General Conference on Asphalt to Include Producers and Users

The Division of Simplified Practice of the U. S. Department of Commerce on May 7 sent out a call for attendance at a general conference for the reduction of varieties of asphalt to include producers, state highway and municipal engineers, the U. S. Bureau of Public Roads, and delegates from national engineering societies. The conference will be held at the Commerce Building, Washington, D. C., 10:30 a.m., May 28 and follows the preliminary conference in Washington, held April 24 (see *Engineering News-Record*, May 3, p. 808).

In a letter announcing the conference R. M. Hudson, of the Commerce Department, says: "It is felt that a reduction of variety in penetration limits called for will work to the advantage of both producers and consumers, and that mutual agreement in this matter can be effectively accomplished through the medium of this office. Secretary Hoover believes that action of this sort by industry is most constructive and is glad to co-operate and support such action by publishing the results in the Department of Commerce 'Elimination of Waste' reports."

To Avert "Buyers' Strike" in Construction Industry

Washington Correspondence

Over-ordering of cement which recently was made the subject of complaint by producers, is being taken up directly between the producers and contractors with good prospects that orders will be pared to actual necessities, according to information received in official circles in Washington. It appears probable therefore that there will be no conference with federal officials on this subject, as had been suggested at one time.

Evidences of a "buyers' strike" in the construction industry, as reported in newspaper dispatches from various cities where temporary withdrawal of projects has been announced on account of high costs, are being watched closely by Washington officials. While a reasonable let-up in new construction projects would be welcomed as tending to relieve pressure upon material and supply houses and upon the labor supply, there is some fear that the psychological effects may extend to other lines of industry. Conditions in the building industry have been recognized as abnormal, and in considering possible inflation of business this industry has been set in a class by itself by government economists.

A general easing of business conditions since the middle of April has been noted in Washington and it is considered by government officials that the caution now being displayed has averted the possibility of a period of inflation.

Business Notes

Clay Products Association announces that Charles A. Newhall, consulting chemist, of Seattle, Wash., has been retained as Northwest investigator for the clay products industries. Mr. Newhall has had many years of practical experience in the manufacture, testing and use of cement and clay products as well as other construction materials. He is a graduate of the University of California and has been practising his profession in the Northwest since 1907. It is a new policy for the association to retain technically trained local investigators in the construction materials field.

Andrew W. Hood, superintendent since 1909 of the Elmira plant of the American Bridge Co., has been appointed acting operating manager of all plants in the company's Eastern division, with headquarters at Philadelphia.

A. C. Linberg has joined the Chicago office of the Cement Gun Co., Inc., Allentown, Pa., as associate to J. M. Crom, district manager. Mr. Linberg was formerly general superintendent with the Fred T. Ley Co., Inc., and the Thompson-Starrett Co. His new work will relate to contracts for the Cement Gun Contracting Co., not only for gunite, but also for the construction of reservoirs, dams, levees and similar work.

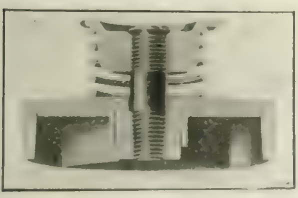
Equipment and Materials

Water Works Equipment

Equipment and materials employed in the water-works field are featured in this issue preceding the annual convention and exhibit of the American Water Works Association, to be held in Detroit, May 21-25.

Flexible Rubber in Pump Valve Increases Service

In a new type of pump valve designed by the Worthington Pump & Machinery Corp., New York, wear is reduced and watertightness secured by the use of flexible rubber for the seat instead of hard rubber in which cracks and cuts occur. Another feature of the new valve, the company points out, is the so-called bottom plate, which is, in effect, a middle seat for the rubber valve proper. The accompanying illustration shows the relation of the parts.

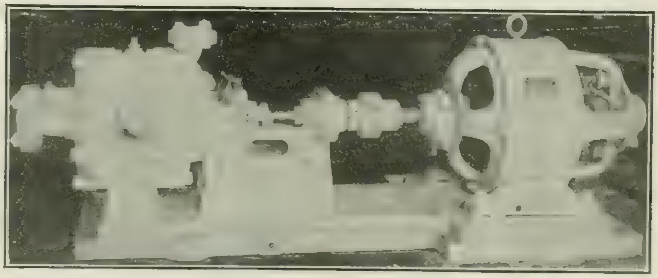


When the valve is closed the middle seat carries the entire load and prevents the rubber seal from cutting on the seats or ribs. The bottom plate moves up and down with the rubber and helps keep the valve in shape even when open. Thus all mechanical functions requiring strength and wear resistance are cared for by metal parts, the flexible rubber acting as a seal against leakage. Even the top of the rubber seal is protected by a thin backing plate which keeps the rubber flat and prevents the possibility of wear from contact with the spring. To assure a smooth, quiet running pump and few repairs, all moving parts are light but rigid.

Pump Designed for Small Output Against High Head

For operating requirements calling for the delivery of a small quantity of water against a relatively high head, the Pelton Water Wheel Co., San Francisco and New York, has recently bought out its type F D centrifugal pump. This pump is built either two or four-stage, the two-stage unit being recommended for heads under 110 ft., while the four-stage pumps are designed for heads as high as 220 ft. The capacity for either type at a speed of 1,750 r.p.m., ranges from 60 to 90 gal. per minute according to the head.

The casting is split vertically to permit easy access to the rotating elements. Communicating chambers from one impeller to the next are provided within the casing itself. A special suction bearing within the suction inlet precludes the possibility of vibration in the shaft. Since this bearing is water-lubricated, it requires no attention while the pump is being operated. Proper balance is insured by the use of an equal number, respectively, of right and left-hand impellers.



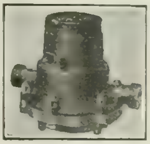
Such a pump can supply either an elevated tank or a pressure tank on the ground level, and it can be arranged to start and stop automatically, so as to require very little attention. It is adapted to the following classes of service: (1) Small public utility systems, either municipal or privately owned. (Taking the average capacity of 75 gal. per minute, such a pump would supply more than 200 gallons per capita per day to a village of 500 inhabitants.) (2) Isolated industries, farms, and country places, for both ordinary service and fire protection. (3) Office buildings, industries, etc., as a booster pump where the city pressure is inadequate.

Meter Detail Improved

This year's model of water meter manufacturd by the Simplex Valve & Meter Co., Philadelphia, contains an improvement in the form of a metal dome with glass cover instead of the glass dome, as was universally used in the earlier stages of manufacture. The glass dome proved too fragile for boiler plant use.

Another feature is the frost-proof type, which is installed in all exposed situations. One recent striking accomplishment cited by the company is the furnishing of a large number of meters for use in measuring the flow in a supply pipe at a large hydroelectric company's plant, having a working pressure of about 900 lb. per square inch.

Water Meter Has New Breakable Frost Bottom



A new feature of the American water meter, manufactured by the Buffalo Meter Co., Buffalo, N. Y., is the provision of protection against frost by means of a breakable bottom of galvanized cast-iron. When the frost bottom breaks out it releases the disc chamber and the intermediate gearing, and permits all their parts to separate and move with the ice. Heretofore, it is claimed, no intermediate gearing has been designed that has parts free to separate when the meter freezes.

Another feature is that the disc chamber seat is in the breakable bottom casing and, therefore, is renewed every time the meter freezes. The flange gasket is not disturbed when the bottom casing breaks and may be used repeatedly. To increase the sensitiveness and life of the meter all submerged bearings are protected against the entrance of sand and sediment. The meter with breakable frost bottom is made in sizes of ⅝ in., ¾ in., and 1 in.

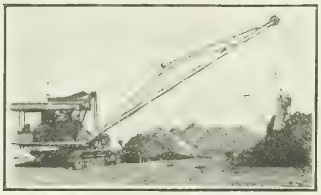
Water Lubricated, Rubber-Lined Bearings for Pump

To facilitate the operation of turbine centrifugal pumps handling water containing grit, the Thomas Pump Co., Chicago, has developed water-lubricated, rubber-lined bearings which are vulcanized into brass sleeves and grooved like the bore of a rifle. The action of the water when flowing upward in the turbine drop-pipe, it is explained, circulates through the grooves and not only serves as a lubricant but carries grit in suspension through the grooves. The bearings also offer resiliency to the revolving shaft.

Bearings of the sort described are being used in deep-well turbine pumps. The use of rubber bearings, the company states, is not new, but it is claimed that only recently have they been adapted to vertical turbine pump installations.

Trench 23½ Ft. Deep Excavated with Dragline

What is claimed to be one of the deepest trenches ever excavated with a ¾-yd. dragline was dug by a Pawling & Harnischfeger machine owned by Kremer & Hog at Minneapolis. The machine, illustrated herewith, had a 38-ft. boom and dug a trench to a depth of 23 ft. 6 in., which is about 5½ ft. deeper than was heretofore considered by the manufacturer possible with this type of machine.



The trench was 5 ft. wide at the bottom and from 12 to 15 ft. wide at the top. The material was for the most part a yellow clay, with bottom material running 3 to 8 ft. of heavy blue clay. A total of 1,700 ft. of this trench was dug in thirty-two 11-hour shifts.

The machine was also used to lower sewer pipe into place. To do this the dragline bucket was replaced with a U-shaped hook. The machine was also used to backfill the earth after the pipe had been laid.

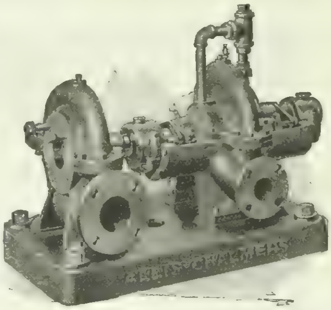
Power Shovel Hoe Digs Trenches for Pipe Lines and Sewers

Designed especially for the excavation of trenches for water-supply pipe lines and sewers, the steam "hoe" attachment for its crawler mounted power shovel has been improved in a number of features by the Erie Steam Shovel Co., Erie, Pa. As shown in the accompanying photograph, the hoe works toward the machine, allowing the latter to ride on solid ground instead of straddling the trench, thus eliminating a cause of cave-ins. The steam hoe, its manufacturers claim, is especially valuable in digging trenches through material that is very hard but that caves in easily, such as cemented gravel and boulders.

With standard dipper handle and boom at the usual angle the equipment can dig a trench 12 ft. deep and dump material 33 ft. distant, piling the excavated material 14 ft. above grade. A longer special dipper handle is made for trenches 18 to 20 ft. deep. The machine, its manufacturer states, is capable of an output of from 200 to 300 yd. a day on trench excavation. The steam hoe is convertible to a power shovel or locomotive crane.

Turbine Pump Auxiliary Driven by Flow from Main Discharge

A small hydraulic turbine-driven centrifugal pump is a type of unit furnished recently by the Allis-Chalmers Manufacturing Co., Milwaukee, in connection with water-works pumping installations for handling the condensate out of the condenser hot-well. The spiral casing having a side opening located at the left end of the base plate is a small re-action type hydraulic turbine, the runner of the turbine being mounted on the extended shaft of the centrifugal pump which it drives. The centrifugal pump is a standard type of horizontal split-casing, double-suction pump. The water for operating the hydraulic turbine to drive the pump is taken off from the main pump discharge pipe or from the series piping between the first and second stages of a series pump unit, and the discharge from the turbine is either piped back to the main pump suction or into the suction well.



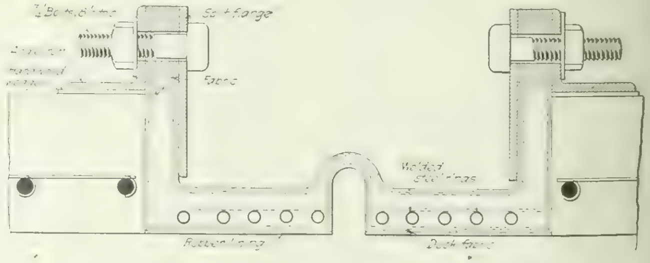
For this hydraulic turbine-driven auxiliary two advantages are claimed: first, its simplicity of operation, as it can be arranged to start automatically when the main unit is started up, and second its economy. A 50 gal. per minute, 75-ft. condensate pump, the company states would require a 7-hp. steam turbine for the drive, and figuring 70 lb. per brake horsepower for the water rate for the small steam turbine, the condensate pump would use 490 lb. of steam per hour. On the other hand, if the pump is driven by a hydraulic turbine under 140-ft. head the turbine would require 360 gal. per minute tapped off from the main pump discharge. This capacity would be pumped at the efficiency of the main pump, or over 80 per cent, and the main pump would be operated by the main turbine having a water rate of around 11 lb. per brake horsepower hour. On this basis, the condensate unit would require only 170 lb. of steam per hour for its operation.

Hydraulic turbine-driven auxiliaries, the Allis-Chalmers engineers point out, can also be used as circulating pumps and even as low-service, raw-water pumps, this type of auxiliary unit is a quite recent application of water-works service.

Flexible Rubber Joint for Concrete Pipe

To provide flexibility for changes in alignment and for expansion of reinforced-concrete pipe, Coleman Meriwether, of Core Joint Concrete Pipe Co., Inc., New York, has developed a joint of rubber and fabric reinforced with welded steel rings, as shown in the accompanying drawing. The joint may be expanded 1½ in. on one side and contracted 1 in. on the other. It is made in sizes to fit pipe ranging in diameter from 6 to 72 in. The concrete portion of the pipe is 16 ft. long and the joint 1 ft. long.

To form a flange, to which the joint is bolted at each end, 2½ x 2½ x ¼ in. angle irons, ¼ in. larger in inside diameter than the outer diameter of the pipe, are placed at each end of the pipe section and tightened with hardwood wedges closely spaced, making the angle ring concentric with the concrete pipe. The joints are bolted up with ¾ x 3¼-in. standard machine bolt spaced approximately 8 in. on centers.



Reinforced Concrete Pipe Joint of Rubber and Fabric

This type of joint, it is claimed, is particularly adapted to subaqueous pipe-line construction or to inverted siphons or pressure pipe lines on land. Irregularities in the foundation material for expansion and contraction are taken care of by the flexible feature of the joint. For subaqueous work a number of sections of pipe can be jointed together on shore, bulkheaded at both ends, floated to place and sunk, thus causing a minimum number of joints to be made by a diver.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

April Sales of Municipal Bonds Show Gain

A gain of about $5,000,000, as compared with the previous month was shown by sales during April of long-term municipal securities, totaling about $75,000,000 as compared with about $70,000,000 in March. The April figures represent the combined output of 408 municipalities which made 540 separate issues as compared with 327 municipalities making 582 issues during March. The increase, according to the *Commercial & Financial Chronicle*, is due to the fact that there were four large issues in April. During that month blocks of $6,394,000, $4,500,000, and $3,540,000 were sold, whereas in March the largest issue placed totaled $3,029,000.

For purposes of comparison it may be noted that the April sales of municipal securities (including states, counties and districts) aggregated $137,000,000 in 1922, $88,000,000 in 1921, and $66,000,000 in 1920. The large volume of last year's output is due to the fact that New York City put out $45,000,000 4½ corporate stock and three states floated $17,000,000 in bonds.

Of the 48 representative issues listed in the table one sold at par, 45 above, and only two below par.

Watch "Engineering News-Record's" Construction Barometer

(*See "Construction News," p. 287*)

An industrial depression is a stubborn, chronic malady. Its beginning is gradual and quiet. It commences and goes on increasing for many months, unnoticed, and its cause is silently doing its fatal work while actual business is increasing by leaps and bounds. When actual depression appears, its cause has almost ceased to exist. From its nature, as well as from its deep-seated and gradual growth, industrial depression is long-lived.—From Industrial Depressions, by George H. Hull.

Large Contracts Let During Week

Among the week's announcement of contracts awarded in Construction News, pp. 287 to 302, are the following large projects:

Hospital, Charlottesville, Va., to W. P. Thurston Co., Richmond, Va., $3,000,000.

University building, Ann Arbor, Mich., to Starrett Bros., New York, N. Y., $2,000,000.

Foundation and sub-structure, Pineville, Ky., to Foundation Co. of America, Chicago, Ill., $2,000,000.

Office building, San Francisco, Calif., to G. Wagner, $1,350,000.

Railroad shops, South Portland, Me., to J. W. Gulliver Co. and others, $1,250,000.

Sewage disposal works, Jersey City, N. J., to J. L. Sigretto, Bernardsville, N. J., $1,104,401.

Musuem, New Haven, Conn., to Sperry and Treat Co., $1,000,000.

Bank and office building, Toledo, Ohio, to Spieker Constr. Co., $1,000,000.

Grading and paving, Los Angeles, Calif., to G. H. Oswald, $615,000.

REPRESENTATIVE PUBLIC BOND SALES DURING APRIL, 1923

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Massachusetts	Sewer, water, park	2,300,000	4	101.15	3.88		1923–62	Estabrook & Co., Boston
County								
Adams, Ind.	Road	14,720 10,320	4½ 4½	100.213 100.14	4.48 4.49	Apr 15, 1923	1924–33	Old Adams County Bank, Decatur
Boyd, Ky.	School	100,000	4¾	100.00	5.00			National Bank of Commerce, St. Louis
Audobon, Ia	Construction	50,000	5	102.60	4.76	May 1, 1923	1928–46	Ballard, Hesser & Beh, Des Moines
Steuben, N. Y	School	225,000	4½	102.08	4.33	Jan 1, 1923	1924–54	Sherwood & Merrifield, N. Y
Bibb, Ga.	School	500,000	4½	100.627	4.45	May 1, 1923	1924–38	Citizens & Southern Co., Mason, Ga.
Cherokee, S. C	School	300,000	5	100.50	4.97	April 1, 1923	1933–62	Keane, Higbie & Co., Detroit
Clay, Minn	Ditch	70,000	4½	100.72	4.43	May 1, 1923	1925–43	Wells-Dickey Co., Minneapolis
Dodge, Wis.	Highway	965,000	5	102.03	4.73		1924–42	Illinois Merchants Trust Co., Chicago
Gloucester, Mass	Street	90,000	4½	102.05	4.08	May 1, 1923	1924–32	Gloucester National Bank
Holmes, O	Road	69,000	5½	100.55	5.30		1923–28	Milliken & York, Cleveland
Multnomah, Ore	School	2,862,000	4¾	100.18	4.73	Feb & May, 1923	1926–43	Clark, Kendall Co., Portland; Halsey, Stuart & Co.; W. R. Compton Co.
Ocean, N. J.	Road	75,000	5½	100.213	5.44	June 1, 1922	1926	Security Trust Co., Camden
Owen, Ind.	Road	9,750	5	100.54	4.89	Apr 15, 1923	1924–33	Fletcher American Co., Indianapolis
Summit, O	Hospital	300,000	4¾	100.19	4.72	April 1, 1923	1924–37	R. L. Day & Co., Boston
Wood, O.	Road	40,000	5	100.19	4.99	May 1, 1923	1924–28	Citizens Trust & Savings Bank, Columbus
Washington, Wis.	Highway	450,000	5	102.91	4.63	April 1, 1923	1925–38	Wells-Dickey Co., Minneapolis
St. Louis, Minn.	Road	1,500,000	5	101.40	4.78	Jan 1, 1921	1931	Redmond & Co., Kissel Kinnicutt & Co., and others
Dearborn, Ind	Road	49,200	5	100.175	4.72	April 2, 1923	1924–38	Peoples National Bank, Lawrenceburg
Aitkin, Minn.	Ditch	215,821	5¼	99.50	5.27	Mar 1, 1923	1929–43	Ballard & Co., Minneapolis
Township								
Washington, Ind.	Road	140,200	5	100.61	4.87	Mar. 15, 1923	1924–33	Fletcher-American Co. and Fletcher Savings & Trust Co.
Municipality								
Alexandria Bay, N. Y	Street paving	29,000	5	100.361	4.98	May 1, 1923	1952	O'Brian, Potter & Co., Buffalo
Anaheim, Cal	Sewer construction	160,000	5	101.85	4.85	April 15, 1923	1924–63	R. H. Moulton & Co., Los Angeles
Bellevue, O	Paving	35,533	5½	102.091	5.10	Mar. 1, 1923	1924–31	First National Bank, Bellevue
Blasdell, N. Y	Sewer	119,229	4½	101.415	4.38	April 1, 1923	1928–53	Sherwood & Merrifield, N. Y.
Bronxville, N. Y	Street and sewer	82,750	4½	101.44	4.32	May 1, 1923	1928–39	Stacy & Braun, N. Y
Burlington, N. C.	Street	297,000	5½	100.31	5.46	April 30, 1923	1925–41	Caldwell, Mosser & William, Chicago
E. Cleveland, O	School	800,000	5	102.111	4.78	April 1, 1923	1924–39	[illegible] & Trust Co., Cleveland
Elbridge, N. Y	Bridge	10,000	6	101.73	5.37	May 1, 1923	1924–28	Sherwood & Merrifield, N. Y.
Ellwood City, Pa	Improvements	135,000	4¼	100.64	4.22	July 1, 1922	1927–31	[illegible] & Co., Philadelphia
Erie, Pa	[illegible] & sewer	425,000	4¼	102.379	4.05	May 15, 1923	1925–53	M. M. Freeman & Co., Philadelphia
Gross Pointe Farms, Mich.	Paving	115,000	4¾	101.12	4.61	June 1, 1922	1924–42	[illegible] & Co., Detroit
Henderson, N. C	Street and sewer	200,000	5¼	100.37	5.21	Mar 1, 1923	1924–45	[illegible] & Co., Toledo
Lafayette, Ind.	School	125,000	5	100.29	4.90	April 15, 1923	1924–28	J. F. Wild & Co., Indianapolis, Ind
Nashville, N. C	Street	[illegible]	5	100.15	4.93	May 1, 1923	1924–28	[illegible]
Ocean City, N. J	School	[illegible]	5	101.419	4.90	May 1, 1923	[illegible]	[illegible] & Trust Co.
Pittsburgh, Pa	School	[illegible]	4.10	100.78	4.03	May 1, 1923	1924–53	[illegible]
[illegible], N. Y	Highway and bridge	[illegible]	5	107.23	4.11	Feb 1, 1923	1925–44	[illegible], N. Y
[illegible], N. Y	Highway	[illegible]	4½	100.713	4.44	May 1, 1923	[illegible]	[illegible]
Scarsdale, N. Y	[illegible]	48,000	4½	102.635	4.28	May 1, 1923	1928–51	[illegible]
Verona, N. J	Paving	[illegible]	4¾	101.433	4.67	April 1, 1923	[illegible]	[illegible] & [illegible], Philadelphia
Williamston, N. C	Street	50,000	6	102.56	5.72	May 1, 1923	[illegible]	[illegible], Cincinnati
Winsted, Minn	Water	30,000	5	100.03	4.99	April 15, 1923	1943	[illegible], St. Paul
Buffalo, N. Y	Water	1,700,000	4	100.278	3.98	May 1, 1923	1953	[illegible] & Co., N. Y
Hudson, N. Y	Street and sewer	[illegible]	4½	102.063	4.21	[illegible] 1, 1923	[illegible]	Sherwood & Merrifield, N. Y.
West Allis, Wis	School, street, sewer	[illegible]	5	[illegible]	4.61		1924–43	[illegible], Chicago
Cleveland, O	Hospital, sewer, etc.	[illegible]	4½	100.28	4.465	Mar 1, 1923	1924–45	[illegible]
Kirksville, Mo.	Water	260,000	4¾	[illegible]	4.67	May 1, 1923	1928–43	[illegible] St. Louis, National [illegible] Co., St. Louis

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 287 to 302, are the following:

Hotel, Philadelphia, Pa., for Kugler Hotel Co., $5,000,000.

Sewers and disposal plant, Kansas City, Mo., P. Hartung, engineer, City Hall, $2,225,000.

Temple, Louisville, Ky., for Kosairs, $1,750,000.

School, Brooklyn, N. Y., for Board of Education, $1,075,000.

Excavation and concrete work for power plant, Campbellford, Ontario, Canada, for Hydro-Electric Power Commission, Toronto, $1,066,408.

Mill, Dallas, Tex., for Dallas Textile Mills Co., $1,000,000.

Big Demand for Labor

A digest of reports from 65 industrial centers received by the Employment Service of the U. S. Department of Labor for the month ended April 30 indicates that there is very little unemployment in any section of the United States. Increased demands for all classes of skilled labor, skilled mechanics and farm hands were found to be general during April. In building and construction lines the scarcity of this class of worker is affecting progress of work to a considerable degree.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 3; the next, on June 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3 64	$4.30	$4.50	$3.40	$3 55	$4.20	$3.85	$4.10	$3.75
Structural rivets, 100 lb	4.40	5.00	5.25	3.75	4.25	5.15	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb	3.54	4.25	+3.50	3.32½	3.45	3.85	+3.65	4.10	3.50
Steel pipe, black, 2½ to 6 in. lap, discount	49%	50%	45%	59½%	53-5%	36%	35.2@47.6%	30.15	32.76
Cast-iron pipe, 6 in. and over, ton	58.50	56.00	+63.00	60.20	60.50	69.00	60.00	70.00	60.00
Concreting Material:									
Cement without bags, bbl	2.70@2.80	2.85	2.25	2.20	2.39	2.85	2.71	2.90	2 68
Gravel, ¾ in., cu.yd	2.25	1.90	2.25	2.00	1.75	1.90	2.15	1.25	1.50
Sand, cu.yd	1.25	1.24	1.90	2.00	1.00	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd	1.75	2.00	2.50	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	65.00	42.00	53.00	60.00	46.75	44 00	41.00	31 00	90 00
Lime, finishing, hydrated, ton	18.60	23.50	22.50	20.00	25.50	24.00	22.00	24.00	21 00
Lime common, lump, per bbl	3.00@3.25	1.50	2.50	1.50	+1.50	2.70	1.75	2.80	11 00
Common brick, delivered, 1,000	23.50	14.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.0893	.115	.1032	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1573	.0893	.115	...	....	.065	108	.11	...
Linseed oil, raw, 5 bbl. lots, gal	1.16	1.26	—1.37	1.35	1.29	—1.39	1.24	.86	+1 38
Common Labor:									
Common labor, union, hour	.75	.35	....	......	....	.50@.55	.56¼	....	..
Common labor, non-union, hour	....	.30	.30@.50	.72½	.35@.50	.35@.50	.50	.50@.62½	+.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 81¼c.; building laborers, 75c.; minimum for pick and shovel men, 50c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers. Steel-pipe, per 100 ft. net.

Montreal quotes on Douglas fir. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 91.00). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

With the spot coke market receding, iron and steel scrap lower and pig-iron quiet, generally, the present downward trend in steel prices becomes a natural development, not to speak of a perceptible falling off in demand. Shapes, plates and bars are now quoted at $2.50@$2.60 per 100 lb., Pittsburgh, for desirable tonnages, with the maximum at $2.65, against $2.75, recently. Premiums on plate shipments are disappearing from the market and buying in both plates and structurals is confined to smaller tonnages. It is evident that the steel price peak has been reached and passed with the tendency developing to approach nearer to a $2.50 base. Steel bars, however, advanced 25c. in San Francisco and 35c. per 100 lb. in Dallas warehouses, during the week. Cast-iron pipe also advanced $2 per ton in Dallas.

The steel ingot output for the month of April, as reported by the American Iron and Steel Institute, totaled 3,321,278 tons, compared with 3,402,007 for March and 2,444,513 during April, 1922.

Linseed oil dropped 5c. in Dallas and Denver and advanced 23c. per gal. in Montreal, since last week.

Cement prices remain firm and unchanged generally throughout the country. Although production during April increased 14 per cent as compared with the preceding month, shipments increased 24 per cent, leaving stocks on hand Apr. 30, of 11,450,000 bbl. as against 13,045,000, one month previous, according to the Geological Survey.

Lumber prices remain unchanged in the nine cities reporting weekly to *Engineering News-Record*. The Lumbermen's Bureau reports that "the general price level is about the same although there are some soft spots here and there."

Lime and brick prices have not advanced despite higher labor costs in both industries. Common brick in New York remains at $20 per M. alongside dock; higher fuel and labor costs at yards, together with recent advance from 80c., to $1 per M. in the cost of unloading brick from barges, having had no effect upon the price to the consumer.

A Consolidation of Engineering News and Engineering Record
McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

Volume 90 NEW YORK, MAY 24, 1923 Number 21

More Publicity Not More Facts

WITH the wide publicity it has received and will continue to receive the American Construction Council's admonitions regarding the building situation admirably reinforce the several similar admonitions of the past weeks. The suggestions of means whereby may be avoided an overexpansion of building with consequent evil effects not only on the building industry but upon business prosperity in general, together with the premises upon which those suggestions are based, are sound provided it is remembered that the emphasis is laid on speculative and unnecessary construction. These two types of construction, furthermore, are peculiar to the large cities and are there confined mostly to buildings of the luxury, office or housing class, of which the first two are as a rule unnecessary and the last two speculative. The desired letdown in such building has already started and the bankers and speculators who read the current economic signs will doubtless see to it that no further expansion occurs. There is, furthermore, enough business in hand that must go on so that the continued prosperity of the industry is assured. But the Construction Council's report, we believe, underestimates the extent to which this caution already pervades the business world and is somewhat confused in discussing further means of getting that world to appreciate the current situation. Publicity of the facts as to construction activity is necessary, and the council's plea for promotion of such publicity is good, but one might assume from the report that those facts are not available. That is not true. They are available and await only increased publicity. A number of agencies, among which is this journal, are collecting and distributing significant figures of construction activity, figures which are authoritative, accurate and timely. Any further service should lie in getting those figures wider distribution, and not in setting up more means of obtaining them, which would only be duplicating work already done.

A Graceful Tribute

IN WASHINGTON last Friday night to the light of many torches a decorated barge carrying two men floated slowly down the lagoon just west of the Washington Monument toward the Lincoln Memorial, at the same time a procession of distinguished citizens in pageant procession moved down the parallel banks. On the step of the marble temple an ex-President of the United States welcomed one of the men and presented him to the President of the United States, from whose hands he received the gold medal of the American Institute of Architects, a tribute to a master architect. In thus honoring Henry Bacon, the designer of the Lincoln Memorial, the architectural profession displayed one of its most engaging qualities—the ability to rise superior to the prosaic detail of the day's work into emotional expression. The Lincoln Memorial is one of the great works of American art and architecture. It is altogether right and proper that the man who conceived it should be honored in a way that will impress all who saw the ceremony or who read of it with the high degree of appreciation the work arouses in his professional fellows. It is perhaps too much to hope that engineers can forget the practicality of the things they do long enough to follow such an example. Perhaps, too, few engineering works are so exclusively the product of one man's brain as is an architectural creation. But there are engineers whose work has justified a pageant similar to that held on the banks of the Potomac and it would add a very necessary humanness to the engineering profession could they relax sufficiently to indulge in such a ceremony when the man and the structure warrant it.

A Professional Obligation

JUST now there is an opportunity to pay a belated tribute to one of the great engineers of the passing generation. Alfred Noble embodied the best characteristics of the engineer. His name is not synonymous with some single huge engineering work; his fame is not that of Goethals or Eads. But through the last quarter century of his life he pursued a calm, judicial way, the sought advisor on many enterprises. Integrity, ability and judgment were his in full measure. The American Society of Civil Engineers at the outbreak of the Great War planned a memorial for him at Washington which not only should honor him but through him honor the engineering profession at the capital. The strenuous years since 1914 have held up the project but now the committee comes before the profession with a request for funds—for $100,000—with which to carry out the plan. An obligation rests on the profession which it must not fail to satisfy.

Safeguarding Water Supplies First

CONCENTRATION on activities designed to insure safe public water supplies was an outstanding feature of the state sanitary engineers' conference held at Washington last week. The multiplicity of details considered and the many problems necessarily left to future consideration for lack of sufficient data illustrate how important this branch of the duties of the engineering divisions of state health departments has become. It is a noteworthy fact that with the growth of these engineering divisions state health department activities have been directed more and more to water supplies, whereas in the earlier years the chief drive in most states was to compel cities to build sewageworks. Under that drive our municipalities were compelled to pour out money for plants that would have had no appreciable effect on public health if they had been properly operated, and which in the majority of cases have been poorly operated. The state sanitary engineers and engineers in private practice have at last brought many if not most of the state departments of health and many city officials to see that water supplies should receive first attention, and that the chief function of sewage-works is to prevent the overloading of our streams beyond their power of dilution and oxidation, and, where public water supplies are affected, that sewage treatment should be regarded as a means of preventing the overloading of water-purification plants, all of which are real safeguards against water contamination.

The Phenol Water Menace

IN COLLECTING data and calling last week's conference on water contamination by phenol wastes the Public Health Service has wrought well. When the extensive data and opinion summarized elsewhere in this issue are printed by the Public Health Service, as presumably they will be, the exhibit will be surprising and perplexing as well as eminently useful. It will doubtless serve to stimulate action to keep these wastes out of streams and lakes used for public water supplies, either by diversion or by treatment. Co-operation with the producers of the wastes should be the first effort because their industry is of great economic importance and because many data must yet be collected and principles established before the phenol problems as related to water supplies—chemical, health and legal—can be solved.

The Job Ahead in Road Building

FACTS and figures made public at last week's annual meeting of the American Road Builders' Association by Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, should remove any misgivings regarding the need for a large scale national road-building program continued over a number of years. Few people have any real conception of the task ahead in highway development. At present the yearly outlay by the federal government, states, counties and townships bulks large when considered by itself. Viewed in the light of the ultimate job of providing the United States with adequate highway transport facilities, however, the yearly budgets of today, running close to a billion dollars for rural highways—and this figure excludes paving work within city limits—shrink to modest proportions.

The nation's total rural highway mileage is about 2,800,000, of which approximately 180,000 miles have been included in the 7 per cent federal-aid system specified in the Highway Act of 1921. Citing the fact that since 1916 about 25,000 miles of the federal-aid highway system had been completed, Mr. MacDonald seems to have ample justification for his statement that "we haven't even started to build highways in this country." Coming from the highest ranking road official in the country this estimate of the situation is significant, and it becomes doubly so when reinforced by results of a new and comprehensive statistical survey of expenditures for rural highways throughout the country, completed recently by the Bureau of Public Roads, showing a total for all purposes, outside of cities, of $970,000,000 during the year 1921. Previous incomplete estimates placed this figure at a considerably lower level—about $600,000,000. The later and more accurate information, therefore, shows that the previous yearly estimates which were considered in some quarters as extravagant were, in reality, conservative. If the nation is ever to catch up with the demands of its highway traffic an expansion, rather than a contraction, of the road-building program must occur. And, as the new construction is completed year by year, the mileage that must be maintained also will grow, a situation which led Mr. MacDonald to say: "I do not see any end to the road-building program."

Some objectors to the large expenditures being made on the federal-aid system labor under the mistake of assuming that the construction is all of the costly heavy-traffic type. As a matter of fact, the Bureau's figures show that only 26.8 per cent of the federal-aid construction thus far completed comes within the foregoing classification, and effective answer to the charge that the new system discriminates against the local road user. The further fact is brought out that in a state like Indiana, for example, 99 per cent of the total population is included in belts 5 miles wide on each side of the federal-aid system.

The question today is not whether we need the roads but whether we can get them built. In roads, as in practically all other forms of construction, we are far behind our needs but we must face the fact that our construction capacity, either in men or materials, is grievously below our needs. It will be necessary, therefore, to apply to our road program the same restraint as is being applied to other construction. The criterion for any proposed road must be the relative ease of getting the men and the material without disrupting the market in either. Fortunately, as the above figures show, the larger part of our proposed roads are local enterprises, imposing no great load on transportation systems, material producers or the national supply of labor. Such roadbuilding must go on, subject only to the restrictive elements in the local labor and material situation. As for the heavy traffic trunk roads, necessity is the major criterion, just as it is in buildings. The thing to remember is that all figures are relative and that a billion dollars a year is not too much to spend in this year of increased production capacity, when the country readily absorbed nearly that much in the low-production year of 1921.

One more point needs emphasis: Less than one-half of the billion-dollar-a-year program is being spent under the control of federal and state agencies. It is clear, therefore, that one of the most pressing problems is the development of local organizations with business and technical personnel qualified to direct the economical expenditure of large sums and to design and construct roads adequate for the needs they are intended to serve.

Lake Rivers as Harbors

THE harbor cities of the Great Lakes confront a genuine problem of public and private business administration in the question of whether the little rivers that flow through them and cut apart their business territory should now be closed to the relatively small amount of navigation surviving from the important water traffic of pioneer days. The question has been discussed in Milwaukee, in Chicago, and in Cleveland, and in all three cities the situation is of equal intricacy, nothwithstanding the differences in local conditions. Some years ago Milwaukee engineers recommended that their river be closed to navigation. In Chicago, old proposals to the same effect have recently been revived on the basis of a rather fantastic project to roof over the river by a continuous bridge which would form a boulevard through the city.

Decision of the question can only be approached properly on the basis of a comprehensive and thoroughgoing study of all elements of the problem, such as was suggested in a letter which we printed from Robert Isham Randolph in our issue of April 12. Of necessity it must be a combined engineering, business, and city planning study. We hope that in at least one of the three cities mentioned such a study will be initiated soon.

But it is important, in approaching a study of this kind, to cast off all ballast of false premise or extraneous consideration. Such premises and complications injected themselves into the letter referred to, and they indicate at once the difficulty or even impossibility of arriving at a sound conclusion unless they are eliminated.

Basic to the problem in all three cities is the fact that the river—whether the Milwaukee, the Chicago, or the Cuyahoga—is a most unsatisfactory and inefficient navigation channel for ships. Narrow, tortuous, and crossed by many busy bridges, it constitutes a terminal approach so defective in its operating characteristics that no transportation man responsible for the expeditious and economical carrying of traffic would tolerate it. The resulting traffic difficulties are felt both by the traffic itself and by the city through which it moves: the traffic movement is slow, dangerous, and uneconomical, while the city is under the double disadvantage of having to bear the undue cost of this traffic and of providing for the expense and losses imposed upon land traffic which must cross the waterway. What these latter costs amount to has never yet been computed, but some idea of their magnitude may be formed from the fact that the single item of operating and maintaining the Chicago movable bridges costs a million dollars annually—fixed charges not included—while it has been stated that the delays to railway traffic alone, caused by the bridges, exceed the total value of the river navigation.

A second basic condition is that all three cities have ample water frontage on the lake shore, far more extensive, accessible, and convenient to the various parts of the city to be served than the river frontage. All three, moreover, have made beginnings toward developing that frontage for shipping terminal use. The movement was strong in Cleveland half a dozen years ago, and in Chicago has gone at least to the point of the construction of a municipal pier, while Milwaukee has developed an elaborate paper plan for a lake harbor development.

Adding the further fact that lake commerce has decreased and changed in type and the fact that practically all the river front property is in private ownership, a sketch of the underlying conditions is obtained.

Of the derived factors of the case, the main one is that railroads and manufacturing and storage industries are massed along the river banks, and that the plan of development of the city is essentially built upon the the basis of the zones of storage, milling, supply, and wholesaling which parallel the banks. The result is that the river effectually cuts apart the city in a harmful way. In Cleveland, where the river flows in a broad valley, the separation is more readily apparent, but Milwaukee and Chicago have in fact the same territorial separation due to the stream itself and the zoning which follows the stream. And in Chicago this zoning girdles the downtown business district as disastrously as does the Union Loop.

With such difficult fundamental conditions to face as have been indicated above, it is only begging the question at the very outset to inject into the discussion such phrases as "paramount public right" and "infringement upon private riparian rights." These rights, such as they are or may be found to be, do not constitute a reason against a river-closing plan except in the cost of purchase or condemnation of property that they might necessitate. The word "paramount," with its ever present suggestion that it is a clincher, is particularly mischievous in this connection.

Equally necessary is it to avoid introducing false or specious considerations. Our correspondent mentioned the federal investment in improvements to the Chicago River for navigation, referring presumably to government *expenditures* and ignoring the fact that an irrecoverable expenditure is an investment only when it pays dividends or at least earns its keep. He referred similarly to investment of the Sanitary District for purposes of navigation and sanitation, an item whose bearing on the matter is questionable in the same sense. He dragged in by the ears the absurd argument that river closure might impede the flow of water and might cause sedimentation which could not be removed. He threw the cost of the Chicago municipal pier into the scale as an argument against river closure—as though this pier, which is on the lake front, would lose rather than gain from making the lake the city's harbor!

But beyond all this, our correspondent removed the case from all discussion in picturing the coming of a busy barge business from the lakes to the gulf through the heart of Chicago with the richly scented Chicago River as its Grand Canal. The very question at issue is whether Chicago can afford to remain a group of scattered communities stringing along the banks of a steamer route or a barge towpath, or whether it can no longer continue to afford this—the same question precisely, in slightly different terms, that concerns Milwaukee and Cleveland. This is the overshadowing question, and whenever it is made secondary to other desires and ambitions, the friends of progress in the Lake cities will be ill served.

But progress in these matters is on the way. Even our correspondent, despite his preoccupation with the possible needs of the Chicago River highway to the ocean, pleads for elimination of the drawbridges and for the universal adoption of fixed bridges across the river. With this approach, we are nearer facing the question of who in the last analysis is entitled to exercise control over the navigation of such a stream—the federal government or the community which the stream serves. Once the principle can be established that the manner of use of the Chicago River is within control of the city of Chicago itself, that the city may decide what type of vessels, if any, is to be excluded, and what restrictions shall govern shipping, it will have a free path to declaring the river a waterway for small vessels only, to levying a river tax to cover the undoubted expense to the city in operating the cross-river traffic, to attaining effective control by acquisition of river-front property, and the like. A course toward a solution, in other words, is open so long as progress has gone to the point where partial closure to navigation is conceded and demanded. We have every faith in the willingness of the federal government to support the conclusions of the local authorities, in the case of Chicago at least, when once the local authorities take hold of the question determinedly and purposefully.

Casting and Sinking Cylinders for Ballantyne Pier

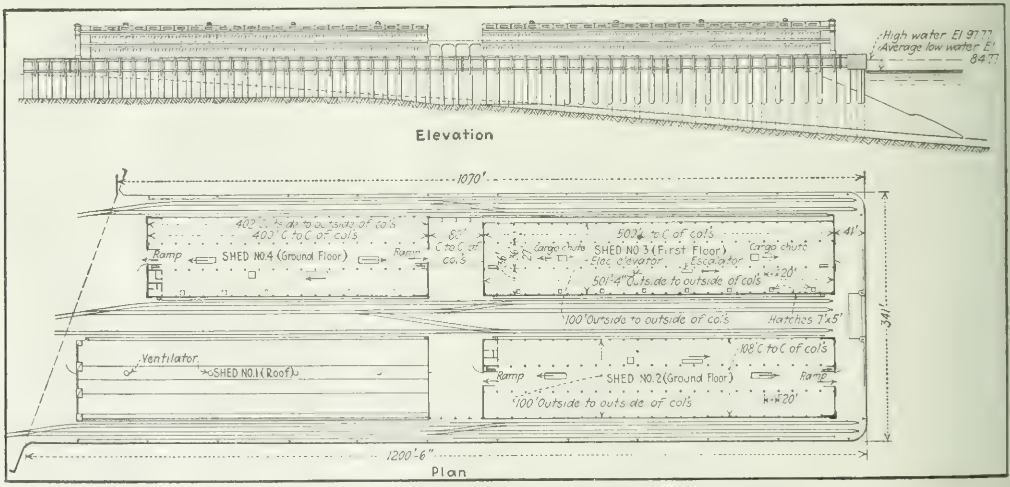
New Shipping Pier at Vancouver, British Columbia, Is of Reinforced-Concrete Framework Founded on Heavy Precast Cylinders—Details of Construction of Foundations

By William Smaill
Chief Engineer, Northern Construction Co., Vancouver, B. C.

THERE is now nearing completion in Vancouver harbor, British Columbia, a large and rather complicated shipping pier, the substructure of which is made up of precast concrete cylinder piers, tied together with precast concrete beams and trusses. The details of the construction and erection of these piers and their connections are the subject of this article.

In May, 1913, the federal government at Ottawa placed the harbor under the control of a Harbor Commissioner, consisting of a president and two commissioners. In 1918 A. D. Swan, consulting harbor engineer, of Montreal, was engaged to make a report on the needs of the harbor and recommendations for its development.

The first undertaking by the commissioners towards the development of the port was the construction of a pier designed by A. D. Swan, and known as the "Ballantyne Pier." This structure is of reinforced concrete throughout. It has a length of 1205 ft. from the shore quay, and a width over all of 341 ft.

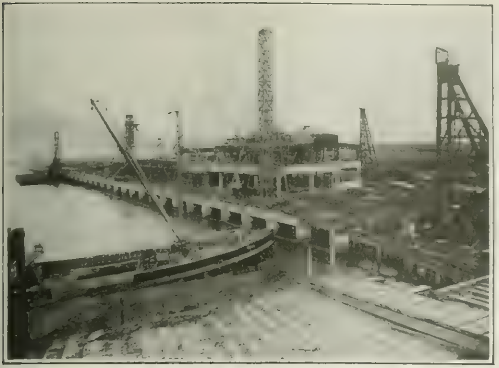


PLAN AND ELEVATION OF BALLANTYNE PIER, VANCOUVER HARBOR

The first contract on the work called for the dredging of the berths on each side (the inner berths have 35 ft. of water at low tide and the outer berths 45 ft.), and the gravel and sand fill forming the heart of the pier and the shore quay embankment. This was let to Grant & MacDonald, dredging contractors, in September, 1920, and completed in November, 1921. Contract No. 2, for the construction of reinforced-concrete pier and transit sheds, was let to the Northern Construction Co., Ltd., & Gen. J. W. Stewart.

Details of Substructure—In the construction of the substructure Mr. Swan's design calls for all portions of the pier which are subjected to the action of the salt water to be precast, so that a careful inspection could be made and the sections well seasoned before being placed in the salt water. It might be noted here that the waters of Vancouver harbor are generally much less saline than the Pacific, being largely diluted by the fresh water from the Fraser River and other smaller streams running into it, and that structures in the harbor are not subjected to any severe freezing conditions. It will be seen from the illustrations that the deck is supported on solid concrete cylinders 7 ft. in diameter which are all sunk to rock. The columns are braced horizontally by means of the lower and upper concrete fender beams, and across the structure by the concrete trusses, the top of the latter being tied into the main heavy concrete girders that are part of the deck proper. The main deck, girders, beams and upper fender beams, being out of the water entirely, are cast in place, the whole being reinforced, and are tied into the trusses and upper sections of bearing columns. This deck is designed to carry a load of 750 lb. per sq.ft. Around the inner section of the deck, to retain the gravel fill in the heart of the pier there is driven a row of 18 x 12 in. x 35 ft. reinforced-concrete sheet piles, supported by concrete bearing beams that are tied into the upper portion of the inner row of concrete cylinders.

The structure as a whole gains an additional stability supplied by the gravel and sand fill in the center of the pier, and all but the outer row of cylinders are sunk through portions of this fill to rock. On the main deck there are four two-story reinforced-concrete transit sheds with a gross floor area of 394,500 sq.ft. All doors are steel and windows wire glass. The sur-



BALLANTYNE PIER, VANCOUVER, IN COURSE OF CONSTRUCTION

Substructure all in, reinforced-concrete framework superstructure being built.

face of the pier is paved for vehicular traffic and sheds can be entered from either end. On the deck proper and to serve the sheds and vessels there is about 8,000 ft. of track. It is the intention to have the pier and sheds equipped with latest facilities in the way of electrically operated cranes, cargo hoists, escalators, trucks, etc. For the speedy and safe handling of cargoes, the pier and sheds are to be exceptionally well illuminated for night work. The total cost of pier and equipment will be about $6,000,000.

Casting Plant—The first work to be done on this contract (No. 2) was to start the manufacture of the precast units. Owing to these units having to be seasoned for at least 60 days after pouring a large amount of storage room was required and to obtain this the nearest practical site that could be acquired was at North Vancouver, two and one half miles across the harbor from the site of the pier, on what is known as the Fell Fill. This is a level fill about 30 acres in extent made up of fine sand pumped in between bulkheads and having a landing pier at one corner to deep water; the whole was well suited for the purpose. The general layout of the yard is shown on the plan.

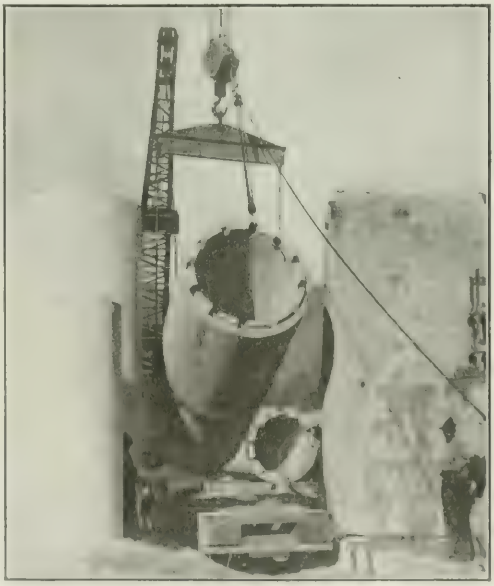
Along the south wall of the fill where the mixing plant was stationed (gravel, sand and cement are all delivered by water), there not being sufficient water at low tide to float sand and gravel scows, timber grids were constructed along this wall so the scows could be placed in position on high tide and have safe landing on grids in low water and a short pile pier was constructed between these grids to deeper water for the cement boats to land. The materials from the scows are handled by means of a traveling timber gantry crane, operating a 1-yd. clamshell bucket delivering the sand and gravel either direct to bins over the mixer or to storage piles on either side. The cement boat ties up to the small pier, delivers the cement on the pier in slings, the slings in turn being handled by the gantry crane and dropped in place through hatches in the roof of the cement shed direct to piles on the floor which is level with the charging hopper of the mixer..

The mixing plant has overhead bins, discharging into measuring boxes which in turn discharge into the hopper of a 1-yd. mixer which is set high enough to discharge into 1-yd. buckets on cars. The cement shed is at the rear of the mixer and the floor on same level as charging hoppers of mixer.

The sand and gravel used are all fresh water washed and carefully screened and graded, the largest size gravel is what passes through a 1½-in. ring. Each scow of gravel and sand is tested to see if the proportions are correct.

In front of the mixer, a 25-ton stiff-leg derrick with a 60-ft. boom is set up, the engine being controlled from a lever house set high enough to give operator full view of the hook at all times. This derrick handles the concrete direct from the mixer to the cylinder forms, sets up and takes down steel forms, steel cages and reinforcing bolts, steaming tarpaulins, raises and turns concrete cylinders, and loads them on cars for removal to the skidways.

The forms for the cylinders, concreting buckets and turning bar for cylinders are designs and patents of the Lock Joint Pipe Co., and this company was given the privilege to purchase and use these forms.

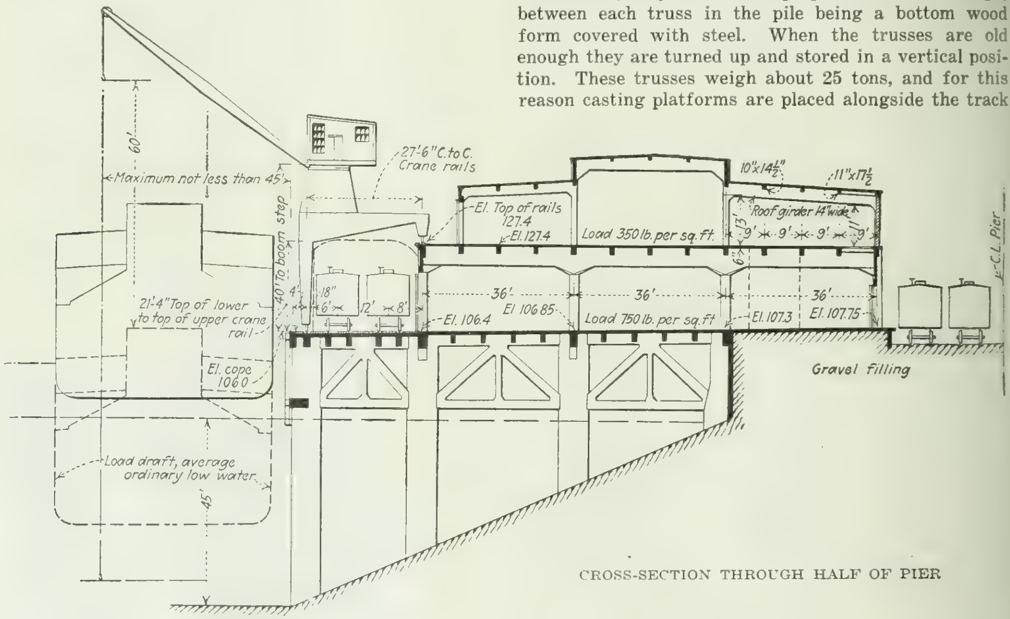


TURNING SECTION OF CYLINDER PIER

In front of the 25-ton derrick and in the same radius boom reach from mixer discharge, a concrete casting platform is built in which steam pipes and jets are cemented in their proper spacing. The cast-iron bases are first set up in their exact location. These bases are shaped to support the inside and outside forms of shell, support the steel cages, space and center accurately the tying and reinforcing bolts, and shape the bell end of the cylinder. The inside form is first set in place, then reinforcement, outside forms, and last the top ring—this top ring supports the upper ends of bolts in position and shapes the spigot end of the cylinder. The concrete is placed in cylinders by means of a 1-yd. cone-shaped bottom discharge bucket.

Casting the Cylinders—A great number of experiments were made in the placing of the concrete in these shells to get a dense mass with a good skin. The method giving the best average results was to use a couple of small air hammers on the outer steel shell while pouring. This necessitated a good deal of strengthening of the steel forms to stand the vibration. The hammers only have to be used on the outside, the vibration being carried through the mass to the inside. The surface of both sides on stripping forms is generally as near perfect as it is possible to make it by any means.

A suggestion was made to try and agitate the forms with a high speed vibrating screen motor attached to them, but as the air hammers were working so well, it was thought best not to spend any more time or money on experiments.



CROSS-SECTION THROUGH HALF OF PIER

The cylinders, of which there are nearly five miles in the pier, are cast in varying lengths from 4 to 17½ ft. long. After the forms are filled, a canvas tarpaulin is placed over the forms and steam is turned on, at each cylinder. There is one inside and one outside steam jet. This steaming time varies with the outside temperature but rarely runs over 10 hours. Next day forms are removed and the following day the cylinder is picked up carefully, turned, placed on a car, which is on depressed track with top of car level with skidways, taken out to skidways in the storing yard and rolled off into place to cure. Precast units have generally been over three months old before being placed in the pier. The concreting of the cylinders starts in the morning and is through by noon; this crew then goes on in the afternoon casting the different precast units. Another shift comes on at 1 p.m. and works until 9 p.m. They strip the cylinder forms, set up new forms, turn and yard the pipe and get everything ready for next day's pour of cylinders.

In concreting the units, the same bottom discharge buckets are used, being carried on a special car made to hold them and transported to and from mixer by a 6-ton gas dinkey to one of the traveling cranes which handles the concrete into place while the dinkey is away for another load. All units are cast on platforms, surfaced with sheet iron, sectional wood forms lined with steel being used. The exposed face of the unit after casting is given a hard trowel finish; in this way all precast units have a smooth dense skin on all surfaces. The side forms are generally removed the next day but the units remain in place on the platform until with specially devised hooks, slings, etc., it is thought safe to remove them by means of a locomotive crane, to special storage piles. This holds true for all except the trusses; they are cast on prepared bases four high, between each truss in the pile being a bottom wood form covered with steel. When the trusses are old enough they are turned up and stored in a vertical position. These trusses weigh about 25 tons, and for this reason casting platforms are placed alongside the track of a traveling 30-ton gantry crane, which track runs along the easterly portion of the yard to the deep water loading stage. In this way the heavy trusses have only one handling, as they are picked up with a 30-ton gantry and carried direct down the track to where they are loaded on scows; the other units are loaded onto cars by the locomotive crane and transported to this loading point by gas dinkey where they are handled to the scow with the gantry. Special slings have been devised for the handling and loading of the different types.

The reinforcing steel which comes in cars is stored at the opposite end of the yard to the mixer. A large motor driven bar bender is used for bending all steel with the exception of stirrups and hoops, the stirrups being bent with a special machine devised by ourselves for the purpose and the hoops in a small set of rolls. The unit reinforcement is generally assembled in platforms or frames set accessible and at proper working height; after fabrication they are handled to the forms by means of locomotive cranes.

The cages and hoops are made in small rolls. They

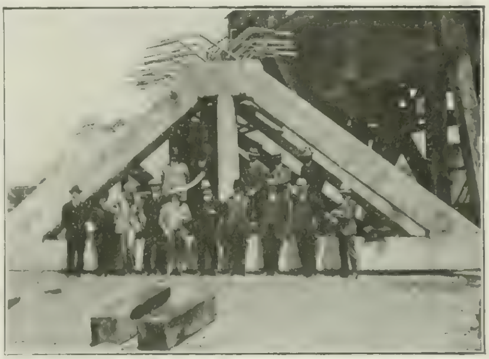
UPPER SECTION OF CYLINDERS
Shows recesses for ends of trusses and bearing beams that support sheet piles, deck beams and girders.

are then placed on a form which sets the proper circle, and the lapped ends are tied. These hoops are then placed in a spacing frame for tying the straight rods in place, Instead of using a lot of individual wires at each joint the No. 16 wire is wound spool fashion, on a short stick, and starting at one end of the rod the wire is wound spirally tight around the rod. Whenever a joint between the hooping and straight rod is reached the hoop is carefully spaced and the wire is wound in both directions around the joint and the winding continued on down the rod to the next joint; in this manner every joint is tied and tied well. Two diagonals of No. 3 wire are placed on opposite sides of the cages and the ends fastened into the cage, a twister is placed in the center of each pair of diagonals and brought up tight. This completes the job of making a rigid cage of reinforcement for the cylinders.

For the supporting of all the unit reinforcement in the forms, the engineers were very anxious not to use steel chairs that might in time rust and carry rust into the reinforcement and blocks and perhaps leave planes not watertight that would be harmful later. Naturally, sky hooks were the first thing thought of and eventually a system of temporary support of all the reinforcement on the job was used hanging the steel up on hooks until forms were filled, when they are removed.

Erection of Substructure—When the piling of the shore quay embankment and heart of the pier was being completed, a central concreting plant similar to the one at the casting yard at North Vancouver was erected on the shore line west of the pier with landing grids The steel yard and shed was situated on the east side of the pier and a standard-gage track placed for use of locomotive crane, 3-ft. gage being used for concrete tracks. Everything depended on the ability to sink cylinders vertically and in exact locations and the time of the completion of the pier depended on the speed with which the cylinders could be set, sunk and filled. There were many preliminary studies made to devise a quick, safe and economical way of doing this work. It was finally decided to use a cylinder driver similar to what had proven successful in use for the handling of large steel cylinders in San Francisco harbor. Drivers were designed and built to carry the heavier concrete shells, and were used on falsework instead of on scows. Although the location of the pier is not subjected to much wind, wave and current, a floating plant, especially in tidal waters, requires constant care and watchfulness. The falsework in this case besides acting as a working platform for the cylinder drivers supported the tracks for transporting the concrete in filling cylinders, carried the derricks large and small used in cylinder filling, placing of trusses and setting upper sections of cylinders. Later on, it acted as support for the formwork used in constructing the main deck.

SHEET PILE CASTING PLATFORM, BALLANTYNE PIER
[illegible] beams at left [illegible] Reinforcement for sheet piles [illegible] hooks from sticks laid across the forms.

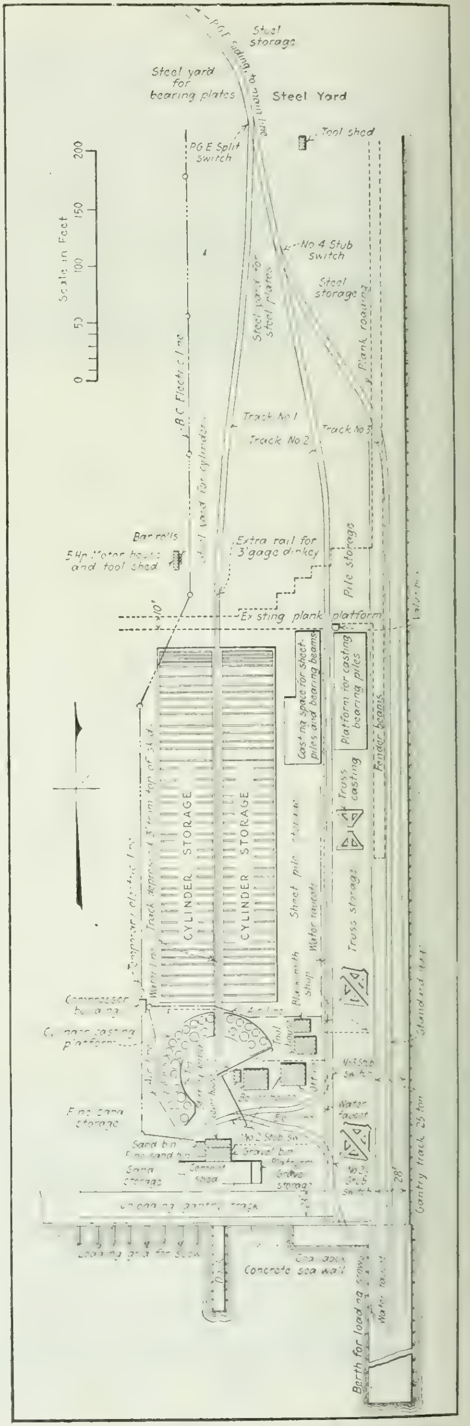


ONE OF THE MAIN TRUSSES—WEIGHT 26 TONS

It took a great deal more falsework than was estimated for the reason that when the time came to pull out of the piling the falsework that might have been used again, teredos had got there first. In this harbor they apparently start their work as soon as the hammer is off the pile. The piling is capped with 14 x 16-in. fir and braced with 4 x 12-in. plank running down to low water level, iron bark or Australian gum shoes are used on skids of drivers, skid derricks, etc., and greasers of same material spiked on to the caps of falsework, the latter being moved ahead and used as often as possible. It was somewhat problematical just what would happen where the piling was only driven about 20 ft. in the fill with the cutting edge of the cylinders passing within a couple of feet of the point of the pile and in places going on down through 30 ft. or more fill before hitting any firm material. It was found in practice that as long as a good load was kept on the piles, such as the weight of the cylinder drivers, the piles would not settle, but if there was no load on a pile near the cylinders, the piles would settle when the cutting edge of the cylinder got below the pile, at times pulling the ⅞-in. drift bolt through the cap. So in order to stop this, piling was only driven ahead as required to support the drivers.

When a section of falsework had been driven, the erection of these drivers was started. These drivers are much like an immense piledriver; the gins are 18 x 20-in. sticks set 8 ft. apart and 70 ft. long. The head block is composed of six 24 x 24-in. timbers, and the skids are 18 x 34 in., with hog rods 2½ in. thick. The engine is a 10 x 12-in. double-cylinder three-drum. One drum carried the load line handling the cylinders, the other two operate the orange-peel bucket used in excavating from inside of cylinders, handling water jets, hydraulic jack, etc. In the center of the head block of these drivers there is a 3½-in. U-bolt; to this U-bolt is fastened a six-sheave block, capacity 80 tons. The lines rove to another similar block attached to the center of a heavy block plate and channel spreader bar, at each end of this bar is suspended a 1½-in. cable about 40 ft. long. The end of each cable is attached to the opposite sides of the working arrangement of a collapsible steel band that encircles and holds the string of cylinders while being lowered into place.

Sinking Cylinders—The general procedure in sinking cylinders is as follows: The approximate depth of the cylinder being known (the tops are all at El. +89 just above low water), a number of lengths are loaded on a scow in the longest lengths that can be used to make this depth and have the upper end of the cylinder out of low water when sinking is completed. The derrick boat removes the first section (a cutting edge), sets it on the extreme forward end of its deck and sets itself so that the cylinder will be centered in front of the gins of the driver. The collapsible band is placed over the cylinder near the upper end, the 1½-in. cables from spreader bar fastened to it, band tightened and cylinder hoisted into place in gins, then lowered so the upper end is a little out of water. The derrick boat takes the next length of cylinder and places it on top of first section in the leads, the waterproof jointing is finished and the two sections bolted tightly together. This operation is continued until a sufficient amount of cylinders have been placed in the leads until the cutting edge rests on the bottom under water. The cylinder is then carefully centered by means of short guide blocks in the gins and back frame of driver; the lowering tackle is lowered free and excavating with the heavy orange-peel bucket started. The sinking process is continued in this manner until the top of cylinder is almost to high water line, when other required lengths are placed. When these lengths are all in place an added 17-ft. length is placed without the joint being waterproofed. Its function is to give increased weight to aid in the sinking and to have the material from the orange-peel bucket discharged free of the cylinder (for use of interior bucket again); one could not be sure of this if the top of cylinder was under water. When the cylinder is finally founded, a driver is sent down to clean up, and then an inspection is made by the engineer so every cylinder has at least two final inspections before sealing. When the foundation is found O.K. a rich concrete (generally 6 or 7 yd.) is placed in the bottom of the cylinders. At the next low tide the

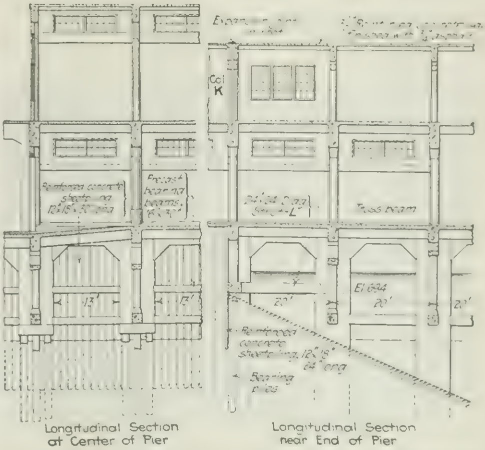


LAYOUT OF CASTING YARD FOR PILES, CYLINDERS AND TRUSSES weight section is unbolted, taken out of the gins and the driver moved to the setting of another cylinder.

After the concrete seal has set for several days a cylinder wooden cofferdam reaching from below low water to above high water is placed on the top of the cylinder, the joint made tight and water pumped out of the cylinder by means of a hydraulic jack. Then men are lowered in a small caisson bucket to remove from the top of the seal all laitance and dirt, clean the inside walls of cylinder, bolt pockets, etc. When all is thoroughly cleaned up, the cylinder is filled (in the dry) up to El. +86 with 1:3:6 concrete using aggregate from 2½ in. down. If the top of the cylinder shell is above El. +89, it is cut off at this elevation and lean fill used between the fill at El. +86 to El. +89. Should the top of the cylinder shell be below El. +89 the richer fill is simply brought up to this point inside the coffer, the latter acting as the form. The cofferdam is left on in either case for at least five days before being removed. When the coffers are removed and concrete of top of cylinders set, the next operation is the setting of the trusses in their proper location on top of the filled cylinders and fender beams.

When these are placed, the upper sections of cylinder shells are placed in position, the joints made tight, and they are filled with concrete up to the opening in them for the deck girders. When this is done this section is ready for the setting of the main deck forms. Theoretically the above statement gives the way the cylinders ought to sink, but practically they rarely do so. What happens is that good progress is made through the placed fill, then are encountered several feet of tough hardpan containing in places a great number of boulders and below this a soft sand rock and finally a hard dense conglomeration. It is found that even small charges of dynamite could not be used in the cylinders without causing cracks, the only solution being the use of high power water jets for this purpose. There are installed two 5-stage 10-in. pumps and one 12-in. 5 stage with a motor capacity of 1,000 hp. These pumps handle the hydraulic jacks as well as the jets. A main is placed in the fill down the center of the pier with valves and branches at different points, pressure used being about 175 to 180 lb.

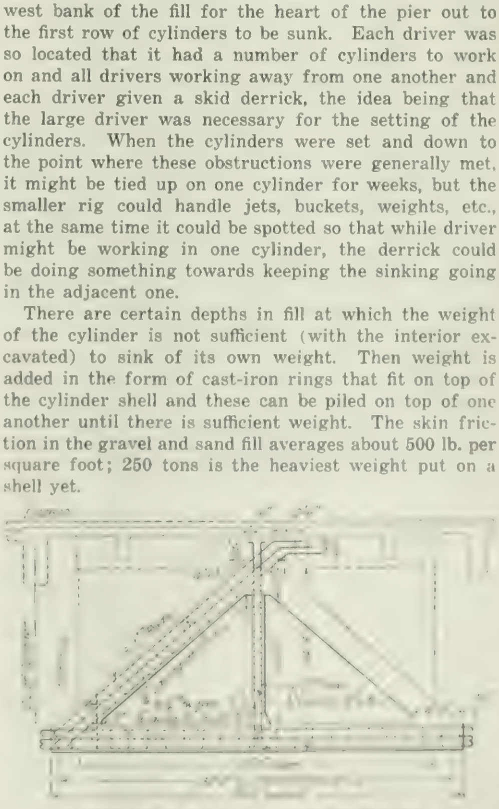
Difficulties in Sinking—When the material gets too hard for any further progress with the orange peel, it is removed and the jets attached to the lines and worked until a foot or so of material has been loosened, when the bucket is used to clean this up, then the jets are used again. Where boulders are encountered jets are used to work around them and if they are too large for the bucket to handle, a diver is sent down and with a small drill drills a couple of holes in opposite sides of the boulder, places pins with rings on in the holes and running chain to the rings, attached to hoisting tackle. Sometimes they come and other times they will not; if they cannot get power enough to pull them the only thing to do is keep working the jets a few shifts until they do. In this way boulders have been raised that would barely pass up through the cylinders, but the real fun is when one gets a good sized boulder under the cutting edge with more of it out than in and the cylinder in the fill 30 ft. or more. This means long shifts of work with divers. If enough hoisting equipment can be hooked into the cylinder to raise it, a charge is placed in the boulder, cylinder is raised, the shot fired, and sinking started over again.


Col K
Reinforced concrete sheeting 12x18x30 ...
Precast bearing beams
Truss beam
El 6.24
13'
13'
20'
20'
20'
Reinforced concrete sheeting, 12x18 24" ...
Bearing piles
Longitudinal Section at Center of Pier
Longitudinal Section near End of Pier

LONGITUDINAL SECTIONS SHOWING PRECAST MEMBERS

It was soon found out that on account of these difficulties the estimated plant would never get the job done in time, so work was started at once on two more drivers and the construction of a 10-ton skid derrick to go with each driver. The job was rearranged, a continuous set of falsework was driven along the west bank of the fill for the heart of the pier out to the first row of cylinders to be sunk. Each driver was so located that it had a number of cylinders to work on and all drivers working away from one another and each driver given a skid derrick, the idea being that the large driver was necessary for the setting of the cylinders. When the cylinders were set and down to the point where these obstructions were generally met, it might be tied up on one cylinder for weeks, but the smaller rig could handle jets, buckets, weights, etc., at the same time it could be spotted so that while driver might be working in one cylinder, the derrick could be doing something towards keeping the sinking going in the adjacent one.

There are certain depths in fill at which the weight of the cylinder is not sufficient (with the interior excavated) to sink of its own weight. Then weight is added in the form of cast-iron rings that fit on top of the cylinder shell and these can be piled on top of one another until there is sufficient weight. The skin friction in the gravel and sand fill averages about 500 lb. per square foot; 250 tons is the heaviest weight put on a shell yet.



DETAILS OF A TYPICAL PRECAST TRUSS

To speed up the filling of cylinders a floating concrete plant was built; the setting of cylinders along the heart of the pier cylinders was always at the outer edge of the falsework and could be easily reached. This plant is also used as a booster in helping concrete the deck.

VIEW IN THE CASTING STORAGE YARD
Showing bearing piles, sheet piles, fender beams, trusses and cylinders.

Prevention of Dust Explosions in Grain Elevators

Rules Proposed by Fire Protection Association to Regulate Construction, Equipment, Operation and Cleaning

WITH the aim of reducing the number and severity of dust explosions in elevators and mills, tentative rules governing building construction, machinery equipment, dust prevention and dust removal were submitted at the annual meeting of the National Fire Protection Association, in Chicago, by the committee on Dust Explosion Hazards. Separate sets of rules apply to terminal grain elevators, flour and sugar mills, pulverized fuel systems and cocoa grinding and pulverizing systems. An abstract of a portion of the rules relating to grain elevators is given below.

Building Construction—Interior walls, including bin walls, shall be smooth and free from pockets or ledges on which dust may accumulate, but where ledges cannot be eliminated they shall have a smooth surface and be made as steep as possible. Pipes and conduits that must be exposed shall be fastened in such a manner as to present a minimum surface for the accumulation of dust.

Roofs and walls of belt conveyor galleries, the side walls of all cupolas above bins, also all curtain walls below bins, shall be of light material offering little resistance to explosive energy. The term "light material" contemplates corrugated galvanized iron, corrugated zinc, corrugated asbestos, brick-tile or gunite, and for cupola construction it is intended to apply only to curtain or panel walls between columns. Concrete may be used if the window area is greater than the minimum noted below.

If the track shed, in which cars are loaded and unloaded, is immediately adjacent to the working house, it must be separated from the latter by a solid dust-proof partition of light material. Fixed windows may form a part of this partition. All other buildings forming part of the elevator shall be spaced as far apart as practicable. Connections between buildings shall be only by belt galleries, tunnels or sprouts. Tunnels not wholly underground must be provided with natural light, and in any event must have adequate ventilation. Where galleries or tunnels are connected to main buildings a partition or fire door shall be provided, solid except for entrance door and apertures for conveyor belt. The entrance doors shall be hinged to swing into the tunnels and shall be self-closing. Small doors or slides, equipped with either fusible link or automatic closing device, shall be provided to close the apertures for conveyor belts in case of fire or explosion.

All storage bins shall be covered, the side walls extending solidly to the roof of the bins, there being no connection between bins. Each storage bin shall be vented to the outside atmosphere by a vent pipe of sufficient size. All bins in the outside rows of the working house shall be vented to the outside atmosphere, but interior bins may be vented into the story over the bins when mechanical difficulties make it impossible to vent such bins to the outside atmosphere.

Tunnels and basements shall extend as much above natural ground level as practicable and shall be large and roomy. All tunnels and basements shall be dry and shall have all the natural light possible, either by means of windows, areaways or sidewalk glass. Basements of all buildings shall be of such construction as to permit the free circulation of air and shall be vented by air shafts exhausting above the roof or by other approved method. Fans or blowers shall be provided when the natural ventilating capacity is not sufficient to provide one complete change of air per hour. To provide adequate air inlet in basements at all times, permanent openings shall be made in addition to the doors and windows.

All buildings and operating rooms shall be provided with a large area of windows or a combination of windows and louvres, the minimum allowance to be as follows: For cupolas and drier building, 40 per cent of the free wall area (space between columns). For galleries between buildings, also shipping galleries, 10 per cent. For track shed and first story of other buildings, 50 per cent. All windows shall be glazed with plain glass, shall be easily operative and arranged to provide the maximum ventilation when open, and shall be preferably of the hinged or tilting type.

Roofs of track sheds, drier buildings, galleries and all cupolas shall be provided with sufficient monitors or ventilators to insure, in conjunction with the windows, one complete change of air per hour, in the area thus ventilated.

Removal of Suspended Dust—All elevator leg heads, garners over scales, and scale hoppers shall be equipped with vents to the outside atmosphere.

Discharge ends of all belt conveyors, boots of all elevator legs, all fixed belt loaders, and other points where there is a throw of the grain, shall be provided with adequate air aspiration, so arranged as to collect only the floating dust that might otherwise escape into the building. Air aspiration shall be strong enough to remove only floating dust and not kernels of grain.

Drier units shall be provided with an adequate system for the removal of dust created through the operation of driers. Cleaning machines shall be equipped with dust collecting systems.

Dust collectors shall be of the cyclone type, at least 90 per cent efficient, and shall be located outside the elevator buildings. They shall exhaust 10 ft. or more above the roof of the plant, or be so arranged that there will be no opportunity for the dust from the exhausts to get back into the elevator.

Removal of Static Dust—All elevators shall be equipped with some type of pneumatic or other effective system for the removal of static dust which collects on floors, side walls, spouts, ledges and boot tanks. The vacuum system is recommended. So far as practicable the use of brooms and brushes for dust removal shall be discontinued.

For removal of dust from motors, drier coils and other inaccessible surfaces, all elevators shall be equipped with a compressed air system, operating at from 80 to 100-lb. pressure. Either fixed compressor with suitable piping and hose or a portable compressor set may be used. When the latter is used it shall be provided with a tank of sufficient capacity to maintain pressure for a considerable length of time, making it unnecessary to bring the tank to pressure while in the elevator.

From the American Association of Engineers' Convention

Rules of Professional Conduct, a New Standard License Law for Engineers, and Other Reports Presented at Norfolk, Va., May 7-9 — Congressman Smith on the Engineer's Political Duty

Principles of Good Professional Conduct for Engineers

From Report of National Practice Committee

THE PRINCIPLES enunciated herein were drawn from decisions in cases of question or difference of view as to professional conduct, of which 44 have been decided by the committee. In the original draft of these principles five were included (two each in Parts I and II, one in Part IV) which are omitted in the present reprint, as they were referred back by the convention, for restudy and revision. The principles as here reproduced were adopted by the convention.

Part I. Relations of the Engineer to the Public

1. The engineer should regard his duty to the public welfare as paramount to all other obligations.

2. He should not use his professional standing as a means of sponsoring or promoting commercial or other undertakings of a speculative character.

3. He should scrupulously avoid connection, by act or omission, with any illegal or questionable undertaking or participation in any enterprise inimical to the public welfare.

4. He should not advertise in self-laudatory language or in any other manner derogatory to the dignity of his profession.

5. He should avoid any publicity giving the impression that technical service in technical matters can be dispensed with; or that technical proficiency along any line is easy of acquisition; or that exaggerated returns may be expected from any limited course of technical instruction.

6. He should avoid any questionable statements or any statements couched in language that would convey a false impression, in any of his reports, advertisements or articles.

7. He should refrain from using any improper or questionable methods of soliciting professional work.

8. He should participate in clean politics and should strive to be a force to assist in the cleansing of politics.

9. He should take an active interest in the public welfare in behalf of which he should ever stand ready to volunteer his special knowledge, skill and training for the use and benefit of mankind.

Part II. Relations of the Engineer to Clients and Employers

1. The engineer should pursue his professional work in a spirit of strict fidelity and full loyalty to his clients and employers.

2. He should inform a client or employer of any business connections, interests or affiliations which might tend to influence his judgment or impair the disinterested quality of his services.

3. He should accept compensation for his services in connection with any work from one source only, except with the full knowledge and consent of all the interested parties.

4. He should regard and maintain as confidential any information obtained by him relating to the business affairs and technical methods or processes of a client or employer.

5. When connected with any work, he should not accept commissions, outside employment, promise of employment, or any other consideration from a contractor engaged upon that work.

6. He should have no business dealings or connections with any client of his employer without the full knowledge and approval of his employer.

7. He should entertain no offers of employment or other considerations from a third party, which may in any way influence his actions or decisions with respect to the relations which may exist between such third party and the engineer's employer or client.

8. He should not accept commissions or other considerations for specifying or recommending supplies, equipment or service.

9. He should have no interest, direct or indirect, in any materials, supplies or equipment used in the construction work of his client or in any firms receiving contracts for his client's work without in advance informing his client of the nature of such interest and obtaining his sanction.

10. He should not engage in the independent practice of engineering without the knowledge and sanction of his employer, and under no circumstances should he compete with his employer on the basis of lower fees.

Part III. Relations of Engineers to Employees

1. The engineer should treat his employees or subordinates in a spirit of fairness, with due regard and consideration for their personal welfare and professional advancement.

2. There should be a professional bond between employer and employee when both are engineers, which will dictate and impel reciprocal interest and mutual consideration.

3. The engineer should pay adequate salaries, commensurate with the importance and responsibility involved in the service.

4. He should encourage the professional pride of his employees or subordinates in their work and should offer them every means of protecting their reputations and the quality of the work entrusted to them by not interfering with the proper performance of the duties for which they are responsible.

5. He should recognize the freedom of his employees to change employment and should in no way hinder employees or subordinates in bettering their condition.

6. He should not discharge an employee, nor withhold employment from him, nor discriminate against him in any way on account of his affiliations or activities in any professional, political or religious organization.

7. He should respect his employee's right to freedom of thought, speech and outside activity as long as the same does not impair the efficiency and value of the employee's service.

8. He should see that his employee is adequately covered by insurance against risk of casuality arising from his work.

9. In advertising or offering employment, he should refrain from any misrepresentation as to the conditions and permanency of such employment.

10. If in public employ, he should assume the responsibility of consistently protecting the interests of his subordinates.

11. He should make every effort to provide steady employment for his employees and when forced to discharge an employee he should give the most generous notice possible and exert every reasonable effort to assist the employee in finding another position.

Part IV. The Engineer's Relations to Other Engineers

1. The engineer should not by word, act or omission injure falsely or maliciously, directly or indirectly, the professional reputation, prospects or business of another engineer.

2. He should not attempt to supplant another engineer after definite steps have been taken toward his employment.

3. If employed in conjunction with another engineer, and by the same client, he should not review and comment conclusively upon the work of the other engineer except with his full knowledge and consent or unless the connection of such other engineer to the work has been previously terminated.

4. He should not use unfair means to effect his professional advancement or to injure the chances of another engineer to secure and hold employment.

5. He should not attempt to inject his services into a project at the expense of another engineer who has been active in developing it.

6. He should not interpose between other engineers and their clients when unsolicited. When solicited, he should

avoid any possibility of doing a brother engineer an injustice.

7. He should not seek or solicit a position occupied by another engineer.

8. He should not attempt to secure work on the basis of lower salaries or fees.

9. He should be courteous, fair, considerate in his dealings with other engineers.

10. He should not commercialize his affiliations with, or official position in, any technical organization.

11. He should not use his professional affiliations to secure the confidence of other engineers in speculative commercial enterprises.

12. As a member of any professional organization, he should avoid any act tending to promote his own interest at the expense of the dignity and standing of the organization.

13. As an officer of a professional organization, he should sedulously avoid any appearance of using his position for personal advertising.

14. He should co-operate in upbuilding the engineering profession by exchanging professional information and experience with his fellow engineers and students of engineering and by contributing to the work of engineering societies, schools of applied science, and the technical press.

15. He should regard himself as a debtor to his profession and should dedicate himself to its advancement.

* * *

A Neglected Duty of the Engineer

From an address by Hon. Addison T. Smith, Chairman, Committee on Irrigation of Arid Lands, House of Representatives

YOUR profession has done and is doing more, possibly, than any other profession for the safety, comfort and happiness of the people. You have spanned the rivers, tunneled the mountains, and erected mighty structures which excite wonder and admiration. You have added to the prosperity and comfort of teeming millions throughout the world. In addition to these great accomplishments, it seems to me, you should be taking a more active part in the preservation of our institutions and in making our laws.

Why do we have so few engineers in active political life? There is no higher duty for the citizens, especially for those who are educated, than that of the study of statecraft. The first consideration of society is good government. Without good government it is not possible for the citizen to enjoy the fruits of his toil, or to be protected in his life, liberty and the pursuit of happiness.

To you men, educated as engineers, "duty" is an appealing word. We frequently hear complaints from all directions concerning our legislators, and often from those who take no interest in politics. Are we doing our part in helping to nominate good men for office, and aiding in electing them? And after all this has been done, are we taking them into our confidence and aiding by suggestion and argument in influencing the enactment of laws which will advance the general welfare?

Because of his technical education and experience in handling large affairs the engineer is naturally a man of influence in his community, and on this account could be helpful in formulating policies and carrying out plans which would be of the greatest benefit to the state and nation. Have you been content to let others take the lead when it comes to great public matters for which your education and experience equip you?

With the trained vision and the ingenuity which distinguish your profession, you have a greater duty, and a greater opportunity for enjoyment of that duty, than have men of other professions. Having this duty and opportunity, you should use it—not merely in handling the materials and forces of Nature for the good of men, but you should consider and act upon ways and means for putting your knowledge into the really practical politics of every-day life, particularly where these affect the proper use and enjoyment of our natural resources. So far as legal, legislative and judicial functions are concerned, we have not yet made the same substantial advance as has been done in engineering; we have not devised a system of laws which will bring to all the people their share of life comforts and enjoyments. If we are to advance, we must utilize more of the vision of the engineer, and put into practical use the ingenuity and initiative which are supposed to be his peculiar characteristic.

I am brought into peculiarly intimate relations with engineers, and in event of the adoption by Congress of a broad national policy of reclamation and settlement of waste lands in all parts of the country, which has been under consideration by Congress for several years, I expect to be even more closely associated with men of your profession. There is much to be done in the way of education of the public on the needs and opportunities of reclamation; also there are obstacles to be overcome in the way of constructive legislation. My committee welcomes any suggestion which you, as citizens from different parts of the country, may make in this connection, because I know that you not merely understand the mechanical or material obstacles to be overcome but also have the local viewpoint as to the human problems and relations.

I have more confidence in the value of the help that you may render because I have seen some of the works which you have devised and constructed. My home-state of Idaho, and especially the southern part where I live, may be said to be largely a creation of the engineer, in that land values, and nearly all prosperity rests upon the adequacy of the structures for water supply built by engineers in private or governmental employment.

In the extension of reclamation work to all parts of the United States, waste lands in the South and East must be reclaimed by drainage. The required works, while perhaps not as picturesque as the great reservoir dams of the West, in the aggregate may be difficult and expensive to build. It is not, however, the magnitude of the work which calls into play the highest engineering skill; many intricate problems must be solved, particularly where question of economy and permanence is involved.

In the past you have not done all that might have been done in the way of seeking political preferment and taking an active interest in public affairs. I hope for you a wider vision as to the opportunities which are before you, and particularly of the duties to the public which you can perform, not merely in your technical capacity but even more in your ability to enlighten and lead your fellow-citizens.

* * *

New Standard License Law

IN THE following paragraphs is given a revised draft of the new standard license law adopted by the association May 7, 1923, on the basis of a report of the legislative committee and subsequent revision of a special committee made up largely of members of state examining boards. The adopted bill is subject to editorial correction and to annotation which is to indicate the manner of applying the standard to varying conditions of different states.

Sec. 1—In order to safeguard life, health, and property any person practicing or offering to practice as a professional engineer or a land surveyor in this state shall hereafter be required to submit evidence that he is qualified so to practice, and shall be registered as hereinafter provided, and from and after twelve months after this act becomes effective it shall be unlawful for any person to practice or offer to practice as a professional engineer or a land surveyor in this state unless such person has been duly registered or specifically exempted as required by the provisions of this act.

Sec. 2—Nothing in this act shall be construed as requiring registration for the purpose of practicing professional engineering or land surveying by an individual, firm, or corporation on or in connection with property owned or leased by said individual, firm, or corporation unless the same involves the public health or safety, or the health and safety of employees of said individual, firm, or corporation; provided, however, such person shall not represent himself as, or use the title of, registered professional engineer unless such person is qualified by registration under this act.

Sec. 3-7—[Create a state board of registration for professional engineers and land surveyors of five members appointed by the Governor, the members to be professional engineers and not more than two of them to be from the same branch of the profession, one being also a skilled land surveyor; provide for a four-year term of office, initial appointment of a board by the governor, removal of members by the governor, power to take testimony, employment of a secretary by the board, election of officers and adoption of rules and by-laws, compensation of the board and payment of expenses from moneys received, and publication of an annual roster of registered professional engineers and land surveyors to be filed with the secretary of state and with each county clerk.]

Sec. 8—Application for registration shall be made to the board on form prescribed by it, accompanied by a fee not to exceed $15 for professional engineers and $10 for land surveyors, such fee to be retained by the board. The application shall contain satisfactory evidence under oath that the applicant (a) is more than 21 years of age; (b) is of good character; (c) has engaged in the practice of professional engineering of a character satisfactory to the board for at least six years—graduation from an engineering school of recognized standing shall count as three years of practice; or (d) has engaged in the practice of land surveying of a character satisfactory to the board, for at least four years—two years of technical school work successfully done shall count as two years of that experience, provided the college work included the study of surveying with the necessary mathematics.

Sec. 9-11—[Provide for examinations for registration at least twice a year, either oral or written or both, or an investigation of the applicant's professional record; registration without examination within one year after adoption of the act, on evidence that the applicant is engaged in practice; and issuance of a registration certificate for a fee of $10.]

Sec. 12—The board shall, from time to time, examine the requirements for the registration of professional engineers and land surveyors in other states, territories and countries, and shall record those in which, in the judgment of the board, standards not lower than those provided by this act are maintained. The board is hereby empowered to arrange for reciprocal registration of professional engineers and land surveyors in other states or countries and to allow registered professional engineers and land surveyors from those states, territories, and countries so recorded to practice in this state under terms mutually agreed upon. The secretary of the board, upon the presentation to him by any person of satisfactory evidence that such person holds a reciprocal registration certificate issued to such person by proper authorities in any such state, territory or country, shall, upon the payment of a fee of $1, issue to such person a certificate of registration under this act.

Sec. 13—The board shall have power to revoke the certificate of registration of any professional engineer or land surveyor registered hereunder who is found guilty of any fraud or deceit in his practice or in securing a certificate of registration, or of gross negligence, incompetence or misconduct in the practice of professional engineering or land surveying. [Charges to be in writing, a hearing to be held within three months, a four-fifths vote of the board to be necessary for revocation, and appeal allowed to civil courts.]

Sec. 14—[Fixes annual renewal fee for renewal certificate.]

Sec. 15—[Provides for use of authorized seal by a registered engineer or surveyor.]

Sec. 16—Nothing in this act shall be construed as prohibiting a corporation, association or partnership from engaging in the practice of professional engineering or land surveying in this state, provided the person or persons connected with such corporation or partnership in responsible charge of the designing or supervision, which constitutes such practice, is or are registered as herein required for professional engineers or land surveyors. The same exemptions shall apply to corporations as apply to individuals under this act.

Sec. 17—[Exempts from the provisions of the act a non-resident offering to practice; a non-resident practicing not more than 30 days in any calendar year, if he is registered in his own state; a non-resident practicing during the time his application for registration is pending; a non-resident practicing as consulting associate of a registered professional engineer or land surveyor for not more than 30 days in any year; employees of registered [illegible] engineers or surveyors; and government officials. No exempt persons are authorized to use the title registered professional engineer, professional engineer, or registered land surveyor.]

Sec. 18—[Provides penalties for unauthorized practice or offer to practice, wrongful use of registration certificate, false evidence before the board, etc.]

Sec. 19—This act shall not apply to any architect registered by the state under the provisions of the act creating the State Board of Architecture. [This section to be used only when there is already a law on the statute books licensing architecture.]

* * *

Public Works Planning as Related to the Tax Burden

From the Presidential
Address of A. N. Johnson

THERE IS an insistent demand for a reduction of the tax rate, and an equally insistent demand for public improvements: a demand for economy on the one hand, coupled with a demand for expenditures on the other. Can these demands be reconciled?

We know from long experience that money for public improvements has been lavishly voted without much consideration of any settled policy. We begin today what we find ourselves unable to finish tomorrow. We stop what we have begun, only to make a fresh start, with the loss of energy required to get under way once again—quite comparable in effect to stopping and starting a heavy train.

A most obvious saving and ultimate economy would result if a continuing sound policy toward public improvements were first formulated and then followed. Year after year, in city, county and state, as well as in national government affairs, engineers have made recommendations and laid down plans of procedure for prosecution of various works over a period of years. But these plans and suggestions have somehow not met with effective public support. The very fact that politicians have seen fit often to follow quite a contrary course is evidence that they know that the engineers' recommendations have but small weight with the public generally. It must, therefore, rest with the engineers themselves to arouse public sentiment, to make clear to all that if real economy is to be secured a logical plan of procedure must prevail. In such a course lies the only hope for ultimate reduction in wasteful expenditures for public improvements.

The improvements must be made; expense must be reduced. The engineers are in position to accomplish much toward a solution of the problem. But it is not sufficient that a good plan be evolved, a sound policy outlined. The public must be convinced. In this situation there is a distinct place for the engineer, both for himself and the public to consider.

* * *

Public-Service Engineering Compensation

From Progress Report of Committee on
Salaries of Engineers in Public Service

THE REPORT recommends reaffirming the salary schedules adopted by the association, and discusses means for bringing about their adoption by public officials. Finally, in the extract quoted, it points out that engineers themselves must fight for adequate compensation.

Just as long as engineers will work for their present small salaries the public is not going to worry at all about what the engineer thinks of the inadequacy of these salaries. The engineer need not delude himself that his sacrifices are appreciated by anybody but his family and himself, for they are not. The attitude of the public is, in the first instance, one of supreme indifference as to the engineer's compensation. This will always be true. When, in the second instance, the public learns of the engineer's discontent these questions immediately are raised: "He knew what the job paid before he asked for it. If he didn't like the pay why did he ask for the job? If the pay is so poor why do so many seek these jobs?" The engineer's eternal hope for an increase, based on recognition of the true value of his services, as well as the more or less unselfish desire to render a public service, alike are unknown to the desperately busy and preoccupied public.

Good Practice in the Design of Crane Runways

A Condensed Discussion of Impact Effect, Lateral Stiffening, Expansion, Rail Fastening and Miscellaneous Points

By Robins Fleming
Structural Engineer, American Bridge Co., New York City

METHODS of calculating stresses and proportioning members of crane runways may be found in textbooks, but some points on design which experience shows to be important are not usually found in the books. The present article discusses a number of such points.

Load Data—If the designer knows whose make of crane will be used, he can design for actual wheel loads and clearances. But a mill building or crane runway is often designed and fabrication commenced before the owner has bought the crane, and the designer then must use available information on other cranes of the lifting capacity that is to be provided for. A table of loads, wheel bases and clearances for electric traveling cranes prepared by the writer for Merriman's "American Civil Engineers' Handbook" (4th edition, p. 829) is, by permission of the publishers, reproduced here as Table I.

TABLE I—LOADS AND CLEARANCES FOR ELECTRIC CRANES

Capacity Tons (2,000 Lb.)	Span, Ft., C to C Rails (A)	Wheel Base, Ft and In B	B₁	B₂	Max. Load, Lb., For Each Wheel (W)	Vertical Clearance (C) Ft. and In	Side Clearance (D) In.	Rail, Lb per Yd.
5	40	9-0		..	13,000	6-0	10	50
	60	10 0			15,000	6-0	10	50
	80	11-0			18,000	6-0	10	50
10	40	9-0			20,000	6-6	12	60
	60	10-0			23,000	6-6	12	60
	80	11 0			26,000	6-6	12	60
15	40	10-0			30,000	7-0	12	60
	60	11-0			33,000	7-0	12	60
	80	12-0			36,000	7-0	12	60
20	40	10-6			35,000	7-6	12	80
	60	11-6			39,000	7-6	12	80
	80	12-0			43,000	7-6	12	80
30	40	11 0			50,000	8-0	13	80
	60	12-0			54,000	8-6	13	80
	80	13-0			59,000	8-6	13	80
40	40	12-0			66,000	8-6	14	100
	60	13-0			71,000	9-0	14	100
	80	14-0			77,000	9-0	14	100
50	40	13 0			80,000	9-6	15	100
	60	13-6			85,000	10-0	15	100
	80	14-0			90,000	10-0	15	100
75	60	12 0	5 0		65,000	12-0	16	100
	80	14-0	5-0		70,000	12-6	16	100
100	60	12 0	5 0		90,000	14-0	18	150
	80	14-0	5-0		95,000	15-0	18	150
125	60	13 0	5-0		110,000	15-0	20	175
	80	15-0	5-0		120,000	16-0	20	175
150	60	18-0	5-0		130,000	16 0	22	175
	80	20-0	5-0		140,000	17 0	22	175
175	60	14-0	7-0	3-6	65,000	17-0	24	150
	80	19 0	7-0	3-6	75,000	18-0	24	150
200	60	14 0	7-0	3-6	75,000	17-0	24	150
	80	19-0	7-0	3-6	85,000	18-0	24	150
Loads and Clearances for Hand Cranes								
2	30	4-0			3,500	4-0	7	30
	50	5-0			4,000	4-0	7	30
4	30	4 0			5,500	4-6	8	30
	50	5-0			6,500	4-6	8	30
6	30	6 0			8,000	5-0	9	40
	50	7 0			9,500	5-0	9	40
[illegible]	30	6-0			10,500	5-0	10	50
	50	7-0			12,000	5 0	10	50
10	30	7-0			13,000	5-0	10	50
	50	8-0	.....		14,500	5-0	10	50

Loads given do not include impact

Data relating to a proposed 250-ton crane submitted by different manufacturers are given in Table II. In this table the term "double track" means two rails 7 to 10 in. apart on each girder, the crane wheels being made to bear on both rails; the wheel load given is the load on each rail.

The designer of a runway to carry a crane of 100 or more tons capacity should have the opportunity of reviewing his calculations from data obtained after the crane is purchased. It is well for him to do so in all cases, but it is especially important with cranes of unusual capacity.

TABLE II—DATA FOR 250-TON ELECTRIC TRAVELING CRANES

Manufacturer	Capacity, Tons Main	Auxiliary	Span (A), Ft. and In.	Wheel Base B, Ft. and In.	B₁, Ft and In.	B₂, Ft and In.	Max. Wheel Load (W), Lb.	Vertical Clearance C, Ft and In	Side Clearance D, Ft and In
X	250	40	100-0	17-0	8-0	3-6	110,000	19-6	2-0
Y	250	40	100-0	17-0	7-6	3-0	110,000	19-6	2-0
Y	250	25	70-9	16-0	5-0	. .	Double Track 115,000	21-6	3-9
X	250	25	70-9	8-0	4-0	.	Double Track 93,000	21-6	2-9
X	250	25	70-9	18-0	3-5	.	Double Track 120,000	21-6	2-9
Z	250	40	100-0	15-0	7-9	3-3	109,500	19-6	2 0
Z	250	25	70-9	11-0	5-0	...	Double Track 92,500	21-6	4-6
Z	250	25	70-9	11-0	5-0		Double Track 105,000	21-6	4-3

Loads given do not include impact.

Impact—Stresses due to wheel loads should be increased 25 per cent for impact, or, what is the same thing, the actual wheel loads should be increased 25 per cent. Some engineers think that impact should be assumed in accordance with the capacity of the crane. A 5- or 10-ton crane, they think, is subject to much rougher usage than one of 40 or 50 tons, and for this reason they would reduce the impact of 25 per cent to 10 per cent for the heavy crane. This reasoning is not verified by experience. A careless operator may be in the cage of a 50-ton as well as in that of a 10-ton crane. Sudden stopping or starting, pulling loads at an angle, slips in the hoisting chains are common to heavy cranes as well as to light ones.

The minimum distance between two cranes on a crane runway usually varies from 2½ ft. for 5-ton cranes to 5 ft. for 50-ton cranes, center to center of adjacent end wheels. It is improbable that when the cranes are close together both of them will be carrying maximum load, and therefore no impact need be included when stresses due to two cranes on the same girder are computed. Of course if the stresses obtained are less than the stresses due to a single crane with impact, the girder should be proportioned for the latter case.

For hand-power cranes impact may be assumed at 10 per cent; girders designed on this basis have proved amply rigid in practice.

Longitudinal Traction Stresses—The tractive force to be resisted on each side of the runway may be assumed at 10 per cent of the load on that side from all the cranes, distributed along the entire length of the runway or between expansion joints in a long runway. Kneebraces from girders to columns are commonly used to resist the longitudinal forces. A better way, where practicable, is to carry the traction stresses to the ground by diagonals in occasional bents, say 100 or 150 ft. apart. If this is done, kneebraces can safely be omitted throughout.

Expansion and Contraction—How much provision should be made for expansion and contraction in crane runways depends largely upon the variations of temperature to which they are liable. Runways under ordinary conditions have been built 600 ft. and longer without any provision for expansion save that the ends were free to move, that is, they were not confined by any adjoining structure. This allows 300 ft. of runway to expand or contract by the tipping of the columns. There is a case of a shipyard runway 1,000 ft. long resting on columns 57 ft. high which has no provision for expansion, but the length of 600 ft. should seldom be exceeded without some provision being made. Runways about furnaces should receive special consideration because of the chance that they may be frequently subjected to high temperatures.

Long lines of girders are liable to overrun in length unless great care is used in fabrication. Expansion joints, allowing adjustment in erection, are one means of overcoming this difficulty.

Lateral Stiffness—Provision should be made to resist the horizontal thrust due to the travel of the load upon the crane bridge. Much trouble in runway girders has come from failing to properly care for this thrust. A common requirement in specifications is that the horizontal thrust on a crane runway shall be assumed equal to 20 per cent of the lifting capacity of the crane, divided equally among all the wheels or 10 per cent divided equally between the wheels bearing on one rail. This thrust, applied at the top flange of the girder, subjects it to double duty in resisting both vertical and horizontal bending, and makes necessary the provision of additional strength as well as stiffness in this flange. To meet these requirements the design of top flange shown by the sketch Fig. 1 is recommended in some text-books, a channel over two angles. This is easy of calculation, but its use is quite limited in practice. To secure an even bearing of rail on the channel, unless the clear distance, *a*, between heads of rivets, is greater than the width of rail base (or splice bars if the angle type is used), the rivets must be countersunk and chipped. This is difficult to do satisfactorily in the thin webs of channels, besides being costly. To bring rivet heads outside the base of the rail, flange angles with not less than 5-in., preferably 6-in., outstanding legs should be used. The covers can be flat plates if of sufficient lateral strength, rolled channels if it is practicable to use them, or built-up channels, as in Fig. 3.

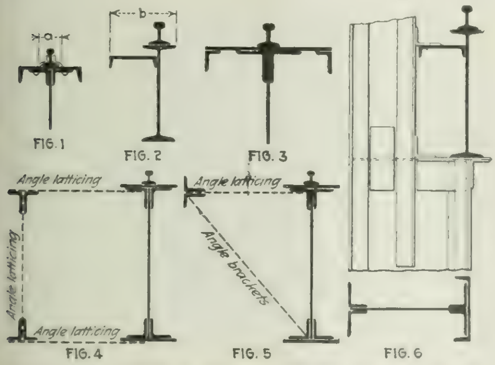


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6

RIGHT AND WRONG DETAILS OF CRANE RUNWAYS

The working flange stress from vertical loading with impact added is usually given in specifications as 16,000 lb. per sq.in. net tension. When the ratio of the laterally unsupported length, l, of the top flange to its width, b, exceeds 12, the compressive working stress should not exceed $19{,}000 - 250\ l/b$. For combined lateral and vertical loadings the working stress may be increased 12½ per cent, provided the section thus obtained is not less than that from the vertical loading alone.

To avoid undue deflection from moving loads the depth of crane girders should be not less than 1/16 the span length.

Girders of short span and for cranes of moderate capacity are often made of a single I-beam stiffened by a horizontal channel attached close to the top flange, as in Fig. 2. The vertical loads may be considered carried by the I-beam and the lateral loads resisted by the channel. In determining the working stress to be used in the top flange for vertical loading the width b in ratio l/b is considered the distance b in Fig. 2. A stress of 16,000 lb. per sq.in. is used for the horizontal channel. No impact is added to the assumed lateral loading. Table III, a list of I-beam girders with lateral stiffening channels for some runway sizes in common use, is taken from the standards of a fabricating company.

TABLE III—CRANE GIRDERS FOR CRANE OF 60-FT. SPAN

Capacity of Crane, Tons	16-Ft. Girder		20-Ft. Girder		24-Ft. Girder	
	I-Beam	Channel	I-Beam	Channel	I-Beam	Channel
	In. Lb.	In. Lb.	In. Lb.	In. Lb.	In. Lb.	In. Lb.
5	15-42.9	8-11.5	18-54.7	8-11.5	20-65.4	10-15.3
10	18-54.7	8-11.5	20-70	8-11.5	24-79.9	10-15.3
15	20-65.4	8-11.5	24-79.9	8-11.5	24-115	10-15.3
20	24-79.9	8-11.5	24-95	10-15.3	Plate Girder	

Runways carrying heavier cranes or of longer spans than those shown in Table III are made of plate girders. For lengths up to about 35 ft. the top flange may be stiffened laterally by a built-up channel of a plate and two angles, as in Fig. 3. The plate should be of a width not less than 1/20 the span length. As before mentioned, the gage of rivets in outstanding legs of angles should be such as to allow the base of rail to clear rivet heads without countersinking. For long spans, especially in out-of-door runways, stiffening girders are necessary; Fig. 4 is an illustration. The two girders should be not less than 1/12 to 1/15 the span length apart. A section as in Fig. 5 should not be used. Experience, costly in one case, has shown that, especially in long spans, the horizontal girder under stress is liable to deflect, throwing stress into the angle brackets and causing twisting in the main girder.

Where two runways adjoin, the inner girders can usually be latticed together, thereby reducing the amount of material over that required for stiffening each girder separately.

Rail Fastenings—The fastening of rails to girders is quite important. For rails resting on I-beams, hook bolts in pairs about 2 ft. center to center of pairs are used. Bolts ¾ in. in diameter may be used for 40-lb., and ⅞ in. for 60- and 80-lb. rails. They should be made to allow ½ in. adjustment either way for alignment of the rails. Rails resting on the top flanges of built-up girders should be attached by clamps spaced not more than 3 or 4 ft. apart. Clamps require not less than 6-in. legs; the adjustment of the rails is obtained by means of eccentric washers (patented clamps that have given excellent satisfaction are on the market). Substantial splice bars should be provided for the rails. Split washers or nut locks should be used on all hook bolts and bolts for rail clamps, rail splices and crane stops.

Riveting of rails to top flanges is not to be commended, as it gives no means for adjusting the alignment.

Crane Columns—Crane runway girders in industrial buildings rest either on column brackets or on columns with the lower part made wider than the upper in order that the load from the crane girder may be transmitted directly to the column base. By reason of the eccentricity involved the use of brackets should be restricted to cranes of not more than 10 tons capacity, preferably 5 tons. In proportioning columns the bending stresses from bracket loads should be calculated and added to stresses from direct loads. With columns as in Fig. 6, eccentricity is reduced to a minimum; the crane-girder load is carried to the base by the channel, the two connecting angles and the portion of the web plate between. For heavy loads an I-bean is sometimes used instead of a channel. In colunms of the gun shop of the Crucible Steel Co. at Harrison, N. J., 20-in. I's and 6 x 6-in. angles were used.

Separate columns are sometimes used under crane girders. These possess the advantage of having stresses determinate, but require more steel and are not as stiff laterally as the wider columns of Fig. 6. Separate girders and columns, parallel and close to those carrying galleries, were used for the crane runway in the machine shop of the American Bridge Co. at Pencoyd, Pa. This was done at the suggestion of the late P. L. Wolfel. His object, to prevent vibration in the gallery floors from the running of the crane, was thoroughly accomplished, although at considerable expense.

The girders of out-of-door runways are often supported by A-shaped frames. The spread at the base should be not less than one-fifth the height. To make available as great an area covered by the crane as possible the inner leg of the frame is made vertical and thus carries most if not all the direct load. The outer leg acts as a brace or backstay. A-frames should be designed for lateral stiffness as well as for direct loads.

When runway girders are made as in Fig. 4 they should, if not too high, be supported by wide latticed columns with vertical legs, one leg under each girder. The legs are usually rolled or built-up channels or I-sections.

Crane Clearances—Ample clearances should be allowed —not less than 2 in. for side and 3 in. for vertical. By clearance is meant the distance between the crown of rivet heads in the steel structure and the outermost portion of the crane. The reasons for clearance are obvious. Columns may not be straight or perpendicular to the base, trusses may deflect, or there may be a slight unlooked-for projection on either truss or crane.

Other Points—In designing crane girders, the resistance of web plates to buckling and the strength of stiffeners, especially end stiffeners, should be considered. In these particulars, standard specifications, such as those of the A.S.C.E. or the A.R.E.A., can be followed.

The designer should bear in mind the detailer. A mistake not uncommon is to make the vertical leg of the top flange angles of girders of a depth that will allow but a single row of rivets, when two rows may be required to take horizontal shear and vertical load. Rivets should be spaced for horizontal shear in the bottom flange and for the resultant of horizontal shear and vertical wheel load in the top flange. Wheel loads may be assumed to be distributed by the rail over a length equal to the depth of the girder but not to exceed 30 in.

Ladders should be provided at each end of a crane runway, at the cage end of the crane.

Yard crane girders should have rigid connections to A-frames, and the tops of the A-frames should not be made too narrow. No light members should be used in yard runways. Cover plates should be used on all outside girders, otherwise water is liable to collect in the trough between the angles under the rail and cause corrosion where strength is most needed for supporting the rail.

Girders in adjacent spans should have the same depth when practicable, even if the span lengths of the girders are different.

When crane runways are installed in old buildings care should be taken that the buildings are strengthened, where need be, for direct loads and vibration. Additional bracing is usually requred.

Rail splices should be staggered by not less than 10 ft., i.e., the splice on one side of the runway should not come opposite the splice on the other side by that distance. Joints between rails should be left in perfect adjustment so that there will be no jar when wheels pass over rail ends.

Crane Troubles—Faulty design in the runway has been the cause of many crane troubles. The lack of lateral stiffness in the girders has already been mentioned. But it should not be assumed that the cause of all crane troubles is in the design of the runway. "Of course we hold the builders of the runway responsible," said a superintendent to the engineer sent to investigate the reason of a crane continually getting out of alignment. The crane, though of 75 tons capacity, had been overloaded 60 per cent and the wheel base was too short for the span of 100 ft.; but the real cause of the difficulty was that the wheels at one end carriage were not exactly the same size as those at the other, thus causing a binding action in the crane and throwing the rails out of alignment.

In another instance the foundations were settling unevenly. In a third, the crane itself had become askew, one end running 8 or 9 in. ahead of the other. In still another, two cranes on the same runway were continually being brought close together. The girders were of long span and designed for but one crane and were thus overloaded, causing decided vibration. This is not a lone instance.

The only remedy to prevent overloading in cases like the last mentioned is to attach a permanent spacer to one crane; instructions to crane operators are not sufficient. There may be exceptions to this rule, however. The writer has in mind an extension built of a strength nearly double that of the original runway. Upon calling attention to the fact he was told that instructions would be given that loads of the full capacity of the new crane should be carried midway between the girders of the old portion. Five years have passed and no trouble has been reported, so that presumably instructions have been followed; there is still time for an accident, however.

Two common causes of crane troubles are neglect and carelessness. Crane runways are seldom examined until there is trouble. The rail fastenings are then usually found to be loose. It is submitted that a structure of this nature should be viewed in the same light as a railroad track, where the rails are watched continually for changes in alignment and for looseness in the connections. Operators are often careless in allowing heavy pieces to swing and strike the supports. An examination of runways about steel mills, foundries and shipyards often shows badly indented columns and bracing, which means a material weakening of the structure.

Uncontrolled Pollution of Bogota Water Supply

Primitive Insanitary Conditions on Water Gathering Areas Cause High Typhoid and Dysentery —Chlorinators Recently Installed

WATER-BORNE typhoid and dysentery prevail to an alarming degree in Bogota, Colombia. Recently George C. Bunker, physiologist to the Panama Canal, investigated the five water supply sources of the city. He installed chlorinators on four of the supplies and exacted a promise from the officials of the Board of Sanitation to complete the installation on the fifth, which Mr. Bunker was unable to do because of a month's illness from the disease he was attempting to combat. Extracts from Mr. Bunker's report to the Board of Sanitation and other observations made by him follow.

Water is supplied to the city from five sources, two of which are small rivers while the other three are still smaller streams. The water from each source flows by gravity into the distribution system. Tanks are provided for only two of the supplies. During the rainy season the water in the districts supplied by the two rivers is necessarily dirty because no attempt is made to remove the clay. It is probable that one-third of the distribution system is in bad shape. The greater part of the mains as originally laid was rather thin spiral steel pipe, which has been in the ground long enough to become badly corroded, with the result that the water escapes when the pipes are under pressure and contaminated ground water enters when the pipes are empty or half full. The sanitary conditions in the two river drainage areas are very bad.

INDEPENDENCE PARK, CATHEDRAL, MONSERRATE HILL
From 600 to 2,000 people visit this church every Sunday. Although located on watershed of city supply no public conveniences exist. Typhoid is continuous in consequence.

To observe conditions on the watershed of San Cristobal River, a trip was made over one of the roads near the stream; 52 persons and 42 burros, oxen and pigs were encountered in 35 minutes of riding over a short section. The road was spotted with the fæces of the different animals while those of human beings were observed along the sides. It is estimated that about 3,000 persons pass to market over this road each week and that practically the same number return. Such a wholesale pollution of this watershed and especially those portions close to the river constitutes a dangerous menace to the health of those people in Bogota who live in the district supplied by water from the Rio San Cristobal.

Along the short section of road traversed several points were noted from which the ground sloped so that a moderate or heavy rainfall would quickly wash all of the accumulated excreta directly into the river. Unfortunately this river is a very rapid flowing stream which means that self-purification cannot be counted upon to remove any of the polluting material introduced into it.

CHLORINATOR HOUSE FOR CHAPINERO SUPPLY
Chlorine is fed into discharge from conduit leading from stream to the storage tanks in foreground.

The most glaring example of pollution and one which is well known by the public is that of the Rio San Francisco supply. Part of the area draining into this river is made up of the south and east slopes of Monserrate Hill on the top of which a church of the same name is situated. On every Sunday from 600 to 2,000 people visit this church and there are no privies or dry closets in the vicinity. Under the existing conditions excreta containing disease germs are continually deposited on Monserrate Hill and intermittently carried down into Rio San Francisco by the rains with the result that a sort of endless chain of infection exists. The pollution of Rio San Francisco by the excreta on Monserrate Hill furnishes the clearest demonstration of water-borne typhoid fever and dysentery which I have encountered in seventeen years' experience in water purification.

LAUNDRY LAID OUT TO DRY AFTER BEING WASHED IN STREAM SUPPLYING BOGOTA WITH WATER

Lehigh University Plans Enlarged Facilties

President Richards of Lehigh University has announced a plan for the enlargement of the university facilities which calls for an expenditure of $11,758,000. This money is to be used in the establishment of the Lehigh Institute of Research and in erecting and endowing several new buildings. President Richards stated that Lehigh needs a new library and auditorium, a metallurgical laboratory, a mechanical and electrical engineering building, a marine engineering laboratory and naval tank, an hydraulic laboratory, a biological greenhouse, an infirmary and an armory.

Cloudburst Flood at Hot Springs, Arkansas

Rainfall of Five Inches in Two Hours on May 14 Overtaxed the Capacity of the Covered Channel of Hot Springs Creek in Mountain Gap Traversed by City's Principal Street

By John R. Fordyce
Consulting Engineer, Hot Springs, Ark.

About five on the afternoon of May 14 a cloudburst flood swept from the sides of the hill down into the valley in which is situated the city of Hot Springs. This flood is of a special interest to engineers because of the fact that the original channel of the small stream which drains the mountain area is covered by an arch roof along the narrowest part of the valley and the city's street is directly over its roof. The conduit proved entirely inadequate to carry the water. Pavements were torn up and wrecked, great property damage of other kinds occurred. Fire broke out and destroyed many buildings. The outstanding favorable circumstance was the fact that no lives were lost.

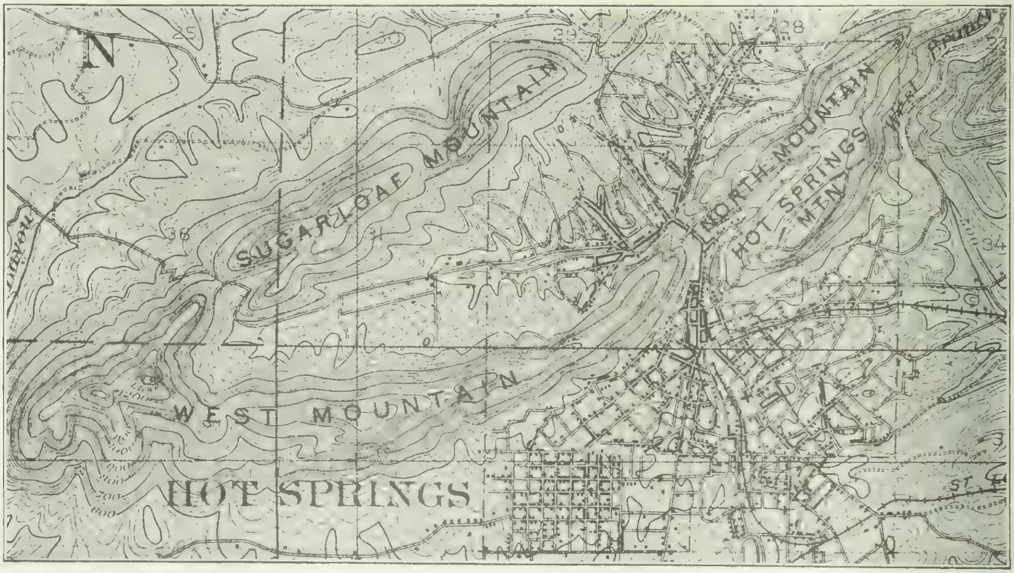


FIG. 1—LOCATION AND TOPOGRAPHY OF HOT SPRINGS—DRAINAGE FROM MOUNTAIN VALLEY PASSES THROUGH COVERED CHANNEL UNDER CITY STREET

The Flood Rainfall—It had rained off and on since one o'clock in the morning of the fourteenth. The government gage at 9 a.m. on the 14th showed 2½ in. of water. There were showers during the day and about 4:30 p.m. it began to rain much harder. An observer reports that at 5:30 the water was curb-high in the streets; at 6 it had gotten over the sidewalks and was beginning to enter the stores, whose floors were about twelve inches above the sidewalk, and at 6:30 it was a foot deep in the stores; at 7 the doors of the store fronts were broken in, and at 8 o'clock it was almost shoulder-high in the more restricted area. From then on the water began to recede, and by 11 p.m. it was not more than knee-deep in the streets.

Toward evening a fire broke out in the central part of town, from lightning. As it was impossible to reach the fire plugs the whole block was destroyed, except for the fireproof Citizens National Bank.

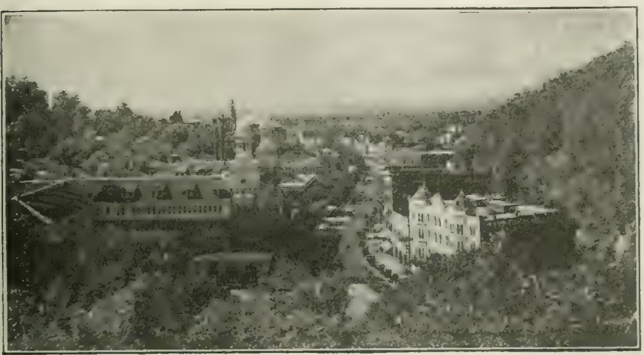
Weather Bureau Data—Data on the rainfall are given by P. P. Patraw, co-operative observer of the Weather Bureau, in the following special report:

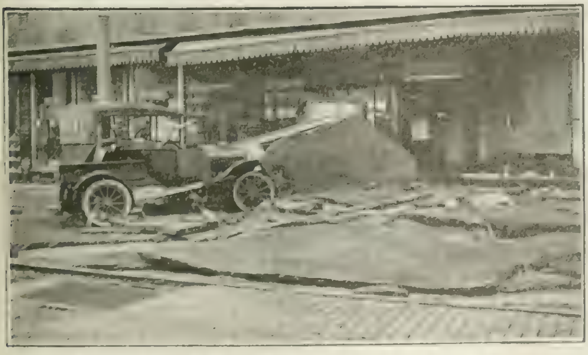
> The storm hit here and it started raining at about 1 a.m., May 14. At 8 in the morning the heaviest part of this storm had passed and it was raining lightly. At 9, when I took measurements, the fall amounted to 2½ in. The rainfall the rest of the forenoon was light.
>
> Another storm started in the afternoon. The force of the storm struck about four o'clock, reaching its height at about 5:30, when the water was pouring from the skies in sheets. At this time the sky had a yellow or brown cast. The rain slackened to little more than a sprinkle at about 8, but in a half hour it began again to rain heavily and continued to about 10:30, when it slackened to a light rain, the electrical storm having passed. Several persons told me of having seen hail, although I observed none, the stones varying in size from moth balls to hen's eggs.
>
> From observations during and after the storm, I am of the opinion that the storm was central over the northern part or more to the north of the city, 90 per cent of the flood waters shedding from Sugar Loaf, North and Hot Springs Mountains, coursing down Whittington and Park Ave. and Fountain St. into Central Ave.
>
> No attempt was made to measure the rainfall at night. At 9 a.m. of the 15th, the gage measured 6½ in. since 9 of the preceding morning. Of this amount I estimate that 5 in. fell between four o'clock and six o'clock the evening of the

14th, and 1½ in. between six and eleven o'clock, making the total rainfall between about one o'clock in the morning to eleven o'clock at night 9 in. It is possible that the gage, not being in the center of the storm, did not record the greatest amount of fall within the city or within the watershed flowing into Central Ave.

A good idea of the force of the current and its destructiveness can be gathered from the fact that midway of the bathhouse row, where the distance between the buildings is 120 ft., the water was 4 to 5 ft. deep and carried down automobiles occupied by people. These people were rescued and taken into the bathhouses along the row. The floors of these buildings were about four feet above the flood and formed places of refuge. Many automobiles which were parked along the curbs were driven by the force of the water through plate-glass store fronts and back into the buildings, wrecking the glass and showcases.

Topography—Hot Springs National Park embraces about 1,000 acres of hills and valleys surrounding the hot springs. These springs flow from the mountain in a small area of about ten acres. The 1,000 acres has been reserved by the U. S. Department of Interior as a national park since about 1833, this having been the first area in the United States set aside for park pur-





UPPER LEFT—VIEW OF HOT SPRINGS, LOOKING SOUTH
The character of the topography, inducing rapid runoff, shows flood danger from excessive rain.

CENTER—PART OF THE BUSINESS DISTRICT BURNED

LOWER LEFT—DAMAGE DONE ASPHALT PAVEMENT
Note blocks between tracks have been carried away.

UPPER RIGHT—CAST IRON BASE OF LIGHT POLE BROKEN BY DEBRIS

LOWER RIGHT—WRECKAGE LEFT BY FLOOD

[illegible]

poses. Bathhouses are on one side of the principal street; the opposite side has been built up very compactly with modern business houses. At a distance of half a mile up the valley from the hot springs, the valley divides in two main branches, occupied by Park Ave. and Whittington Ave., and both these valleys are drained by large creeks. In addition there are numerous lateral ravines, all of which bring in their supply of water.

The total area in this drainage basin is approximately 4 square miles. The 9 in. of water which fell in this area completely filled the channel of Hot Springs Creek. This stream has been covered with an arch roof since 1883. The largest section of this closed conduit is 278 sq.ft. It is necessary to state that the sides of the mountain are wooded with pine, hickory and scrub oak. Clearing has been done, along the immediate side of ravines and streets. The slope of the hillsides is about 1 on 2.

Earlier Floods—This is the third flood in Hot Springs since the creek was covered. The first, shortly after the covering was completed, was not very serious and overflow of the streets resulted only because the upper part of the conduit became obstructed by small wooden bridges and other debris which washed down. One or two lives were lost in that flood. The next flood, in 1910, was very mild compared to the present. The water rose quietly in the streets and at no time was deeper than 3 ft. Photographs of that flood show people standing in the street and vehicles in water to the hubs. In the present flood, however, the greatest damage was done by the velocity of the water, whose destructiveness was greatly increased by cross-currents coming in from lateral ravines.

After the flood of 1910, Congress took notice of the situation at Hot Springs. A complete survey of the situation was made in 1912. The principal fact developed by this survey is that three engineering problems confronted the city of Hot Springs: (1) Provision of means to take care of unusual floods, (2) widening of the street or construction of side streets to take care of the increasing traffic, and (3) construction of a proper sanitary sewer system. In the report J. W. Barnett, consulting engineer, said that the sanitary conditions were most serious; nothing has since been done to improve them.

It will be seen from the map that the narrow street between North Mtn. and Hot Springs Mtn. and West Mtn. is the only means of communication between the north and south end of town and between the regions north and south of the mountains. It is almost impracticable to build a road across the mountain for several miles either side of the town.

Owing to the peculiar situation, it is not possible to deepen Hot Springs Creek. The masonry is laid in inferior mortar and would probably not survive the shock of blasting. But further, and most important to Hot Springs, is a fact which was not known at the time of Mr. Barnett's report, namely, the beds of shale on which the arch is constructed act as an impervious stratum which holds in the water of the hot springs and confines them in the highly cracked quartzite strata of rocks (it has been demonstrated by excavating for the various bathhouses that when this shale is removed the hot water from the springs escapes out of crevices in the quartzite, draining springs which are located higher up on the sides of the mountains). This fact alone will prevent the deepening of the creek even if other things were favorable. It would be impracticable to build a second conduit parallel to the present one because this would obstruct the traffic along the street, which is now very much overcrowded. The solution suggested by Mr. Barnett was the construction of a tunnel under the eastern end of West Mtn., to carry the water from the junction of the Park and Whittington Ave. creeks and leave the present conduit free to take care of the drainage from the North and Hot Springs Mtn. areas. This tunnelway might also serve as sanitary sewer, and could perhaps be doubledecked and made large enough to act as a roadway for excess traffic. It was estimated that the cost of all of this construction would be less than $500,000. The estimated damage to property and loss of patronage chargeable to last week's flood is estimated conservatively at $1,000,000, so that without a doubt the citizens of Hot Springs should take the necessary steps to prevent these floods in the future.

Because of the fact that the government controls the drainage area, and built the conduit which has now proved insufficient, the people here feel that the government should join them in any new construction work which may be necessary.

Pavement Damage—The upper part of Park Ave. is paved with wooden creosoted blocks on either side and bricks in the street-car width. Both the bricks and the creosoted blocks were torn up by the flood. Central Ave. was re-paved with asphalt in 1917. This pavement was entirely wrecked by the flood of the 15th; it separated from its base and was floated out of its place.

Future Railway Practice in England

Developments which are likely to take place in British railway practice as a result of the consolidation of all lines into four large systems are reviewed by J. F. Gairns in the *Railway Gazette*, London, and it may be that changes along somewhat similar lines will result in this country if the projects for railway consolidation should materialize. The following is a summary of the lines of development predicted:

1. Standardization of locomotives, not so much from the engineering point of view, which has already received attention, but because the new railways are so large that general availability on a wide scale will be essential.
2. Standardization of office methods, forms and returns.
3. Passenger fare standards, but with liberal concessions.
4. Freight rates will necessarily be standardized, and modifications will be made on systematic lines.
5. Economic study of all phases of railway operation.
6. General systematizing of train service schedules, though circumstances will always involve certain variations. The need for special fast trains will probably become greater, notwithstanding the fact that uniform train schedules are a desirable feature of economic train working.
7. Additional facilities for through and extension services beyond present frontier points of the individual systems.
8. Alternative routing, utilizing all possibilities afforded by the grouping of hitherto independent lines.
9. Considerable extension of through services and facilities between the companies, even though it will be possible to confine a large proportion of traffic within the limits of the new systems.
10. Signaling will be developed with greater freedom.
11. Electrification will be considerably extended.
12. The high-capacity freight car will gradually find its place, but mainly by the adaptation of traffic methods to suit it.

Marl-Sand Road Construction in Minnesota

Combination Compares Favorably with Sand-Clay —Dusting in Dry Weather Chief Drawback—Cost Reasonable

MARL, a soft earthy material composed principally of an amorphous form of carbonate of lime, of which there are many deposits in Minnesota, has been successfully used mixed with sand for surfacing roads in that state. So far sand-marl roads have been built only experimentally but this season several localities will adopt this type in their regular work. A full report on the laboratory studies and field experiments is published in a bulletin of the University of Minnesota Engineering Experiment Station by Charles H. Dow and from this the following notes are taken.

Final practice in experimental construction is exemplified by a 2,800-ft. stretch in Crow Wing County about 7 miles east of Pequot. This work is described and the conclusions from all three experiments are given as follows:

The road was divided into sections about 200 ft. long; 4 in. of marl, with 6 in. of sand were used for the greater part; 5 in. of marl and 7 in. of sand were combined on the steepest grade, and a skin coat of 2 in. was disked into a level stretch already comparatively firm. There proved to be little benefit derived from this last. The application of marl needs considerable depth of mixing to secure a thick, homogeneous crust over the sand.

Hauling and spreading began at the distant end of the section nearest to the pit, as wet marl is a difficult surface upon which to haul. Spreading followed on the next section beyond, making it necessary to haul through the loose material of the first section during the time it was being mixed. This did not develop any great difficulty, because a plow team was available to help, as it was occasionally needed. So the benefit of hauling over the smooth road as it was completed, section by section, was realized.

Hauling was done by team entirely, with pole-bottomed wagons. The haul varied from 2,000 to 6,000 ft. About 1 cu.yd. to a load was carried. There were several rains during the progress of the work. The marl was mixed with considerable difficulty, requiring repeated use of the spade disk harrow. Traffic cut in rather deeply, at first, but after a small amount of maintenance, the surface became smooth and rutless.

The method was determined by this experiment as follows:

1. Smooth the subgrade by a convenient method and bring it to a very low crown, say not over 3 in. for 20 ft. of width.

2. Spread one-half of the total amount of marl to be used over a width of about 2 ft. less than the proposed finished surface.

3. Thoroughly pulverize the marl as finely as possible with a disk harrow before plowing. If dry, tooth harrows may be used. Some marls are friable, and there a tooth harrow was very satisfactory.

4. Plow this marl coating under, setting the plow to elevate the required amount of sand to be mixed with the marl. This will vary with the kind of marl used, but will be approximately equal in amount. The first furrow should be started at the left of the center, throwing towards the center, and so on around, leaving at its completion, deep furrows at each side of the road.

5. Spread the remaining half of the marl.

6. Thoroughly pulverize the second coating of marl.

7. Plow three times more, the second plowing beginning at the outside and finally leaving a deep furrow in the center. The third plowing leaves furrows at the sides and the fourth plowing leaves a furrow in the center again. If the marl is very wet, it will be advisable to do some pulverizing between the plowings. Be sure the first plowing is not deeper than the ones following, so as not to lose any of the marl.

8. The last operation is to blade the surface to the proper crown and contour.

Maintenance should fill the ruts two or three times in the first few days. Light blading appears to be best for this purpose. The crown should be kept low. In fact it was kept flat on the 12-ft. width.

Cost figures follow. This cost very closely approximates a reasonable charge for doing the work and may be considered typical on this class of road. The length in this case is 2,800 ft.

Shaping subgrade	$23.40
352 cubic yards of marl in pit at $0.10	35.20
Digging and hauling marl	238.20
Spreading	50.85
Mixing marl with sand of subgrade	40.50
Rental of tools	3.00
Total	$391.15

The experimental roads were built during June and July and have been held under observation until the last of October. This has carried them through long dry periods, the most trying time for marl roads. Although this period of observation is not long enough to justify ultimate conclusions, certain deductions seem warranted and appear definite enough to record.

As a slab to bear up the weight of traffic against breaking through into the subgrade, the marl-sand surface has proved entirely satisfactory.

The surface has withstood heavy rains without noticeable injury. Beyond a certain amount of absorption, it seems to be impervious to water. In fact, the road seems to thrive on moisture.

The application of a uniform coating over the width of the road, with a very low crown, seems to be confirmed in principle, the idea being to induce traffic to use the full width of the roadway, preventing ruts and concentrated wear. Therefore, a feather-edge application would be insufficient.

After protracted dry weather and under heavy traffic, the surface becomes very dusty, this dust being somewhat more offensive than the ordinary kinds. Light traffic produces little or no dust, even during protracted dry weather.

We may say that, for light traffic, the surfacing of a sand subgrade with marl-sand surface is satisfactory from every standpoint, compares favorably with other forms of treatment, and is a great improvement over the loose sand through which it is built. The surfacing promises to be durable and permanent under such traffic.

Moderate traffic will require surface treatment on account of the dust nuisance. The blanket of fine gravel, of not over an inch in thickness spread over about two-thirds the width of the roadway, has been entirely satisfactory for this purpose. Calcium chloride serves the same purpose during its life, perhaps even better. Because marl holds moisture well, the applications seem to be effective for a long time.

Under heavy traffic, disintegration by dusting in dry weather will be rapid without surface protection. Our gravel blanket must be thicker and we shall then have in effect a gravel road upon a base course of marl-sand. There are indications that this combination is almost ideal because of the freedom of the marl-sand from waves and surface pockets. Only a moderate thickness and width of gravel are necessary, as it does not need to contribute structural strength, in addition to the marl slab beneath, and occasional travel at the extreme sides will be well taken care of by the marl.

Comparison was made in the laboratory of marl with clay. Where clay is available and it can be combined in accurate proportions with sand as a surface mixture, it is probably superior to marl. Pit clay varies greatly in its sand content and is difficult of manipulation in surfacing. Clay is at its worst in wet weather and at its best in dry weather. Contrasting the qualities of clay with those of marl that have been set down, we may say that marl compares very favorably with clay and is superior in some respects as a surfacing material for roads.

Building a Gravel Retaining Dam by Dragline

Low Concrete Dam on Porous Bottom Has Flexible Concrete-Block Apron—Built in Halves in Cofferdam

By C. H. Eiffert

Maintenance Engineer, Miami Conservancy District, Dayton, Ohio

A CONCRETE dam has been built across the Great Miami River at Hamilton, at the upstream end of the local river improvement of the Miami Conservancy District, to prevent the drift of gravel into the improved channel and thus reduce the cost of maintenance work. Immediately above the dam the Hamilton Gravel Co. has a cableway extending across the river and excavates gravel continuously from the channel, so that the material held back by the dam is not likely to accumulate to a troublesome degree.

The dam is of the overflow type and rests on a porous foundation of well graded gravel, varying in size from ordinary sand to boulders more than a foot in diameter. The length between abutments is 801 ft. and the height above the stream bed from 5 to 9 ft. A continuous cut-off wall of steel sheet piling 8 to 12 ft. in depth is provided at the upstream end.

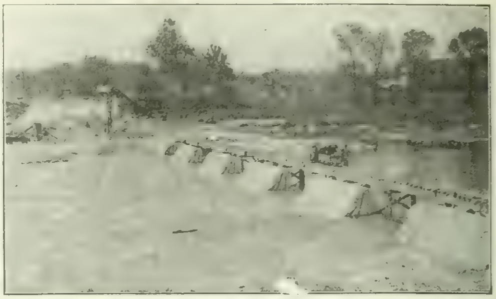


FIG. 1—EAST HALF OF DAM

Stream diverted through openings for construction of west half. Excavation in west cofferdam in progress. Cable on side of stringers provided to hold deck together in case of washout. On Sept. 3 the deck was swept off by high water and drifted to the bank, being saved by the cable.

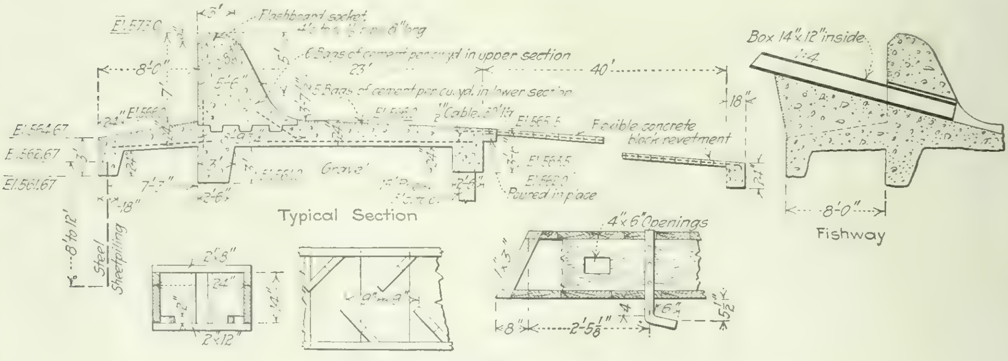


FIG. 2—DETAILS OF CONSTRUCTION OF DAM, APRON AND FISHWAY

An interesting feature in the design of this dam is the use of a flexible apron of concrete blocks. These blocks are the same as those used by the District for the flexible revetment on channel improvement described in *Engineering News-Record* of Aug. 12, 1920, p. 292. The blocks are held together by ½-in. galvanized cables which have their upstream ends embedded in the monolithic apron. The downstream ends of the cables are held in place by concrete blocks 18 x 24 in. x 6 ft., cast in place. In case scour occurs at the lower edge of this apron, settlement of the apron will take place and continue to a depth at which no further scour will take place.

The principal feature of interest in connection with the actual construction was the use of a dragline excavator mounted on caterpillars for excavating, building cofferdam and driving piling. This machine started work at the east end of the dam and worked forward to the middle of the dam, the river still flowing in its low water channel to the west of the cofferdam. An 8-in. electrically driven centrifugal pump, running about half the time, kept the excavation free from water. The method used in driving piling was the same as that used on the Black St. bridge (*Engineering News-Record*, July 21, 1921, p. 120). The east half of the dam then was concreted, except for five 24-ft. openings, and its block apron was placed. When this work was completed, the dragline, which meanwhile had been used on other work of the District, returned and removed the cofferdam, diverted the stream through the five openings, and proceeded with excavating, building cofferdam and driving piles for the west half of the dam until its completion.

Gravel and sand for the concrete were obtained from the nearby gravel plant, and were delivered to the mixer by a 1½-yd. rocker dump car handled by a small electric hoist. A 1-yd. electrically driven mixer was used.

For the purpose of delivering the concrete to the dam a trestle was built just above the face of the dam, the top of rail being about 2 ft. above the crest of the dam. Piles for this trestle were driven by the dragline as it proceeded with the other work. A concrete car with side door was built and the concrete delivered to the dam by a 3-ton Plymouth gas locomotive.

The dam was poured in 30-ft. sections except where the 24-ft. openings were left. The aprons and portion below the dam proper were poured in one run and followed by the dam proper. The two runs were connected by keys and $\frac{3}{4}$-in. steel stubs 4 ft. long, set 18 in. center to center.

When the body of the dam was completed the five flow openings were filled, one at a time, beginning with the most westerly. They were closed by 8 x 16-in. timbers offset far enough from the face of the dam to leave room for building forms, and were made tight with earth and manure. When the last opening was to be closed the flow was only 8 in. in depth and amounted to 58 sec.-ft. This small discharge was due largely to the fact that the principal part of the flow was being utilized by the hydro-electric plant of the Ford Motor Co., whose tailrace discharges below the dam.

After closing the last opening it required 60 hours for the water to rise to the top of the dam. This was sufficient time to complete the forms, pour the concrete and remove the forms. On this section a hand pump was used to remove seepage water between the 8 x 16-in. timbers and the forms until the concrete had become set.

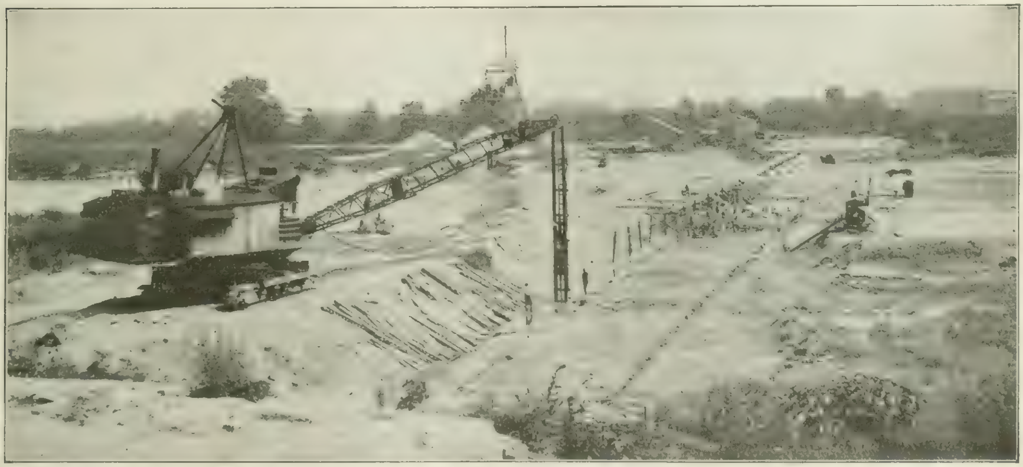


FIG. 3—ARRANGEMENT OF CONSTRUCTION PLANT

East half of dam completed; dragline driving steel sheeting in west half. Toe piles already in place. Gravel and mixing plant in background. Concrete trestle being extended to west. Drainage pump at right.

Work on the dam and abutments was started June 6 and completed Nov. 9. The concrete amounted to 3,400 cu.yd.; 16,000 blocks were laid in the apron. Work is now in progress on the revetment downstream from the abutments.

Paris Plans Moving Underground Sidewalk

Of thirteen plans submitted for the proposed underground moving sidewalk for Paris, five will be retained for experiment, according to *The Engineer*, London. These five will be tested over a circular distance of 300 m., in two groups. The four plans of the first group are based on the principle of parallel bands at graduated speeds, enabling passengers to step from one band to another until the most rapid is reached; landing places would be alongside the slowest band. The fifth plan is based on the idea of variable speed, slow movement at stations and higher speed between stations.

An English Rail Failure

In a rail-failure accident on the London & Northwestern Ry., England, on Oct. 30, 1922, inadequate track inspection was a contributory cause, according to the government report recently issued. The engine of a passenger train from Blackpool to Manchester, running at 40 m.p.h., was derailed but fortunately there were no casualties. The accident occurred near Moorside, on one of the fast tracks of a four-track line. This track was laid in 1912 with 96-lb. bull-head 45-ft. rails secured in 56-lb. cast iron chairs by tapered oak keys or wedges, each chair being fastened to the tie by two spikes and two trenails. The joints were spliced by short bars with four steel bolts having self-locking nuts. In the entering end of one rail the second bolt had dropped out of place some time before the accident occurred but neither the section foreman nor his assistant in walking the track had noticed a loose nut or missing bolt.

The report states that the men employed as trackwalkers were accustomed to walk diagonally from one track to another instead of taking the full length of each track, although this practice gives ineffective inspection because not all the space is covered, and is dangerous to the men.

At the bolt hole thus left empty there was an old fracture in the web, extending back from the hole, and it is considered that the impact of the first truck wheel of the engine broke off the end of the rail, there being two new fractures running upward and outward in opposite directions from the bolt hole. The old crack was concealed by the splice bars. Tests and chemical analyses of specimens from the end of the rail showed that both the chemical and physical conditions were satisfactory.

It is stated that for twenty-one years up to Dec. 31, 1921, only three accidents on English railways had been caused by broken rails. In 1922 two such accidents occurred.

Phenol Contamination of Public Water Supplies

Menace in Byproduct Coke Oven Areas Considered at Conference Called by Public Health Service—Preventive Measures

THE INCREASING contamination of public water supplies by phenol from byproduct coke ovens, gas works, and possibly from plants manufacturing tar products, was the subject of a conference in Washington on May 18 following the annual conferences of state sanitary engineers, and state and territorial health officers. The phenol conference, called by the surgeon general of the Public Health Service, had as its chairman Dr. A. M. Stimson, director of scientific research, Public Health Service, and was attended by state health officers, state sanitary engineers and representatives of the Bureau of Mines and other federal bureaus.

Dr. Stimson exhibited a spot map showing the results of a questionnaire sent by the Public Health Service to state health officers asking whether they had experienced phenol troubles. The replies and the discussion at the phenol conference showed water contamination in New York, Pennsylvania, West Virginia, Ohio, Indiana and Illinois, with much likelihood that, unless controlled, trouble would extend materially in those states and in the central western states generally on account of the prospective multiplication of coke ovens.

W. H. Dittoe, chief engineer of the Ohio State Department of Health, said that every city that takes its water supply from the Ohio River, from East Liverpool to Cincinnati, has phenol trouble from time to time, as do some cities on the Mahoning River, and also Cleveland, Loraine and Elyria. The phenol taste is brought out by water chlorination. It is a health concern because it may cause a lowering of the rate of chlorination or even shutting off chlorination, with corresponding loss of protection to health. One Ohio city has had to abandon chlorination. Every Ohio city using the Ohio River is prepared to shift from chlorine to excess lime treatment. It was further brought out by Mr. Dittoe and others that the phenol contamination may force cities to use water of poorer quality from other sources and individual water consumers to resort to local wells, which latter may be polluted.

Prevention—Preventives for phenol troubles were also discussed at the meeting. These fall into attempts to prevent the discharge of phenol-loaded ammonia-condensation wastes into waters used for public supply, and attempts to remove phenol. The latter has been accomplished at some plants by using the condensation wastes in the coke-quenching pits. One speaker said that this had been held to be objectionable because it colors the coke and another speaker cited odor troubles as resulting from the practice. As to legal action, the attorney general of Ohio has ruled that the health authorities of that state cannot bring legal action under police powers because no damage to health has been proven, but several speakers expressed the belief that court relief could be secured under some line of action in view of the threatened menace to public health along the lines already indicated. The Cleveland City Council has passed an ordinance aimed against phenol contamination, which is serious there because a considerable part of the city cannot be supplied with filtered water until projected additional filters are built, thus making chlorination the only protection.

In closing the discussion Dr. Stimson expressed agreement with Dr. Bain of the Bureau of Mines who had called attention to the industrial importance of the coking interests and had urged co-operation with the industry. Dr. Monger, health commissioner of Ohio, moved that it was the sense of those present that the Public Health Service be requested to investigate the public health aspects and the Bureau of Mines the economic phases of the problem. This motion was adopted.

Sanitation of Water Supplies Main Topic of Conference

State Sanitary Engineers and Public Health Service Men Discuss Activities and Problems—New Treasury Water Standard

Engineering News-Record Staff Correspondence

WATER was the dominant topic of the four sessions of the conference of state sanitary engineers held at Washington, D. C., May 16 and 17. Many other activities of engineering divisions of the state health departments were discussed but none so extensively as the sanitation of public water supplies. The Treasury standards for drinking water on interstate trains and vessels received much attention, the discussion on this subject being opened by Surgeon A. J. McLoughlin, of the U. S. Public Health Service. The conference approved a tentative draft of new bacterial standards prepared by a sub-committee of the surgeon-generals advisory committee of 42 which is considering the Treasury standards in all their aspects. The business proceedings of the conference are reported in the current news section. A summary of the technical proceedings follows:

Revision of Treasury Water Standard—Of the three divisions of the new standard—bacterial, field survey and chemical—only the tentative draft of the subcommittee report on bacterial index was officially before the conference. That report, as submitted by Abel Wolman, of Maryland, proposes to rely solely upon B. Coli as the index organism; that is, it omits the total count. It would fix 10 cc. as the *standard portion* and five such portions as the *standard sample*, and provide that not more than 10 per cent of *all* the 10 cc. portions examined should show B. Coli, with more detailed provisions to cover both high and low total numbers of samples collected. In cases where about 100 portions of water are examined this 10 per cent limit would imply a probable density of about one B. Coli per 100 cc., but would permit *some* of the portions to run to 3, 5 or 10 B. Coli per 100 cc. It should be understood that the use of the 10 cc. portions is for water of approximately standard quality and does not preclude taking smaller portions of water that is highly polluted.

There was an apparent unanimous endorsement of B. Coli as the sole bacterial index in the Treasury standard but some questioning as to details of its application. Finally, the report was endorsed by the conference. No data on the proposed chemical standards were submitted. Considerable discussion on the proposals for field survey standards that have been circulated for purposes of criticism indicated that no approach to finality here has been reached and that the subject seems complicated and beset with difficulties.

Collection and Shipment of Water Samples—A. N. Holmquist, New York, stated that water analyses are not made unless the local health officer says a question of health is involved. The sanitary division interprets the results of the analyses as made by the laboratory. There was a strong body of opinion on the one hand, that samples should be collected and shipped only by technically trained persons in connection with a field survey while on the other a number of speakers were apparently willing to rely upon local health officers and one or two thought that given proper printed instructions, good results could be had if samples were collected by laymen. The differences of opinion seemed to depend largely on available facilities, no one venturing to suggest that collection by a state agent, who would make a survey and transmit the sample to a state laboratory, was not the ideal plan. The need for a better container for shipping samples than any yet devised was voiced by several with no one maintaining that the ideal container is available. The need for improvement, however, seemed to be for something less expensive for shipping iced samples both to save outlay for containers and shortages at times of great sampling activity. The discussion indicated that existing conditions seemed to make it necessary in some quarters to ship bacterial samples un-iced.

Limitation and Control of Water Chlorination—In behalf of a committee on the subject of limitation and control of water chlorination, Abel Wolman, of Maryland, submitted a report in the course of which 50 p.p.m. of turbidity was the only specific limit to chlorination without other treatment that the committee recommended. It was felt that data are lacking for setting limits either as to bacterial load or organic content of the water, although both are highly desirable. The committee urged duplicate equipment for chlorination or where not feasible, then duplication of those parts most likely to break down. Finally, the committee stated that the success or failure of chlorination depends more upon the human element than on either the process or the equipment. E. S. Tisdale, of West Virginia, said that all men in charge of chlorination in that state are provided with turbidimeters and also with color standards for chlorine dosage. A majority of the 61 chlorinating plants in West Virginia are now in charge of Grade A operators and have duplicate spare parts if not entire equipment. A. N. Holmquist said that one operator in that state who has water of high organic content reports that he can chlorinate it up to 15 p.p.m. of organic matter. The report of the committee was adopted and the committee was continued.

Safe Loading of Water Filter Plants—A tendency to lessen expenditures for the operation of sewage works within the last few years was noted by Mr. Jewell, of Kansas, making it necessary to establish a factor of safety for water filter loading. W. L. Stevenson, of Pennsylvania, spoke of the shift in that state from pressure to secure sewage treatment to a drive for water purification with a recognition of sewage disposal by dilution as legitimate. Studies of loading of Ohio water filtration plants were noted by F. H. Waring, of the Ohio State Department of Health, and by H. W. Streeter, of the Public Health Service. These studies will be continued by the state and federal governments particularly along the Ohio River.

The activities of sanitary engineering divisions of state health departments were brought up by J. F. Jackson, Connecticut, and discussed at length under both this heading and under a committee report on laws, organization and policies. The consensus of opinion was that conditions existing in each state, such as relative needs for various lines of work, men and funds available, statutory authority and public opinion, should govern the range of activities of these divisions. The desirability of having the water and sewage laboratories under the direction of the engineering division was urged by some of the speakers. There was a diversity of opinion on whether the engineering division should make plans for sanitary works for other state departments, with an apparent leaning towards doing so except in the larger states where there are many institutions and a state architect, or similar officer in charge of design work for them.

In New York the state architect designs sewerage and water supply systems subject to the approval of the health commissioner who in turn relies upon the advice of state sanitary engineers. During this and other discussions engineers of at least two states expressed themselves, one for and the other as inclining to favor having state sanitary engineers pass upon plans for garbage disposal plants, the second speaker apparently basing his opinion chiefly upon economic grounds.

The conference requested the committee on activities to report an outline of what activities are considered necessary, what desirable, and what undesirable on the part of sanitary engineering divisions of state departments of health on mosquito control; a discussion on watershed control, led by Sol Pincus, until recently with the Public Health Service; and a discussion of the importance of statistical records correlating expenditures with resulting effects on specific communicable diseases —in the course of which one member told of the favorable impression made on a legislative budget committee by an exhibit of typhoid reduction since the establishment of sanitary control of water supplies. Well-water supplies were given considerable attention and the necessity for their chlorination in some cases was urged. There was a valuable paper on deep wells in which the importance of sealing the space between the outer side of the casing and fissured rock was urged, as also the sealing of the space between the inside of the casing and the pump barrel to prevent the admission of contaminated water.

Perpetual Logging Operation New Offer to Lumbermen

The largest body of fir timber ever put on the market by the Government is now being offered for sale, announces the Forest Service, United States Department of Agriculture. Ths timber, chiefly Douglas fit, totals 685,000,000 board feet and is only the first unit to be offered for sale in the Willamette watershed, which has a total of 4,500,000,000 feet of merchantable timber. The Forest Service plans to offer this timber at such a rate and under such conditions that a mill may be maintained there for all time. If the timber is cut at the rate of 50 millon feet a year it will require fourteen years to cut over this first unit, and at the end of that time succeeding units will be placed on sale.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

A Great Engineering Project

HISTORY OF THE BARGE CANAL OF NEW YORK STATE—By Noble E. Whitford, Assoc. M.Am.Soc.C.E., Assistant Engineer, State Engineer's Department. Albany, N. Y.: State Engineer and Surveyor. Cloth; 6x9 in.; pp. 610; halftones.

This book is a companion volume to Mr. Whitford's "History of the New York Canals," a too little known piece of engineering literature, which conceals under the forbidding cover of a state document a lively story of one of the most important engineering developments in history. The Erie canal and its companion waterways in the early days of the nineteenth century came at the beginning of the great industrial development of this country and were of and in that development. Their projection, design and construction are as important from a historical and economic as they are from an engineering viewpoint. The Barge Canal, on the contrary, has yet to justify itself economically, and for that reason the later volume is not so sound as its predecessor, for Mr. Whitford throughout takes the attitude of one who describes a successful fight of an entirely praiseworthy project against the forces of evil who would have prevented it.

The economic and chronologic history of the New York State Barge Canal is worth recording, though probably not in the detail given it here; but it is not altogether fair to write the history in the vein in which it has been written. So far there has been no proof that those who opposed the $101,000,000 proposition of 1901 (which has now grown to nearly twice that amount) were not justified in their opposition. Possibly time will prove the opponents wrong.

Mr. Whitford's story, however biased his attitude toward the canal, is a complete one. It is not intended to be an engineering description, except in generalities, for previous reports of the state have quite well covered the engineering details of the Barge Canal. It is a complete record of the political, legislative and administrative processes which led to the construction of the waterway.

Folwell's Sewerage Revised

SEWERAGE: The Designing, Constructing and Maintaining of Sewerage Systems and Sewage Treatment Plants—By A. Prescott Folwell, M.Am.Soc.C.E., Past President Am.Soc.M.I., Editor Public Works. Ninth Edition. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6 x 9 in.; pp. 477; 80 line cuts and halftones. $4.

When the first edition of this book appeared, some twenty-five years ago, it contained little on sewage treatment. In the more recent editions that subject has been given additional space until now about 160 pp. are devoted to expository and descriptive matter, besides what the author seems warranted in believing to be by far the most complete list of American sewage-works ever published, a list by states, classified broadly by methods of treatment in use.

The chief if not the only material revision in the present edition is in the section on sewage treatment. Although that section presents an up-to-date summary of principles and methods it needs expansion in some details, particularly under the activated-sludge process. This latter section has only 3 pp. or but little more than the sections on the electrolytic and direct-oxidation (called by Mr. Folwell "direct-oxygen") processes, as against 2 pp. for the Miles-acid process, not yet permanently in use. Of the portions of the book not mentioned, about 200 pp. are given to design, 65 to specifications, etc., and construction, and 8 pp. to maintenance.

The fact that the book has gone to the ninth edition in twenty-five years is a good testimonial to its reception by engineers and the engineering schools.

Elementary Reinforced-Concrete Design

CONCRETE CONSTRUCTION FOR ARCHITECTS: A Concise Treatise on the Design of Reinforced Concrete Slabs, Beams, Girders, Columns and Footings, and a Description of the Actual Design of a Concrete Building Involving the Use of Flat Slab Construction—By DeWitt C. Pond, Author of "Engineering for Architects." New York: Charles Scribner's Sons. Cloth; 6x9 in., pp. 203; 89 line cuts. $4.

Except that the introductory chapter is so elementary in its treatment as to remind one of a bed-time story in the naïve manner with which the subject is approached, this book is a clear enough statement of the details of conventional reinforced-concrete building design. Nearly half of the book is devoted to detailed methods of working out the design of a large reinforced-concrete building in New York. The first part is, according to the subtitle of the book, "A concise treatise on the design of reinforced-concrete slabs, beams, girders, columns and footings." It would seem to an engineer familiar with the numerous books on reinforced concrete that an architect capable of understanding anything about reinforced-concrete design could get the information here presented out of any of the current engineering books, but an engineer is notoriously a poor judge of architectural mentality.

Production and Sale of Market Milk

MARKET MILK—By Ernest Kelly, in Charge, Market Milk Investigations, Dairy Division, Bureau of Animal Industry, Department of Agriculture, and Clarence E. Clement, Market Milk Specialist, Dairy Division, Etc. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6x9 in.; pp. 445; 121 line cuts and halftones. $3.75. 18¾s. net.

Everything in the production and sale of market milk, from the cow to the consumer, is taken up in this volume. The book is written more from the viewpoint of the milk producer, jobber, and distributor than from that of the consumer and the public health officer, but in view of the many books treating the subject from the health viewpoint a volume concerned primarily with the business aspects of city milk supply is welcome; all the more welcome because it is for the public interest to have the "practical" and particularly the economic aspects of the milk supply set forth in so much detail as is here done.

After a brief review of the milk industry, milk as food and milk in relation to public health are considered. Equal space is given to the chemistry of milk, a few pages to milk bacteriology and 17 pp. to keeping down the bacterial count. In more detail the authors take up organization of milk control, inspection, and scoring. Milk production cost, co-operative agencies, transportion, milk handling plants, pasteurization, mechanical refrigeration, and delivery to consumers are detailed. There are 26 pp. on distribution cost and 55 pp. of "Practicums," the latter being practical details, rules, and statistics.

The volume can be heartily commended to all who wish to know the details of milk production and the steps in its subsequent handling until delivered to the consumer.

Work Periods in Continuous Industries

THE TWELVE-HOUR SHIFT IN INDUSTRY -By the Committee on Work-Periods in Continuous-Industry of the Federated American Engineering Societies. With a Foreword by Warren G. Harding, President of the United States. New York: E. P. Dutton & Co. Cloth; 6x9 in.; pp. 302. $3.50.

For some years study has been directed toward devising means for doing away with the twelve-hour shift in the continuous industries without at the same time imposing an undue handicap. The first engineering meeting devoted to the subject was held in 1920, in Philadelphia, to consider the technique of changing from the two-shift to the three-shift system. Shortly afterward a study of the steel industry, made possible by a grant from the Cabot Fund, was conducted, and in 1921 a further inquiry under the same auspices took under consideration the problem with regard to the larger steel manufacturers in the United States. In that year also the Cabot Fund made a grant to the Federated American Engineering Societies to carry on two studies—one a general survey of the continuous industries, and the other particularly directed to conditions in the iron and steel industry.

The present volume presents the report of the Committee on Work Periods in Continuous Industries which directed these investigations. The general conclusion of the committee is that only a small part of industrial work, say 5 to 10 per cent, involves processes that require continuous operation, and the number of workers affected is relatively small. The desirability of abandoning the two-shift system, it concludes, lies not so much in the extent to which it prevails as in humanitarian considerations, along with the economic demand for that length of day's work which will in the long run effect maximum production. The weight of evidence, the committee reports, indicates that the change can usually be made at small financial sacrifice on the part of workers and of managements, and that under proper conditions no economic loss need be suffered. It is held that the change cannot advantageously be made by fiat and that to effect it suddenly or without adequate preparation will be sure to cause lowered production. On the other hand, the committee's judgment is that when the change is pre-planned and the co-operation of every one is enlisted, gains will accrue to all concerned—workers, managements, owners, and the public.

The general survey was conducted by Horace B. Drury and the investigation of the iron and steel industry by Bradley Stoughton, both of whom analyzed exhaustively the conditions that prevail in the fields assigned to them and the considerations that have led to the continuance of the 12-hour shift. Dr. Drury summarizes his conclusions as answers to the following questions: What is the extent of continuous work in American industry? What are the alternatives to the 12-hour shift? Are there technical difficulties in changing from two-shift operation? What are the factors to be considered in changing from two-shift to three-shift operation? How does the change from two-shift to three-shift operation affect the number of shift workers? What is the effect of 8-hour as compared with 12-hour shift operation on the quantity and quality of production, absenteeism, labor turnover, and industrial accidents? How do wage rates on 8-hour shift operation compare with wage rates on 12-hour shift operation? What is the general opinion of managers of three-shift plants regarding three-shift as compared with two-shift operation? Do employees make good use of the increased hours of leisure? To what extent have plants reverted to two-shift operation?

Mr. Stoughton concludes that the advantages to be derived from the employment of the 8-hour shift include increased efficiency, due not only to better physical and mental condition of employees but also to the appeal to a higher grade of men; better morale; elimination of the floating gang and a higher prestige for the employer with the general public, an asset that may be of considerable value during times of industrial controversy.

Made Better by Enlargement

ENGLISH AND ENGINEERING: A Volume of Essays for English Classes in Engineering Schools—Edited by Frank Aydelotte, President of Swarthmore College. Second Edition. Cloth; 6 x 8 in.; pp. 415. $2.

By adding to the number of essays the new edition of this useful and inspiring book has been made better than the first (see *Engineering Record*, Feb. 17, 1917, p. 275). The twenty-eight essays are grouped under: Writing and Thinking, The Engineering Profession, Aims of Engineering Education, Pure Science and Applied, Science and Literature, and Literature and Life.

Engineers are represented by J. L. Harrington, George S. Morison, A. G. Christie and J. B. Johnson. Among the other authors given a place are Ruskin, Arnold Bennett, Frederic Harrison, Louis D. Brandeis, F. A. Walker, Huxley, Tyndall, Matthew Arnold, Wordsworth, Stevenson, J. S. Mill, Emerson, Carlyle, and Macaulay.

Three objects of the volume as it now stands are stated by President Aydelotte (now of Swarthmore in the capacity indicated instead of being professor of English at M. I. T.) as follows:

> (1) To teach the student to write not by telling him how, not by doing his thinking for him, but by stimulating him to think for himself about his own problems, about his work and its place in the world.
>
> (2) To lead the engineering student to think of the occupation for which he is preparing himself not as a trade but as one of the liberal professions.
>
> (3) To lead him to see how his work of designing material conveniences for men is bound up with the spiritual advancement of the race—with the world of science, of literature and of moral ideals.

There are not many practicing engineers, it seems safe to say, who would not find it to their interest and profit to read this volume, even though it might be a matter of re-reading in the case of some of the essays. For engineering students the book deserves high commendation.

PUBLICATIONS RECEIVED

Notes on Pamphlets and Reports

A Bulletin on Highways and one on Motor Trucks have been published by the Purdue University (Lafayette, Ind.). The first is on Fundamentals of Construction and Maintenance of Secondary Type Highways, by Charles C. Albright, professor of railway civil engineering, and is designed for the Engineering Extension Service. The second, on Truck Operating Costs, by Ben H. Petty, assistant professor of highway engineering, reviews cost factors and cost recording methods, including forms.

Hydrogen-Ion Investigations multiply. One of the latest to become available is An Experimental Study of the Relation of Hydrogen-Ion Concentrations to the Formation of Floc in Alum Solutions, by Emery J. Theriault, Assistant Chemist, and W. Mansfield Clark, Chief of Division of Chemistry, Hygienic Laboratory, United States Public Health Service. (Reprint from Public Health Report, Feb. 2, 1923; pp. 20, including diagrams and formulas.)

Thermal Stresses in Car Wheels, by George C. Burgess, physicist, and G. Willard Quick, associate physicist, U. S. Bureau of Standards (Technologic Papers; pp. 37; illustrated, 15c.) summarizes tests on eight worn and eleven new steel wheels of five types of manufacture, in which the rims were electrically heated to 380 deg. C. to simulate service conditions under heavy brake applications.

The Malaria Problem of Southeast Missouri is reviewed by Dr. M. V. Ziegler and Dr. K. F. Maxey, U. S. Public Health Service, in Reprint 815, Public Health Reports (pp. 20).

Many Papers on Public Baths and other matters related to public hygiene and recreation are printed in the 1922 *Journal* of the American Association for Promoting Hygiene and Public Baths (Arthur M. Crane, Manager, Nutley, N. J.).

International Courtesy is exemplified in Bulletin 217, U. S. Bureau of Mines (pp. 127; illustrated), on the Preparation, Transportation, and Combustion of Powdered Coal, by John Blizzard, "published through the courtesy of the Canadian Department of Mines."

The Government Service for Water-Power and Electricity, Netherlands East India (Bandoenig, Java), has published its report for the year 1921. Besides 60 pp. of text, tabular summaries and diagrams it contains a colored folding map of Java showing its main rivers and power stations.

Standard Methods of Milk Analysis, the collaborative production of the American Public Health Association and the Association of Official Agricultural Chemists, is out in a fourth edition (pp. 40; A.P.H.A., 370 Seventh Ave., New York City; 40c.).

Plankton and Related Organisms, by W. C. Purdy, Plankton Expert, U. S. Public Health Service, reviews biological investigations made in 1914-15 as a part of A Study of the Pollution and Natural Purification of the Ohio River (Public Health Service; pp. 78; line cuts). The studies as a whole, conducted under the direction of Surg. W. H. Frost, were interrupted by the war.

The School of Engineering Research, University of Toronto (Ont.), has issued Torsional Strength of Rectangular Sections of Concrete, Plain and Reinforced, by C. R. Young, W. L. Sagar, and C. A. Hughes (pp. 25; line cuts).

The Result of a Year's Test of a Hollow Tile and Concrete Floor Slab Reinforced in Two Directions comprises Technological Paper No. 220, U. S. Bureau of Standards (pp. 65; line cuts and halftones). The authors are W. A. Slater, engineer physicist, Bureau of Standards, and Arthur Hagener and G. P. Authes, engineers, Whitacre Engineering Co.

The Notable Paper by Isaac S. Walker, general manager New Chester Water Co. (Drexel Building, Philadelphia), on the Purification of the Chester Water Supply with Special Reference to the Pollution of the Delaware River, read last October before the Pennsylvania Water Works Association, may now be obtained from the author in pamphlet form (pp. 30). Among other things it gives float and bacterial observations to show the effect of the large volumes of Philadelphia sewage discharged into the Delaware above the Chester water intake. The conclusion, after considering the typhoid rates also, is that the sewage is nearly all destroyed and typhoid and other water-borne disease germs wholly destroyed by natural agencies before the intake is reached.

The National Paving Brick Manufacturers Association (Cleveland, Ohio) has published the *Proceedings* of the Permanent Committee on Simplification of Variety and Standards for Vitrified Paving Brick of the U. S. Department of Commerce. The pamphlet contains relevant statistics for the years 1914-22 and minutes of meetings held Nov. 15, 1921, March 27, 1922, and March 27, 1923.

The Engineers Club of Pernambuco (Club de Engenharia, Rua 15 de Novembro, Pernambuco, Brazil) has started the publication of a bulletin. The first number contains, among other things, articles on the Pennsylvania tunnel beneath the Hudson River, New York City, and on the irrigation in the Piranhas valley.

Under the Title, A Quarter Century of Cumulative Bibliography, 1898-1923, the H. W. Wilson Co. (New York City) describes its system of cataloging new books, with excerpts from reviews, and of indexing periodical literature. These useful services cover *Engineering News-Record*, the other McGraw-Hill papers and the books of the McGraw-Hill Book Co., besides the journals and books of scores of other technical publishing companies.

The Consolidation of Railroads in the United States forms the 56th research report of the National Industrial Conference Board (pp. 107; 10 E. 39th St., New York City; $2). After sketching a historical background, proposed consolidations into nine systems are reviewed.

Statistics of Manufactures in Massachusetts for 1920 covering 10,262 establishments, 695,832 employees and $4,370,276,822 of goods are presented, with text, in a 170-p. report just issued by the Department of Labor and Industries, Boston.

New Books and Revised Editions

BUSINESS CYCLES AND UNEMPLOYMENT. Reports and Recommendations of a Committee of the President's Conference on Unemployment, Including an Investigation Made Under the Auspices of the National Bureau of Economic Research. With a Foreword by Herbert Hoover. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 405; diagrams. $4.

CIVILIZATION AND CLIMATE—By Ellsworth Huntington, Author of "The Pulse of Asia." Second Edition, with New Introduction. New Haven Yale University Press. London: Humphrey Milford-Oxford University Press. Cloth; 6x9 in.; pp. 333; line cuts. $3.50.

CLIMATIC CHANGES: THEIR NATURE AND CAUSES—By Ellsworth Huntington, Research Associate in Geography in Yale University and Stephen Sargent Visher, Associate Professor of Geology in Indiana University. New Haven: Yale University Press. London: Humphrey Milford-Oxford University Press. Cloth; 6x9 in.; pp. 329; 13 line cuts. $3.50.

THE ENGINEERING INDEX, 1922—New York: The American Society of Mechanical Engineers. Cloth; 7x10 in.; pp. 675. $6.

Over 600 periodicals, reports and other publications were selected from some 1,300 examined for the purpose of making up this volume, which is the 21st in the series and the 4th since the Index was taken over by the American Society of Mechanical Engineers.

FINANCIAL INCENTIVES FOR EMPLOYEES AND EXECUTIVES—Compiled and Edited by David Bloomfield; Introduction by Meyer Bloomfield. Two volumes. (The Modern Executive's Library.) Cloth; 5x8 in.; pp. 325 and 407. $4.80 for the two volumes.

Discusses types of wage systems, piece, day and week work, bonus systems, thrift plans, mutual benefit associations and pension systems, compensation for store, office and sales workers and for foremen and executives.

HIGHWAYS AND HIGHWAY TRANSPORTATION—By George R. Chatburn, Professor of Applied Mechanics and Machine Design, Lecturer on Highway Engineering, University of Nebraska. New York: Thomas Y. Crowell Co. Cloth; 6x9 in.; pp. 472; line cuts, maps and halftones. $3, net; postage extra.

HUTTE: Des Ingenieurs Taschen-Buch—Herausgegeben vom Akademischen Verein Hütte. E. V. In Berlin. 24 Auflage. I. Band. Berlin: Wilhelm Ernst & Sohn. Cloth; 5x7 in.; pp. 1308; 559 line cuts. $2 in Germany.

The 1923 edition of Vol. I of this well-known German handbook for engineers.

MAN AND CULTURE—By Clark Wilson, Ph.D., Curator-in-Chief, Division of Anthropology, American Museum of Natural History, New York City. (Crowell's Social Science Series.) New York: Thomas Y. Crowell Co. Cloth; 6x9 in.; pp. 371; 17 figures in the text. $2.75 net; postage extra.

MECHANICAL TESTING: A TREATISE IN TWO VOLUMES—By R. G. Batson, M. Inst. C. E., M. I. Mech. E., Associate of King's College, London, Senior Assistant in the Engineering Department of the National Physical Laboratory, Teddington, and J. H. Hyde, A. M. Inst. C. E., M. I. A. E., A. M. I. Mech. E., Senior Assistant in the Engineering Department of the National Physical Laboratory. Vol. II. Testing of prime movers, machines, structures and engineering apparatus. New York: E. P. Dutton & Co. Cloth; 6x9 in.; pp. 446; 313 line cuts and halftones. $10. The earlier volume, published in 1922, dealt with Materials of Construction.

OIL VALUATION AND TAXATION: The Federal Income Tax and Its Methods Applied to the Oil Industry—By Jas. I. Tucker, B.S. LL.B., Assoc. M. Am. Soc. C. E., Consulting and Appraisal Engineer, formerly Director School of Civil Engineering, University of Oklahoma. Author of "Contracts in Engineering." Houston, Tex.: Gulf Publishing Co. Flexible; 4x7 in.; pp. 332; two folding plates.

THE RIDDLE OF THE RHINE: Chemical Strategy in Peace and War—An Account of the critical struggle for power and for the decisive war initiative. The campaign fostered by the great Rhine factories, and the pressing problems which they represent. A matter of pre-eminent public interest concerning the sincerity of disarmament. the future of warfare, and the stability of peace. By Victor Lefebure, Officer of the Order of the British Empire (M.E.), Chevalier de la Legion d'Honneur, Officer of the Crown of Italy, Fellow of the Chemical Society, etc.; With a preface by Marshal Foch and an introduction by Field Marshall, Sir Henry Wilson, Bart., Chief of the Imperial General Staff. New York: E. P. Dutton & Co. Cloth; 6x8 in.; pp. 282; 5 halftone plates. $2.

SERVICE MONOGRAPHS OF THE UNITED STATES GOVERNMENT—Prepared by the Institute of Government Research. Baltimore: Johns Hopkins University Press. Cloth; 6x9 in. $1 each.

No. 4: The Alaskan Engineering Commission. By Joshua Bernhardt. pp. 124.

No. 17: The Federal Power Commission. By Milton Conover. pp. 126.

No. 16: The Coast and Geodetic Survey. By Gustavus A. Weber. pp. 107.

No. 23: The Office of the Supervising Architect of the Treasury. By Darrell Hevenor Smith. pp. 124.

Each volume gives the history, activities, organization and personnel of the branch of government treated, together with its publications, the laws under which it works, a financial statement and a bibliography.

THE SIGNIFICANCE OF THE FINE ARTS—Published Under the Direction of the Committee on Education of the American Institute of Architects. Boston: Marshall Jones Co. Cloth: 6x9 in.; pp. 481; 128 halftone plates. $3.50; or edition de luxe, $7.50.

STIMULATING THE ORGANIZATION—By Orline D. Foster. New York and London: Harper & Brothers. Cloth; 6x9 in.; pp 414. $4.

Designed to stimulate production and sales.

VENTILATION: Report of the New York State Commission on Ventilation Appointed by the Governor of tne State of New York at the Request of the New York Association for Improving the Condition of the Poor and Supported by the Milbank Memorial Fund, C.-E. A. Winslow, Chairman. New York: E. P. Dutton & Co. Cloth; 7x10 in.; pp. 620; 134 line cuts and halftones. $15.

Rail Joint Experiments in Europe

Extended experiments with rail joints of various types on the German railways indicate that the best design is the suspended joint, spliced with heavy bars and carried by ties placed as close together as will permit of proper tamping. This summary of the report of results is given in the *Revue Generale des Chemins de Fer*. In addition, a base support or bridge plate may be used, and it is noted that in any case the rails should be secured firmly to tie-plates which are attached to the ties by fastenings independent of the rail fastenings. With steel ties, a twin or duplex tie supporting both rails has been found satisfactory. Supported joints with a single tie or with a three-tie arrangement have not given good results. Numerous special joints of more or less complicated design were tested but all were abandoned as being inferior to well made joints of the ordinary type.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

For the Federation

Sir—Permit me to comment on the editorial in your issue of April 12, p. 652, relative to the vote of the Am. Soc. C. E. on the question of joining the F. A. E. S.

I held the position of vice-president of the F. A. E. S. for two years. I attended the organization conferences, every meeting of the Council and Executive Board, and all but two, I believe, of the meetings of the Committee on Procedure. I had an excellent opportunity to inform myself as to the ideas, opinions and ideals of the men in charge of federation affairs.

I wish to say that the following statement in your editorial is, in my opinion, grossly unfair. I never observed any such attitude and cannot imagine how such an impression could have obtained wide credence:

"For two years those behind the Federation have gone ahead on the idea that it was a perfected organization. Take it or leave it, they said in effect to the civils, all the time bringing to bear all possible pressure to make them take it."

On the contrary, it was thoroughly understood that the federation was not a perfected organization and that there was much room for improvement. As to "making the civils take" the organization as it stands, the charge is ridiculous. Those behind the federation have repeatedly stated to the civils that any amendments to the constitution presented by them if they came in, would be given full consideration.

You write: "It would be fair to start on the assumption that the civil engineers would be interested in a looser form of co-operative organization, one that is more representative and more responsible and which is neither so expensive nor so centralized as the F. A. E. S. has proved itself to be."

Let us see if this assumption is a safe one. The American Society of Civil Engineers had an equal part with other national engineering bodies in the development of the federation idea and in the framing of its constitution. It is equally responsible with the other societies for the "unrepresentative, unresponsive, expensive ($1.50 per year per member) and centralized" organization it has twice refused to support.

Civil engineers also are responsible in large measure for the "poor record" (sic) of the Federation. Twenty-nine members of the Am. Soc. C. E. have been members of American Engineering Council through their connection with other engineering societies. Included in the list are the council's two presidents, two vice-presidents, one treasurer.

In my opinion, the Am. Soc. C. E. has expressed itself most emphatically as being opposed to co-operation. It has acted most inconsistently by declining to participate in the most significant movement ever inaugurated looking toward the solidarity of the engineering profession—a movement in the inception of which it had a large part and for the management of which its own members are largely responsible.

Furthermore, the Am. Soc. C. E. has, by its adverse vote, expressed a severe indictment of the engineering profession. Included in the membership of American Engineering Council have been twenty-nine presidents and past-presidents of important national engineering societies. The Am. Soc. C. E. in supporting the "arguments against joining" the federation issued by its opponents has, in effect, declared that the most prominent engineers in the United States are unable to conduct their own affairs in a manner to inspire confidence in their fellows. If this be true, Lord help the profession collectively!

W. E. Rolfe,
M. Am. Soc. C. E.

St. Louis, Mo., April 21, 1923.

Floating Dredges and Land Dredges

Sir—With reference to the comparison of dredges of different types for drainage work, in *Engineering News-Record* of March 29, p. 579, in our experience we have found that walking dredges can be best adapted to the digging of small lateral ditches where the width does not exceed, say, 10 to 15 ft. When it comes to digging drainage ditches larger than this it seems that floating dredges can handle the work much more economically than any other type of equipment. Draglines are also used extensively for such work.

It is difficult to draw a distinct line of adaptation for all of these machines, but generally speaking it would seem that the small walking dredges could be used advantageously on small ditches wherever the banks are solid enough to sustain the weight of the machines. For the medium and larger ditches a floating dredge or dragline would be a better proposition.

HARVEY T. GRACELY,
Marion Steam Shovel Co.

Marion, Ohio, May 1, 1923.

Sir—The question as to floating dredges and land excavators for drainage ditches, suggested by the article in *Engineering News-Record* of March 29, p. 579, can be answered only in a general way, since there is merit in both dredges and dry land machines.

Local conditions govern the type of equipment most suitable. The design and dimensions would have to be considered also in order to properly equip any particular drainage ditch. On large projects where the land is covered with heavy timber a floating dredge is preferable; in fact, this is the only practical machine with which to do work of that character. For ditches where the land is not covered with heavy timber and on which the surface is reasonably solid to facilitate traction, a dragline machine equipped with either a walking device or caterpillar traction could be used successfully and profitably.

E. G. STERNBERG,
Sternberg & Horton, Drainage Contractors.

Chicago, May 10, 1923.

Sir—In the article on "Records of Walking Dredge Work in Delta Land Drainage," in *Engineering News-Record* of March 29, p. 579, it appears that the author missed the point in his effort to draw a comparison between the economics of floating and land dredges, in that he confined most of his discussion to the particular type of walking dredge which spans the ditch. The description of that type was interesting, but the limitations peculiar to any equipment which spans the excavation put it in a class by itself and should not be considered as applying to land equipment in general. As a matter of fact the "straddling" type is practically subject to the same degree of limitation as the floating type, but in the opposite direction, as the former can not dig a wide ditch and the latter can not dig a narrow ditch.

Conditions in the lower Mississippi delta are much more favorable to floating equipment than those described in the article referred to, as the large number of natural waterways forming a network through the country usually make it possible to move a floating plant from one job to another without dismantling and without the necessity of digging channels for which payment is not made. There are numerous dredges in operation in the vicinity of New Orleans which were designed for one specific job but which have worked on a dozen or more jobs scattered over a wide area; and there never has been any expenditure for moving from one job to another excepting towage bills in the canals, bayous and lakes. In spite of this, however, there is a growing demand for land equipment to meet local conditions which can not be handled to advantage by floating dredges. The land dredges used in this locality are mounted on skids and rollers or are of the caterpillar type, though the large levee-building machines are mounted on railway type trucks using single or double track.

New Orleans, La.
May 7, 1923.

ARTHUR M. SHAW,
Consulting Engineer.

Mackay Reservoir Seepage Records Bear Out Experimental Data

Sir—Your issue of April 26 contains an article dealing with seepage losses at the Mackay Dam on Big Lost River, Idaho, which is of special interest in connection with a paper on the same subject presented a few years ago to the Am. Soc. C. E., and reported in the *Transactions* of that society, Vol. LXXXI, pages 1 to 73. In the discussion of that paper at least two engineers, the writer being one, pointed out that on the basis of the tests then made, and assuming that the material under the dam was homogeneous and of the same character as that used in the model upon which the tests were made, the indicated seepage loss for a gage height of 100 ft. was 360 sec.-ft. Believing this result to be the clear indication of the test, and regarding such a loss as probably prohibitive, he suggested the possibility of an error in the test data as recorded in the paper, and called attention to the interest that would attach to actual records of seepage when they became available.

In the light of the actually measured seepage, now published for the first time so far as the writer is aware, it is of interest to note that by the same method that indicated a seepage loss of 360 sec.-ft. for a gage height of 100 ft. there would result indicated seepage losses of 112 sec.-ft. and 127 sec.-ft. for gage heights of 50 ft. and 55 ft. respectively, which agree closely with the observed seepage losses. For lower gage heights the agreement is apparently not so close, which, in the absence of complete data, can not now be accounted for.

As pointed out by several in the original discussion it is believed that more valuable information is to be obtained from a study of the performance of structures under working conditions than from a study of models, and in the present instance there seems to be an excellent opportunity for just such a study.

It is to be hoped that conditions since completion of the Mackay dam favor the securement of very accurate data as to quantity of seepage loss, zone of seepage loss upstream, zone of seepage recovery downstream, and other related data, for the varying storage depths under which the reservoir will be operated.

JOSEPH JACOBS,
Consulting Civil Engineer.

Seattle, Wash.,
May 9, 1923.

Operating Local Gravel Pits

Sir—The article in your issue of May 10 entitled "Operating Local Gravel Pits for Concrete Road Work" was of unusual interest to me, but it leaves the impression that the commercial producers of sand and gravel are excessive in their prices which, I am sure, is rarely the case, and although there was a very substantial saving for the state I am wondering if some contractor is not holding the bag. Of course the shipment of sand and gravel over fifty miles runs up heavy freight charges, which may have been the controlling factor in this instance.

Edmund Shaw with whom I am associated makes sand and gravel plants a specialty and in a number of instances the producers have sold their produce below production cost because they failed to give sufficient attention to the items of depreciation and amortization, both of which are large in the average gravel plant.

In regard to the statement of the county highway commissioner that the material was produced for about 70c. per yard, if a commercial producer allowed his production cost to reach such a figure he would be out of business over night.

From my observation the farther we get away from state or government control of manufacturing the more economical the production.

MELVIN E. HARTZLER,
Consulting Engineer.

Chicago. Ill., May 16, 1923.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

By the Annual Report of the Southern Pacific Company a net income of $32,600,000 for 1922 as against $30,618,788 for 1921 is shown. This is at the rate of $9.47 a share on its capital stock.

The Dominion of Canada Has Authorized the construction of a new grain elevator at Montreal with an initial capacity of 2,500,000 bu. The elevator will be erected at Tarte pier by the Montreal Harbor Commission and is designed to have an ultimate capacity of 10,000,000 bu.

In Order to Meet the Needs of its growing export and import business the Southern Railway Co. has completed the dredging of the dock and approaches to its pier No. 4 at Pinner's Point, Va. The dredging operation has been carried out on both sides of the pier to a depth of 33 ft. at mean low tide, so that now the pier can accommodate four of the largest steamers using that port.

On May 16 the Interstate Commerce Commission began a hearing on the consolidation of the Eastern roads into several large systems, as called for by the Transportation Act. All the principal railways affected in this proposed consolidation will be given an opportunity to be heard on the question of the desirability of each tentative combination, or to propose others.

A Model Road is Being Constructed in Missouri on a four-mile stretch of the St. Charles road near Columbia by the Engineering Experiment Station of the University of Missouri. The most approved back-sloped, flat-bottomed ditch type road will be built. Manufacturers of material and road machinery are contributing equipment and operators.

Two More Railroads Have Succeeded in wiping out their deficits. The Nashville, Chattanooga & St. Louis reports a net income of $1,680,521 for 1922 as against a deficit of $259,801 for 1921, while the Chicago, St. Paul, Minneapolis & Omaha shows a net income of $1,177,929 as against a deficit of $285,671. The N. C. & St. L. RR. Co. at the same time reports that it will spend $1,225,000 on track and like improvements, and $2,500,000 on cars and locomotives.

An Immense Jubilee, in Which President Harding will be the central figure, is planned by the citizens of Alaska to commemorate the construction of the Alaskan R.R. by the U. S. Government. The railway, which is 467 miles long, was completed this month at a cost of $56,000,000. It is planned to have the ceremonies culminate in the driving of a gold spike by President Harding, either at the ocean terminal at Anchorage or at the great Tanana River bridge near Nenana.

Rutgers College Is Newest of Mines Bureau Stations

Rutgers College at New Brunswick, N. J., has been chosen as the location for the new mining experiment station for the bureau of Mines. The new station will specialize in problems involved in the production and use of the nonmetallic minerals, and New Brunswick was selected as centrally located in the northern section which produces nearly all of the talc, three-fourths of the silica, nine-tenths of the slate, and three-fourths of the building stone of the country. The total production of non-metals north of the Potomac is $245,000,000, south of the Potomac, $92,000,000.

Concrete Test Road Stands Up Under 33,000 Trips

Thirty-three thousand trips have been made around the circular concrete track in the wear test being conducted by the Bureau of Public Roads of the U. S. Department of Agriculture and the first evidences of wear are just becoming noticeable.

On account of the manner in which the traffic apparatus is constructed 33,000 trips are equivalent to the passage of 66,000 trucks equipped with solid tires and so loaded that the weight per inch width of tire is 600 lb. The track is constructed of a number of different kinds of concrete and at the present stage of the test the wear is so slight that comparisons cannot be made between them.

New York Civil Engineers Elect Edwards President

At the annual meeting of the New York Section, American Society of Civil Engineers, on May 16, J. H. Edwards was elected president for the coming year, Allen Hazen vice-president, Prof. H. P. Hammond treasurer, and F. W. Scheidenhelm and Richard de Charms directors.

A special committee reported the results of an extended study of the subject of structural safety in building. The committee work resulted from an animated discussion of the subject at the section meeting of Oct. 18, when various proposals for reform in building methods were presented by members of the section. The report found none of the proposals satisfactory for acceptance, and recommended that building procedure be reformed by recognizing building to be a specialized technical activity involving a distinct hazard, and accordingly restricting it to architects and structural engineers as alone competent to carry it on. A method by which this might be done was presented in some detail. The committee also recommended that action to carry its recommendations into effect be initiated through the society. The subject is to be considered by the section further at a meeting early in the fall.

Construction Council Would Avoid Building Crisis

Board of Governors Urge Slackening of Work—Increase in Output of Materials Recommended

A program designed to avoid a crisis in the construction industry this year and to provide a foundation for a permanent plan to eliminate the danger of similar crises in the future was discussed at a meeting of the Board of Governors of the American Construction Council held in New York City on May 16 and recommended to the building public.

The sentiment of the Board representing all factors in the construction industry was unanimously favorable to the program which had been prepared by a committee appointed for the purpose by Franklin D. Roosevelt, president of the Council. This committee consisted of M. C. Rorty, president, International Telephone Securities Corporation; N. F. Hoggson, of Hoggson Brothers, New York; and John Donlin, president, the Building Trades Department of the American Federation of Labor.

DIGEST OF REPORT

The report of this committee pointed out that the volume of construction projected so far this year exceeds the volume of the same period last year by more than 40 per cent and that the experience of 1922 demonstrated that during that year facilities for producing material and conducting field operations were taxed about to their limit. Construction work is limited not only by the available supply of labor and by inadequate transportation, but also by the restricted supply of manufactured products and materials produced by the basic industries which in turn are dependent upon the same factors. It related that stocks of materials on hand in practically all of the construction materials are lower than last year, while unfilled orders are greater. Recent figures, for example, show that orders on hand for common and faced brick are about 60 per cent higher and the stock on hand about 60 per cent lower than in 1922. Material prices are said to be rapidly rising and jobbers and manufacturers unable to maintain their quotations for more than a day or two at a time on certain products. The bidding of prospective buyers for material is sending prices upward and deliveries are becoming so uncertain that the practice of over-ordering for each job tends further to complicate the situation.

Labor rates also, the committee reports, are rapidly increasing, especially in the building trade. Employers are bidding for workers and paying bonuses to an extent even greater, in some cases, than in 1920. Regardless of what opinions may be as to the reasonableness of a wage of $15 or $18 per day for skilled mechanics, the committee believes that under present conditions these scales will soon stop building operations and leave the laborer in a more unfavorable position than he would occupy under steady employment under a lower wage. The limited production capacity of many industries appears unable to meet a continuation of the present demand and even where plant facilities are adequate, the committee reports that output may be limited by labor and transportation.

The committee notes that to the credit of many manufacturers they have not only shown a desire to hold their prices within bounds, but have actually succeeded in doing it to a great extent. Cement and steel are notable examples of materials in which factory prices have been relatively stable. Whether the spread of prices between the manufacturer and the consumer is the result of speculation, local material corners or merely the unbridled bidding of buyers, is a matter that should be ascertained and made known to the public.

COURSE OF ACTION OUTLINED

After discussing the various influences that might be set in motion to remedy these conditions, as, for example, the increase of production and the expediting of shipments and the elimination of restrictions on output on the part of local labor unions, elimination of which the committee reports would exert a significant influence in holding costs below that point where building becomes uneconomical, it outlined a second course of action which in its judgment should be invoked. These include publicity of construction costs so that the public may be enabled to follow the trend of prices and restricted demand at the point where investment becomes economically unsound.

The committee also declared that investment in new structures at an index number approximating 200 will unquestionably prove unsound in many instances when the general level of prices has declined. By informing the public of the index number from month to month it can govern its actions accordingly. It is suggested also that it may be possible to delay governmental, municipal and state construction until the peak of private building has subsided or until some curbing influence has been exercised on speculative building.

OTHER REMEDIES

Other remedies that are suggested by the committee include curtailment of speculation and over-ordering of materials on the part of dealers and construction companies by the establishment of bona fide material sale contracts obligating the buyer and seller to mutually advantageous positions. There is a big possibility, also, the committee believes, of controlling the situation to some extent through the steadying of prices by dealers and of wages by labor, but this, it believes, must come about as the result of mutual agreements between contractors, the building trade and those concerned with the handling of material. In order to bring about the necessary co-operation, the committee called upon one influence that can be brought to bear effectively, namely, the co-operation of the editors of the country. Publication of the construction index for the country or for a particular locality may call the attention of readers to the rising trend of construction costs and thereby effectively influence the demand.

As a preparation for steps to prevent future crises, it was decided at this meeting that the Department of Commerce should be asked to organize a statistical service that would gather and disseminate information as to construction, labor and material costs for the benefit of the general public and that if for any reason the Department of Commerce should not be able to do this that an investigation be made within the Council itself as to the practicability of its organizing and conducting such a service.

I.C.C. Commissioner Will Teach Transportation Course at Yale

In the selection of Winthrop M. Daniels, Interstate Commerce Commissioner, to occupy a chair in connection with its transportation course, Yale University has taken another step looking toward the ultimate realization of the Strathcona School of Transportation.

Mr. Daniel's work will be confined largely to public policy toward the public utilities engaged in transportation. This course of study will supplement those now being conducted by Prof. Dudley on the mechanical engineering side of transportation, and by Charles J. Tilden, professor of engineering mechanics, on highway transport.

Mr. Daniels' work will not be confined to public policy towards railroads, but will deal also with bus and truck transportation, electric railways, inland water transportation and transportation by air. In his second term, Mr. Daniels expects to take up a special course in the valuation of utilities and a course for graduate students on regulation of utilities.

Mr. Daniels' resignation as a member of the Interstate Commerce Commission becomes effective July 1. The President has designated Frank McNanamy as the successor to Mr. Daniels.

Delegates for Asphalt Conference on May 28 Are Named

At the general meeting to consider a reduction in varieties of asphalt for road work, to be held at 10 a.m. May 28 in the offices of the Division of Simplified Practice, Department of Commerce, Washington, D. C., the American Society of Civil Engineers has named as its representative Col. R. Keith Compton, of Baltimore, who will serve in a similar capacity for the American Society for Municipal Improvements. The delegate of the American Society for Testing Materials is C. L. Warwick. Representatives will be named this week for the American Association of State Highway Officials, the U. S. Bureau of Public Roads and the Chamber of Commerce of the United States.

State Sanitary Engineers Broaden Membership Basis

Chiefs of the sanitary engineering divisions of half the states in the Union and the three allotted representatives of the Public Health Service of the United States met in Washington, May 16 and 17 as the fourth annual Conference of State Sanitary Engineers. Subject to approval by letter ballot the conference voted to admit assistant state sanitary engineers as associate members, with all privileges except that of voting. It was also decided to restrict attendance at the conferences to the membership, except on invitation of others by the executive committee, and to give out to publications no papers or committee reports until after their presentation, nor until they have been reviewed by the executive committee.

Hereafter statistical reports will be submitted once in five years by these five committees: Water Supply, Milk Supply, Sewerage, Bathing Places and Mosquito Control.

The officers chosen for 1923-4 are: Chairman, W. H. Dittoe of Ohio; vice-chairman, H. F. Ferguson of Illinois; secretary, H. E. Miller of North Carolina. Future meetings will be held, as was this one, at the same time and place as the annual Conference of State and Territorial Health Officers.

Hughes Names Delegates to Navigation Congress

American delegates to the thirteenth International Congress of Navigation, which will meet in London in July, under the auspices of the Permanent International Association of Navigation Congresses, were named to-day by Secretary of State Hughes, following the receipt of an invitation from the British government.

The congress will deal with questions of inland and ocean navigation, largely from an engineering viewpoint. Membership of the United States in the association was authorized by Congress in the rivers and harbors act of 1902.

The American delegates, who were selected from government departments concerned with navigation, include the following:

Colonel J. C. Sanford, Corp of Engineers, U. S. A., retired.

Captain Frank T. Chambers, C. E. C., United States navy.

Colonel J. C. Oakes, Corps of Engineers, U. S. A.

Major O. N. Solbert, U. S. A., military attache at the American embassy in London.

Captain Charles L. Hussey, naval attache at the American embassy in London.

Rear Admiral William E. Reynolds, commandant of the U. S. Coast Guard.

John C Hoyt, hydraulic engineer, U. S. Geological Survey.

Colonel E. Lester Jones, director of the Coast and Geodetic Survey.

George R. Putnam, commissioner of lighthouses.

Walter Tower, commercial attache at the United States embassy at London.

Captain W. F. Purdy, operating manager of the U. S. Shipping Board at London.

Huntington T. Morse, European manager of the Emergency Fleet Corp.

Billion a Year for Rural Roads, Says MacDonald

New Figures Given at Road Builders' Annual Meeting—Frank Page Elected President

HITHERTO unpublished figures indicating actual expenditures of close to a billion dollars a year on the nation's rural highways and a summary of results of the detailed traffic census conducted in Connecticut through the joint efforts of the State Highway Department and the Federal Government were given out by Thomas H. MacDonald, chief, U. S. Bureau of Public Roads, at the annual meeting in New York, May 15, of the American Road Builders' Association. Present-day road-building efforts, viewed in the light of the amount of work to be done in the future, led Mr. MacDonald to remark: "We haven't even started to build highways in this country."

NEW OFFICERS

Frank Page, chairman, State Highway Commission of North Carolina, was elected president of the association and the other candidates for officers and directors on the regular ballot, including, as vice-presidents, E. L. Powers, W. F. Keller, S. F. Beatty and Samuel Hill, and, as treasurer, James H. MacDonald, were elected to office. By his election to one of the vice-presidencies of the association E. L. Powers terminates a service of 16 years as secretary; by action of the board of directors Ethel A. Birchland was named secretary pro tem. The newly elected directors are: J. R. Draney, New York; W. A. Van Duzer, Harrisburg, Pa.; Frank T. Sheets, Springfield, Ill.; E. J. Mehren, New York; I. W. Patterson, Providence, R. I.; Wm. R. Smith, Meriden, Conn.; H. K. Bishop, Washington, D. C.; J. H. Cranford, Washington, D. C.; C. M. Babcock, St. Paul, Minn.; H. S. Carpenter, Regina, Canada; S. T. Henry, New York; R. Keith Compton, Baltimore, Md.; Fred A. Reimer, Newark, N. J.; Charles M. Upham, Raleigh, N. C.; H. G. Shirley, Richmond, Va.; Will P. Blair, Cleveland, Ohio; Frank Terrace, Orillia, Wash.

FRANK PAGE

Reports received from the executive committee, the treasurer, and the Convention Committee, the latter accompanied by a financial statement audited by Haskins & Sells, certified public accountants, showed that the receipts from the sale of exhibition space at the 1923 convention in Chicago were $62,824.77 and the disbursements $56,332.81, leaving a profit of $6,491.96.

At the first meeting, May 15, of the new board of directors Chicago was selected as the place of the next annual convention and Good Roads Show, the dates selected being Jan. 13-19, 1924. The previous board had referred to the new administration a proposal made by the Highway Industries Exhibitors' Association to the effect that the exhibitors' association conduct the next Show, but in the name of the American Road Builders' Association, and turn over to the latter out of the profits a sum to be agreed upon to cover the expenses of running that organization. This proposal was amplified and explained by S. F. Beatty, president of the Highway Industries Exhibitors' Association and a vice-president, also, of the American Road Builders' Association. A discussion of the proposal followed, terminating in the adoption, unanimously, of a motion to the effect that the American Road Builders' Association should conduct the 1924 National Good Roads Show, but in so doing should seek the co-operation of the Highway Industries Exhibitors' Association. Authority for making detailed arrangements with the exhibitors' association rests in the hands of the executive committee of the American Road Builders' Association consisting of Thomas J. Wasser, S. T. Henry, and William R. Smith, with the president and treasurer of the association as members ex officio.

At the annual get-together dinner Toastmaster James H. MacDonald introduced the new president and after Mr. Page's address, Thomas H. MacDonald, of the Bureau of Public Roads, outlined the present status of the nation's roadbuilding program and its future development and told of the traffic census in Connecticut. Any consideration of our transportation problem, said Mr. MacDonald, must start with a realization that this country is organized on a basis of railway transportation for major movements. The total highway mileage in the United States was given as 2,800,000, of which about 180,000 miles, or 6.4 per cent, are at present included in the so-called 7-per cent federal-aid highway system authorized by the highway act of 1921. Figures recently compiled by the U. S. Bureau of Public Roads indicate expenditures for all purposes on rural highways during 1921 of $970,000,000, this figure being considered in excess of previous estimates based on incomplete data. Of this amount, less than half—or $450,000,000—was spent on state or federal aid work, indicating clearly, according to Mr. MacDonald, the need for the development of local organizations to handle large sums of money and provide adequate supervision of road construction. It was regarded as significant that after citing the great outlay being made for roads in the United States, Mr. MacDonald said: "I do not see any end to the road-building program. In fact, judged by the size of the task ahead of us, we haven't even started to build highways in this country."

In answer to the criticism of a railroad official who said recently that "there exists a positive mania for long distance roads, whereas lateral highways are our real need," Mr. MacDonald pointed out that of the 25,000 miles of federal-aid highway completed since 1916, only 26.8 per cent are of the heavy traffic type.

Among the interesting disclosures of the recent traffic census in Connecticut were that 35 per cent of all passenger automobiles are engaged on business trips, carrying an average of 1.7 persons as against three persons in cars on non-business trips. In general, the Connecticut figures prove, Mr. MacDonald asserted, that only an insignificant portion of the states motor truck traffic competes with the railroads.

A.G.C. Directors Adopt New Overhaul Specification

Station-to-Station Method of Yardage Computation Accepted for Road Work—Other Business

Directors of the Associated General Contractors of America, meeting in New York City, May 14 and 15, unanimously approved a station-to-station method of figuring overhaul for road construction, with 400 ft. free haul, and recommended that the association's committee on co-operation take up the subject with state highway officials. Station-to-station calculations, adopted in preference to the center-to-center and the mass methods of overhaul, are similar to the method used by railroads, but this is the first time that the system has been recommended for use in overhaul on highway work. The report accepted by the directors was prepared by J. H. Ellison, of Winston Bros., Minneapolis.

The directors pledged the co-operation of the membership with the managers of the Federation of Boys Clubs in an effort to have youths apprenticed in the building trades. Managers of the Federation, which includes 150 clubs in 110 cities organized somewhat along the lines of the "Big Brother" movement, at a recent meeting in Washington were addressed by Gen. R. C. Marshall, Jr., executive head of the Associated General Contractors, who pointed out that from the financial standpoint the tide of opportunity has turned from the white collar jobs to the crafts, and that some of the building trades now have only one-third the number of apprentices they had in 1919.

A resolution was adopted urging E. J. Russell of St. Louis to accept reappointment by the American Institute of Architects as a member of the National Board for Jurisdictional Awards. Mr. Russell has been chairman of the Board since its organization and recently announced his desire to retire with the expiration of his term this year, owing to the time involved in the Board's work.

George Griffith, Jr., of Los Angeles, was appointed chairman of the Highway Division of the Association, succeeding L. L. Rogers, resigned.

The directors approved a manual designed by headquarters to contain the various forms which are being evolved for contractors by the association. Reports were submitted showing wide interest in these forms, which include a standard equipment rental schedule, financial statement, job overhead and other features.

Considerable time was given to discussion of the heavy flow of contracts and difficulties of obtaining supplies of materials and in securing labor.

Denver Authorizes Bond Issue of $6,500,000

Bonds to the amount of $6,500,000 were authorized at a municipal election held in Denver on May 15. The proceeds will be used for extending and enlarging the distributing system, constructing a conduit from Marston Lake to Denver and building a filter plant. Burton Lowther is chief engineer of the Denver municipal water-works. Bonds are to constitute a lien on the system and are to be retired out of revenues from which will also come the interest.

Committee to Probe Coal Storage Is Named

F.A.E.S. Announces Plans and Scope of Investigation—Will Co-Operate With Federal Agencies

Announcement of personnel and plans of the committee which is to direct a national investigation of the storage of coal in co-operation with the U. S. Coal Commission, the Department of Commerce and the Bureau of Mines is made by the Federated American Engineering Societies. The committee members are:

H. Foster Bain, director of the U. S. Bureau of Mines, Washington; David Moffat Myers, former fuel administrator, New York; Perley F. Walker, dean of engineering, University of Kansas; W. H. Hoyt, chief engineer of the Duluth, Missabe and Northern Ry., Duluth, Minn.; S. W. Parr, professor of applied chemistry, University of Illinois; Edgar S. Nethercut, secretary of the Western Society of Engineers, Chicago, and Roy V. Wright, editor, New York. The chairman is W. L. Abbott, chief operating engineer of the Commonwealth Edison Co., of Chicago.

This main committee, it was stated by Dean Mortimer E. Cooley, president of the Federation, will work with committees in every state, studying local conditions through local engineers in an effort to find a solution for the problems of coal consumers from the small households to the largest industries.

Thirty national and local engineering societies, members of the Federation, have been enlisted in the work, and will be aided by other engineering groups, state administrative committees, federal and state agencies, private enterprises, civic bodies, corporations and individuals. The investigation, the first of its kind to be undertaken in this country, will deal with the whole range of problems affecting the storage of coal.

Factors involved, according to the Federation's statement, comprise cost, embracing the question of financing and providing means whereby coal in storage may be used as collateral; amounts of coal consumed at different periods, particularly by industries; provision by industrial organizations to aid the workers of the nation in securing coal supplies during the summer at a low cost; methods of handling and storing; effects of storage on the heating value of coal· transportation facilities; allaying labor unrest, and reducing the number of mines and miners.

The investigation is the third nationwide inquiry to be conducted by the Federation as a part of its public service program, the other two having been the "assay" of the Hoover Committee on Elimination of Waste in Industry, and the Survey of the Committee on Work Periods in Continuous Industry resulting in the recommendation, endorsed by President Harding, of the adoption generally of the eight-hour day.

Michigan Central Improvements

Three principal works planned by the Michigan Central R.R. for the current year are: track elevation at Green St. and Central Ave., Detroit; nine miles of double tracking from Jackson, Mich., to Rives Junction, and completion of the large classification yards at Niles, Mich., described in *Engineering News-Record*, Jan. 8, 1920, p. 81.

Alaska Railroad Bridge Across Tanana River

THE ACCOMPANYING view of the 700-ft. truss span of the new bridge carrying the Alaska R.R. over the Tanana River was taken on Feb. 9, 1923, just after the span had been swung. The view is taken from the north bank of the river and the south approach makes a long loop to the right in order to pass through the City of Nenana on the south bank. About 2,380 tons of steel were required for this span, which was built and erected by the American Bridge Co. This bridge was described in *Engineering News-Record* of March 15, p. 476, in an article by Col Frederick Mears, U. S. A., chairman and chief engineer of the Alaskan Engineering Commission. The cover picture of the March 15th issue of *Engineering News-Record* shows the falsework for the steel span being erected.

Tests to Check Concrete Design Being Made

An expensive series of concrete strength tests on an actual building operation under the combined auspices of the Joint Committee on Concrete and Reinforced Concrete, the Portland Cement Association, the U. S. Bureau of Standards, and a committee representing the contracting industry has just been undertaken. In general the tests are to demonstrate the practicability under job conditions of the principles of concrete mixtures recently evolved in various laboratories.

The tests are to be carried out on an 8-story building operation which Stone & Webster, Inc. has under way for the Victor Talking Machine Co. at Camden, N. J. Delaware River aggregates, common to the Philadelphia market, will be used.

Strict water control which will be accomplished by accurate water measurement at the mixer, checked by slump and flow table tests, will be required. Numerous 6 x 12 in. cylinders three every hour of mixing time will be taken for 28-day, 90-day and 1-yr. breaks, which are designed to show the uniformity of strength obtainable with accurate water control under job conditions.

Another line of investigation requires the cutting of cylinders from actual structural concrete, to demonstrate whether molded specimens correctly represent the actual material in the building. It is also the intention to make several batches of especially designed proportions to test out the latest principles derived from laboratory investigation.

A comparison between field made and laboratory made concrete with identical materials is also to be made, as well as a thorough study of the cements used. The technique of job testing will also receive attention.

W. A. Slater, engineer physcist of the Bureau of Standards, is director of tests. He will be assisted by Stanton Walker, a concrete technician from Lewis Institute in Chicago, who is in direct charge of the field testing work. Richard L. Humphrey is chairman of the Joint Committee, and M. J. Whitson of Stone & Webster with M. M. Upson of Raymond Concrete Pile Co. are joint-chairmen representing the contracting industry.

Public Roads Bureau Tests Concrete Curing

Methods of curing concrete road slabs are being tested by the Bureau of Public Roads of the United States Department of Agriculture at its Arlington Experiment Station. About the middle of April a number of 6-in. slabs, beams for breaking by bending, and compression specimens were cast with 1:2:4 concrete using gravel aggregate. One set of specimens has been air cured while others have been cured under wet sand, wet earth, tar, asphalt, other coverings and frequent sprinkling with no cover.

Twenty-eight-day tests will be made on the bending and compression specimens and on cores cut from the slab and at frequent intervals additional compression tests will be made on cores from the slabs.

A progress report will be made within a few weeks.

South Dakota Has State Road Fund

A summary of the methods of financing highway construction, which was sent out recently by the American Association of State Highway Officials, embodied an error in stating that South Dakota depends entirely on its counties for highway funds. This misapprehension was made possible by the fact that the legislature in South Dakota makes no appropriation of road funds but the money collected for automobile licenses is handled as a state fund. Since the summary of the Association of State Highway Officials was made public, the South Dakota legislature has provided a state fund for road maintenance. The gasoline tax was increased so as to provide the money for that purpose.

Engineering Societies

Calendar

Annual Meetings

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; Annual Convention, Ithaca, N. Y., June 20-23.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, Annual Convention, Chicago, July 11-13.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

The Syracuse Section of the American Society of Civil Engineers, has elected the following officers: President, Louis Mitchell; vice-presidents, Glenn D. Holmes and Henry D. Brewster; secretary-treasurer, Henry G. Throop.

Personal Notes

A. T. Canfield, engineer, Kansas City Southern Ry., has accepted a position with the Cross-Widdell Engineering Co., Inc., of Kansas City.

Abram Swan, Jr., city engineer of Trenton, N. J. for many years, has been elected one of the city commissioners of that city to succeed J. Ridgway Fell, retired.

F. O. Condon, formerly district engineer, Moncton, N. B., has been appointed engineer of maintenance-of-way, Canadian National Ry., Atlantic Division.

H. J. Crudge, formerly assistant engineer of bridges, has been appointed building engineer, Atlantic Division, Canadian National Ry., Moncton, N. B.

R. L. Rowland, former district engineer for the Portland Cement Association has resigned to enter the paving contracting field, with headquarters in Seattle. Mr. Rowlard will be succeeded by H. M. Hadley.

Stovel & Brinkerhoff of New York City announce the addition of H. M. Van Gelder as partner and a change of name to Stovel, Brinkenhoff & Van Gelder, engineers and constructors.

Construction and Foundation Corp. announces its removal from 372 Lexington Ave., New York City, to 50 East 42nd St.

George G. Hatter, executive manager of the Pennsylvania State Highway Department, has resigned and, with George H. Biles who resigned from that department March 15, will do consulting engineering work.

C. E. Rice, city engineer of Wooster, Ohio, has been appointed city engineer of Massillon, Ohio, to fill the vacancy created by the death of Harold Howald.

F. J. Bachelder, consulting engineer, removed his office on May 1 from 8 S. Dearborn St., Chicago, to Illinois Merchants Bank Bldg., that city.

Lane, Davenport & Peterson, architects and engineers, formerly at 2320 Dime Bank Bldg., Detroit, Mich., are now occupying their new offices at 1017-1020 Charlevoix Bldg., Park Blvd. and Elizabeth St., Detroit.

Chester G. Wigley, formerly chief engineer of the New Jersey State Department of Health, has opened at 2 East 23rd St., New York City, an office for practice as a consulting sanitary engineer, including designs, construction, reports and appraisals of water and sewage works.

L. S. Coburn has resigned from the North Carolina Highway Commission to become resident engineer with the Kentucky State Highway Department, and will be located at Morehead, Ky.

C. L. Orr, formerly assistant county engineer of Holmes County, Ohio, has been appointed city engineer of Wooster, Ohio.

Dr. George K. Burgess, new director of the Bureau of Standards, Washington, D. C., has been named by President Harding as chairman of the Federal Specifications Board, succeeding S. W. Stratton, former director of the Bureau.

N. F. Harriman, who has been acting chairman of the Bureau of Standards, Washington, D. C., has been named by the President as vice-chairman and technical secretary of the Federal Specifications Board.

H. C. Dickinson, who has been on leave of absence from the Bureau of Standards, Washington, D. C., to serve as director of research of the Society of Automotive Engineers, has resumed his work at the Bureau as physicist and has, in addition, been designated as chief of the heat division.

Harland Bartholomew, engineer of the St. Louis City Plan Commission, has been invited to visit Springfield, Mo., to make a survey of the city and offer suggestions for city improvements.

B. J. Pardee, civil engineer, formerly with the California State Highway Commission and the Associated Pipe Line Co., has been appointed city manager of Visalia, Calif., effective June 1.

Oscar R. Elting, who has been a special investigation and maintenance engineer with the Bureau of Water Supply, Akron, Ohio, since 1913, has accepted a position in the Boston office of Barbour and Dixon, consulting engineers.

R. S. Lea, consulting engineer of Montreal, sailed from New York May 12 on a trip to England and the Continent.

Ira Morrison, for the past eight years city clerk of Chico, Calif., has been appointed city manager under the provisions of a recently adopted charter.

Jacob Feld has left the Turner Construction Co., New York City, to become bridge designer for the Long Island R.R.

George W. Craig, city engineer of Calgary, Alta., has resigned, to take effect May 31. Mr. Craig is a Virginian, was educated in Nebraska and served fourteen years in Omaha as assistant city engineer and as city engineer.

John H. Wilson, consulting engineer, has been appointed city engineer of Duluth, Minn., succeeding E. K. Coe, who has taken up private practice. E. Fuller has been appointed office engineer and R. M. Palmer field engineer at Duluth.

J. P. Schwada, engineer of construction for the new Riverside Pumping Station at Milwaukee, Wis., has been appointed city engineer following the resignation of George F. Staal, noted previously in these columns.

H. R. Seward, for ten years city engineer of Waco, Texas, has resigned and is now city engineer of Ranger, Eastland County, Texas.

W. E. Joor and H. M. Bird have organized the firm of Joor Engineering Co., structural and civil engineers, at 601 Slaughter Bldg., Dallas, Texas.

J. Warren Mylchreest, director of public works of the city of Middletown, Conn., has resigned, effective June 15.

Nicholas F. Jahn and Vincent Bressi, engineering and highway contractors who have operated in the northern section of the Pacific Coast, have removed their headquarters from Seattle, Wash., to 522 Byrne Bldg., Los Angeles, Calif.

Edgar A. Kingsley has been appointed city engineer of Dallas, Texas, succeeding George D. Faitrace. Mr. Kingsley has been successively city engineer of Little Rock, Ark., state highway engineer of Arkansas, supervising engineer of the Bell County, Texas, highway system, paving engineer of San Antonio, Texas, superintendent of roads for the intermediate section of the lines of the A. E. F. in France, and consulting engineer at San Antonio and Little Rock.

Black, McKenney & Stewart, engineers, announce the removal of their offices to 1653 Pennsylvania Ave., N.W., Washington, D. C.

Otto F. Weisgerber has resigned as city engineer of Appleton, Wis., and will move at once to California.

General George W. Goethals, consulting engineer of New York City, has been engaged to make a survey of the water possibilities of the Pike's Peak watershed.

Major A. B. Cutter, city engineer of Everett, Wash., who is taking a course in business administration in

New York City, has wired his resignation to the Everett city council, and the council has named as his successor Sumner E. Paine. Major Cutter went overseas as lieutenant with the 18th Engineers, later being promoted to the grade of major and assigned to Base Section 6 as section engineer.

R. V. Glenn, consulting engineer for Tarrant County, Texas, at Ft. Worth, in charge of an extensive highway program since 1920, has resigned to become president of the Interstate Rawhide Paving Corp. at Ft. Worth.

Obituary

Walter V. Cohen, assistant engineer on drainage and sewage disposal in the office of the commissioner of public works, New York City, died April 30, aged 51 years. He had been actively engaged on the preparation of a plan for rebuilding and new construction of sewers for the Borough of Manhattan. From 1906 to 1910 he was engaged on hydraulic and sewer designs for the Drainage Division, Borough of the Bronx and from 1910 to 1912 on the design of the cut-and-cover aqueduct and pressure tunnels for the Catskill Aqueduct. Since 1912 he has been connected with design and construction of the 41st and 46th Streets tunnel relief sewers, the Dyckman St. screening plant, and the Thompson St. automatic pumping station.

Prof. R. Carr-Harris, lecturer in civil engineering and architecture at the Royal Military College, Kingston, Ont., and subsequently occupying the same position at Queens University, died May 13 in his eightieth year. He had also done important work in connection with the construction of the Intercolonial and Canadian Pacific Railways.

John H. Scott, railroad contractor of Los Angeles, Calif., died recently in Ripley, N. Y., while returning in his automobile to the Pacific Coast from a visit to his old home near Syracuse, N. Y.

John J. Hopper, civil engineer and register of New York County from 1914-1918, died May 16 in New York City. Mr. Hopper began his career as assistant engineer in planning the street and sewer systems of the Bronx. He contracted for the excavation and erection of the heavy masonry in Columbia University, the building of the elevated structure of the New York Central R.R. from 115th St. to the Harlem River, and the original section of subway from 103rd St. and Broadway under Central Park to 135th St. and Lenox Ave.

John Egan, pioneer railroad builder, died May 10 at Dixon, Ill. Mr. Egan was chief engineer of the Southern Missouri R.R. and later became general superintendent in charge of construction of the Canadian Pacific, West, at Winnipeg. He also built the Great Northern from Minot, N. D., to Helena, Mont. Later he went to the Hill roads and then to South America as vice-president of the Brazil Ry. Co. Upon his return to this country in 1910 he was president of the Kansas City street railways and light and power company until he retired in 1916.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Action on Lumber Standards

Standardization in the lumber industry took a step forward as a result of the meeting of the Consulting Committee on Lumber Standards, held in Chicago, May 14-16. The chief elements of progress were the ratification of basic lumber grades and the establishment, so far as the committee was concerned, of the standard sizes of boards, dimension and finish. The grades recommended by the committee cover the whole range of lumber qualities, divided into two general groups. The first basic group will be known as Select Grades A, B, C and D; and the second basic group will be known as Common, Nos. 1, 2, 3, 4 and 5.

The committee acted favorably upon the recommendation of the Forest Products Laboratory both in the nomenclature of the basic grades and in most of the details of lumber sizes. It was decided that the terms "inch board" and "two inch measurement" be dropped, and in the interests of sound business the term "standard board" and "standard dimension" be adopted and applied to both hardwoods and softwoods. It was decided also that $\frac{13}{16}$-in. S2S (measured at standard commercially dry shipping weight and moisture content for each species) shall be adopted as a minimum thickness of the standard "factory" board, and "box" board, which comprises lumber for remanufacture.

It was recommended that $\frac{25}{32}$-in. S1S or S2S (measured at standard commercially dry shipping weight and moisture content for each species) shall be adopted as a minimum thickness of the standard "yard" board, which comprises lumber for general construction and other ordinary purposes, graded on the basis of the use of the piece as a whole. For standard dimension stock not more than 12-in. wide, the size recommended was **$1\frac{5}{8}$-in.** S1S or S2S (measured at standard commercially dry shipping weight and moisture content for each species).

It was agreed that $3\frac{5}{8}$, $5\frac{5}{8}$, $7\frac{1}{2}$, $9\frac{1}{2}$ and $11\frac{1}{2}$-in. S1E or S2E (measured at standard commercially dry shipping weight and moisture content for each species) be adopted as the standard finished widths of boards, dimension and finish and that consideration be given to the general production of $\frac{1}{2}$-in. boards when not over 8-in. wide. Commercially dry lumber should not exceed the weights approved by the Central Committee.

Trans-Atlantic Rates Reduced for Heavy Machinery

Based on information from American Commercial Attaché Walter S. Tower, the U. S. Department of Commerce states that recent reductions in trans-Atlantic freight rates on heavy-weight shipments range from 25 per cent on parcels weighing under 2 tons to as much as 7½ per cent on parcels weighing from 7 to 10 tons. The new rates for various weights of shipments, as compared with the old, according to facts supplied by one of the leading operators in the trans-Atlantic service, are indicated in the accompanying table.

TRANS-ATLANTIC FREIGHT RATES ON MACHINERY

Weight (Ton = 2,240 Lb.)	New Rates Per 100 Lb	New Rates Per Cu.Ft.	Old Rates Per 100 Lb.	Old Rates Per Cu.Ft.
Under 2 tons	$0 60	$0 30	$0.75	$0 40
Over 2 and not exceeding 3 tons	74	37½	1.05	.55
Over 3 and not exceeding 4 tons	78	40	1.25	65
Over 4 and not exceeding 5 tons	.83	.42½	1.45	.75
Over 5 and not exceeding 6 tons	.91	.47½	1.65	.85
Over 6 and not exceeding 7 tons	1.00	.52½	2.15	1.10
Over 7 and not exceeding 10 tons	1.10	.57½	2.65	1.35
Over 10 and not exceeding 15 tons	1.14	.60		
Over 15 tons	(1)	(1)	(1)	(1)

[1] Specially contracted for.

Note—All these rates are applicable to weight or measurement, at ship's option.

Balance of Trade Against U. S. for First Time Since 1914

For the first time since 1914 the balance of foreign trade in imports and exports of merchandise turned against the United States in March when, according to figures just issued by the U. S. Department of Commerce, imports totaled $402,000,000 as against exports of $341,162,349, an excess of imports over exports of nearly $61,000,000. This excess is the largest for any one month in the country's history.

For the first four months of 1923, figures of the Department of Commerce show, merchandise exports were $1,324,773,214, as compared with imports of about $1,375,000,000, or a trade balance against the United States of about $50,000,000, compared with a balance in our favor of about $272,000,000 in the same period of 1922 and of about $938,000,000 in the same period in 1921. For April it is estimated that the balance between imports and exports will be about even.

The import movement, according to Dr. Julius Klein, of the Commerce Department, appears to have been largely made up of raw materials brought into the United States for manufacture. Rising prices in this country are said to have discouraged exportation.

Trenching Machine Types for Various Kinds of Work

Advice to users of trenching machines, with particular reference to the selection of the proper type for the character of work planned, is contained in a recent memorandum sent out by the Pawling & Harnischfeger Co., Milwaukee. "If you do a lot of shallow trenching," the memorandum states, "use the wheel type machine and dig the trench in any soil up to 7½ ft. deep and 28 in. wide at one cut. For deep trenching use the ladder type machine, which digs to 18 ft. deep and 42 in. wide. For a greater width than 42 in. the dragline has proved to be the most practical trench excavator."

Business Notes

Henry Woodland, secretary and treasurer of the Allis-Chalmers Manufacturing Co., Milwaukee, died suddenly May 14. He was a native of Utica, N. Y., and before joining the Allis-Chalmers organization served with the New York Air Brake Co. and as treasurer of the Gates Iron Works, Chicago, which was consolidated with the Allis-Chalmers organization in 1901.

Westinghouse Electric & Manufacturing Co. East Pittsburg, Pa., for the year ending March 31, 1923, has reported a net income of $12,263,485. Dividend requirements were $6,033,428, so that over twice this amount was earned and more than $6,000,000 added to the surplus. Gross sales for the year were $125,000,000 which represents an increase of $25,000,000 oves the sales of last year. Current assets total over $106,000,000, and current liabilities less than $17,000,000.

The **Blackwood Electric Steel Corp.**, Parkersburg, W. Va., will soon erect in that city a modern electric steel foundry. The design and supervision of the plant is being handled by Mills, Rhines, Bellman & Nordhoff, engineers, Toledo, Ohio. The structural steel contract has been placed and the remainder of the material will be contracted for soon, so that the plant can be constructed immediately and put in operation in the early spring.

Clark R. Mandigo, formerly assistant city engineer, Kansas City, Mo., has resigned his position as chief engineer for the Western Paving Brick Manufacturers Association, to accept the position of engineer and secretary for the Kansas Association for Public Improvements. The latter association was recently formed with a membership of contractors doing all classes of public works in the State of Kansas. Offices have been opened at 616 Dwight Building, Kansas City, Mo.

Layne & Bowler Co., water supply contractors, Memphis, Tenn., has recently organized associate companies in New York, Chicago, Stuttgart, Ark., St. Petersburg, Fla., and Memphis, Tenn. Under the new arrangement men and equipment can be supplied more promptly than when all business was handled directly by the parent company. The associate companies are complete within themselves, each having its own officers, men and equipment. The officers are all former Layne & Bowler men who have been with the company for periods of from six to thirty years.

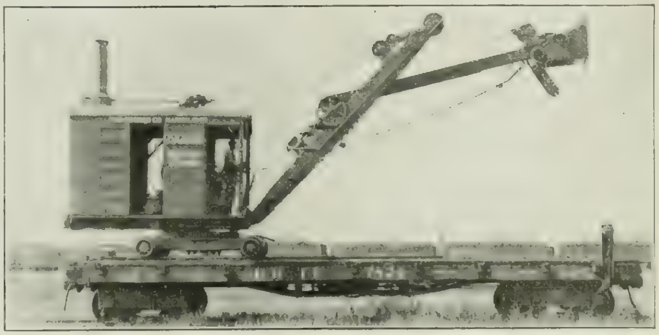
Marquette Cement Manufacturing Co., Chicago, has purchased the plant, stock and good will of the Cape Girardeau Portland Cement Co., Cape Girardeau, Mo.

Equipment and Materials

Improvements Made in Revolving Type Railroad Ditcher Shovel

Increased efficiency and lower maintenance costs have been sought through improvements that the Osgood Co., Marion, Ohio, has made during the past year in its heavy-duty revolving type railroad ditcher shovel of ¾ and 1 cu.yd. capacity.

The main body has been redesigned to increase strength with only slight additional weight and has fitting surfaces machined to insure interchangeability of truck frames, thus making it possible to mount the same machine on railroad trucks of either standard or special gage, traction or continuous tread trucks. This feature, it is claimed, is a great saver in mechanical outlay as the same machine can be put on different mountings and used for cleaning ballast, laying rail, ditching right-of-way, unloading, loading, or stocking coal, as a locomotive crane and many other uses where a machine of extreme mobility is required.



The machines are designed for ready conversion to steam shovel, crane, single-line clamshell or dragline outfit. The auxiliary hoisting drum is sufficiently strong to operate a clamshell or dragline bucket with a single line, eliminating a set of sheaves on the bucket, reducing wear and tear on the line as well as speeding up operation. All points of great stress are reinforced to withstand excessive wear and strain. Important shaftings are oversize to insure ample strength.

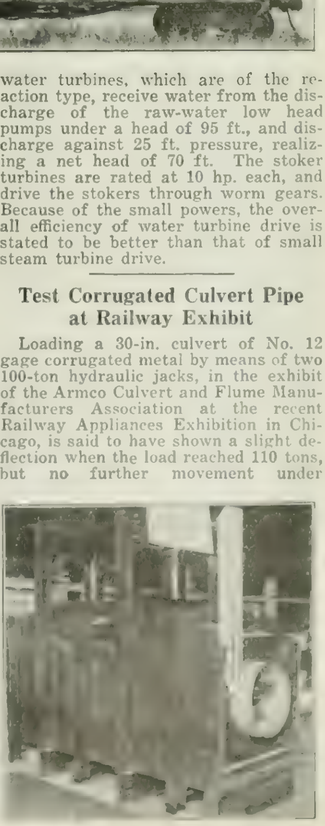
Features of Cleveland's New Pumping Equipment

New developments made in apparatus for water-works plants by the De Laval Steam Turbine Co., Trenton, N. J., relate to higher duties, increased capacities in single units, utilization of very high steam pressures and superheats, and improved heat balance and utilization of steam. A departure from previous water-works practice in all of these respects is represented, the company states, by the equipment of the new Fairmount Station, Cleveland, which is to pump filtered water from the Baldwin reservoir into the city mains. Steam at 300 lb. pressure and 200 deg. F. superheat is supplied to five De Laval geared-turbine-driven centrifugal pumps, three of which are designed to deliver 20,000,000 gal. per day each against 450 ft. maximum head, and two to deliver 20,000,000 gal. per day each against 154 ft. maximum head. The fuel cost chargeable against pumping, it is predicted, will be exceptionally low, due to the fact that large quantities of steam are to be bled from some of the turbines at 125 lb. pressure for the heating of a hospital and other city establishments, while from others steam is bled at 10 lb. for heating the pumping station and close-by municipal buildings.

A novel feature is the use of water turbines for driving the condensate pumps and the stokers. These small water turbines, which are of the reaction type, receive water from the discharge of the raw-water low head pumps under a head of 95 ft., and discharge against 25 ft. pressure, realizing a net head of 70 ft. The stoker turbines are rated at 10 hp. each, and drive the stokers through worm gears. Because of the small powers, the overall efficiency of water turbine drive is stated to be better than that of small steam turbine drive.

Test Corrugated Culvert Pipe at Railway Exhibit

Loading a 30-in. culvert of No. 12 gage corrugated metal by means of two 100-ton hydraulic jacks, in the exhibit of the Armco Culvert and Flume Manufacturers Association at the recent Railway Appliances Exhibition in Chicago, is said to have shown a slight deflection when the load reached 110 tons, but no further movement under



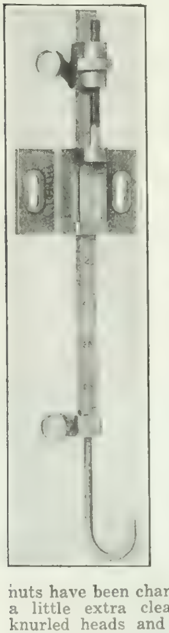
frequent applications of 120 tons. The culvert was bedded in coarse wet sand about 12 in. deep above and below it, the sand being retained by planking against the structural steel posts which carried cross girders for the reaction bearing of the jacks. On the sand were three ties spaced 18 in. on centers and supporting two 12-in. channels (instead of rails) 4 ft. 8½ in. apart. Each jack rested on a channel and its reaction was taken by an overhead steel frame, as shown in the accompanying illustration.

Apparatus for measuring the deflecton consisted of three 2-in. cylinders supported independently of the culvert and having plungers bolted to the crown of the pipe. Flexible tubing connected the cylinders with three ½-in. glass gages 6 ft. high, containing a colored liquid, any movement of the crown being magnified sixteen times by this device. These cylinders were placed inside the pipe middle and ends. It is planned to use this apparatus for an extended series of tests on pipes of various diameters and thickness.

Small Pump Used to Ice Logging Roads in Canada

Indicating the varied uses of the small Evinrude centrifugal pump, one is now at work icing logging roads in the Canadian woods near Hudson Bay. The pump is slung down a water hole and lifted up to drain to prevent freezing.

Hook Gage Improved



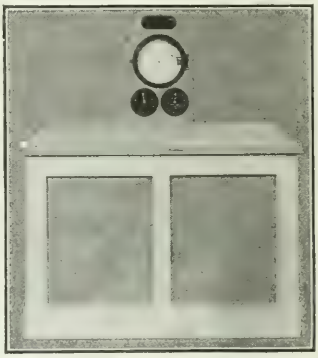
Based on experience in the field of hydraulic measurement W. & L. E. Gurley, Troy, N. Y., have devised certain refinements which make their hook gage more convenient for the user. The improvement has been in eliminating, as far as possible, the possibility of inaccurate reading through absence of good light or other troublesome conditions.

The new Gurley hook gage is graduated on a square tube. The change from the usual round tube overcomes the possibility of its turning in the bracket, a happening which often turned the graduated side of a round tube out of line with the vernier. At the same time the new construction brings the reading face flush with the vernier so that there is no shadow to handicap an accurate observation. The clamp nuts have been changed slightly to give a little extra clearance between the knurled heads and the wall on which the gage is mounted. In addition, the clamps have been made larger and more positive, as well as easier to get at.

The adjusting screw has been brought over into line with the graduated scale of the gage so that its vertical movement can be accomplished more easily and a fine setting arrived at with a minimum of effort. The hook and its rod are still of a round section and so arranged that the rod can be extended as necessary to get the right height and rotated so that the tip of the hook breaks the surface where light reflection is the best.

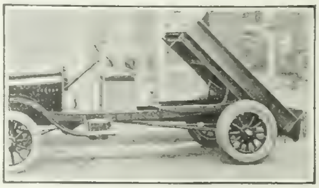
New Rate Controllers for Detroit Filtration Plant

At the new filtration plant in Detroit, which will be inspected during the annual convention of the American Water Works Association this week, the Builders Iron Foundry, Providence, R. I., is installing 80 Venturi rate controllers of special design. As indicated in the accompanying photograph of the operating table, the controller gage has four dials. The upper one is a totalling dial for integrating the amount of water flow from the filter. The middle dial records on a 12-in. chart the rate of flow. The two lower dials indicate loss of head and the instantaneous rate of flow from the filter. The controller gages are operated by mercury levels.



Self-Dumping Steel Body Designed for Ford Trucks

The Wood Hydraulic Hoist and Body Co., Detroit, is building for use on the Ford truck a self-dumping steel body unit of the same general design as the bodies which the company has supplied for heavier trucks. The body, with its mounting frame, hinges and locking device, is a complete unit ready for bolting on the truck frame. There are no holes to drill or parts which are attached separately.



The hinges on which the body tilts embodies two pins or fulcrums which have a definite effect of displacing the center of the loaded body towards the rear while dumping, assuring quick action and obtaining a high dumping angle. The body is returned to the down and locked position by a handle attached to the front of the body, only a slight effort is required as the body when empty is in a balanced condition. The releasing handle is arranged for convenient operation by the driver and positively locks the body against accidental operation.

The tail gate opens and closes automatically, requiring no attention from the driver.

Publications from the Construction Industry

Electric Hoists and Overhead Cranes—LINK-BELT Co., Chicago, has just issued a new book on electric hoists and overhead cranes, illustrated with photographs showing recent adaptations of this equipment in widely divergent fields. For instance, the practice of a sewer contractor in Maryland who used a hoist for removing dirt, and the methods employed at a shipbuilding plant in Texas, which adopted the same scheme for moving and placing timbers, are covered in the new publication.

Heating and Ventilating Equipment—BISHOP & BABCOCK Co., Cleveland, in a 278-p. illustrated handbook describe a complete line of heating specialties and ventilating equipment, including traps, thermograde auto-valves, pressure-regulating valves, damper regulators, vacuum pumps, governors, squirrel cage, propeller and steel-plate fans. There is a considerable amount of heating and ventilating data included in the book in the form of tables, curves and sketches of typical industrial layouts.

Light Excavator—BAY CITY DREDGE WORKS, Bay City, Mich., in a 40-p. illustrated catalog, features its one-man excavators for sand, gravel, ditching, and road work. These excavators may be operated either with dipper or clamshell attachments of about ⅜-yd. capacity. The equipment is operated by a gasoline engine and weighs 18,000 lb. The outfit also may be operated with a skimmer scoop or as a land dredge with various types of mounting.

Air Valves—MULTIPLEX MANUFACTURING Co., Berwick., Pa., in a 35-p. illustrated booklet, features the Crispin air valve to prevent the collapse of pipe lines. The valves are of a type which automatically permit the escape of air while the line is being filled and the entry of air while it is being emptied. The limit of size on a single valve is 4 in. Where larger openings are desired clusters of two or four are placed on a single assembling casting.

Non-Metallic Gears—WESTINGHOUSE ELECTRIC & MANUFACTURING Co., East Pittsburgh, Pa., in a 20-p. illustrated booklet, describes the advantages of its non-metallic Micarta gears and pinions. Noiselessness and durability are among the chief advantages claimed. The base material in these gears is a fabric woven to a definite weight of thickness and especially treated to condition it for impregnation with a binder. After the binder has been absorbed the processes are carried to their final stage when heat and pressure are applied.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Bricklayers' Strike Called on New York Building

Demand Raise in Basic Wage From $10 to $12 a Day—Many Important Structures Affected

A STRIKE of bricklayers working for members of the Mason Builders' Association on a number of important building operations in New York City went into effect May 21 and involved from 1,500 to 2,000 workers. The issue is the demand of the union men for a raise in the basic wage from $10 to $12 a day. It is estimated that structures involving an aggregate cost of over $100,000,000 are affected by the strike which involves operations now in progress by a number of the large building construction companies, including the George A. Fuller Co., the Thompson-Starrett Co., Marc Eidlitz & Son, the James Stewart Co., Cauldwell & Wingate, T. A. Zimmerman, Inc., and others. A shutdown of work by the bricklayers, if it continues, will affect other building trades including plumbers, carpenters, sheet metal workers, plasterers and painters.

Some of the important New York buildings affected by this week's strike are the Federal Reserve Bank, the new store on Fifth Ave. of Saks & Co., the nineteen-story annex of R. H. Macy & Co., buildings of the New York Telephone Co., the Greenwich Bank, the Cotton Exchange, and a number of large apartment houses.

Frank E. Conover, president of the Mason Builders' Association, has stated that the strike was called "ostensibly to secure a basic wage of $12," but that its "real purpose is not the amount of money; it is the attempt to establish the $12-day as the standard basic rate for a period of two years, making the peak wage permanent."

February Wages for Common Road Labor Same as 1922

Wages of common labor for road work in February were practically the same as for the same month of 1922, according to the Bureau of Public Roads, U. S. Department of Agriculture. Averaged for groups of States the price per hour was as follows: New England, 48c.; Middle Atlantic, 40c.; East North Central, 34c.; West North Central, 29c.; South Atlantic, 21c.; East South Central, 19c.; West South Central, 24c.; Mountain, 38c.; and Pacific, 47c. In some of these sections the figures are based on a small amount of work due to the season of the year.

The price per hour for other classes was as follows: Superintendents, 79c. to $1.11; foremen, 53 to 88c.; truck drivers, 27 to 64c.; roller engineers, 35 to 81c.; mixer operators, 31 to 98c.; steam-shovel operators, 65c. to $1.19; carpenters, 43 to 76c.; concrete finishers, 35 to 78c.; mechanics, 30 to 61c.; teams without drivers, 24 to 80c.; and teams with drivers, 29c. to $1.12. In almost every case the upper limit of price prevails on the Pacific slope.

Steel-Castings Bookings Decline

A decline of almost 40 per cent from the March high record occurred in the April bookings of commercial steel castings, according to reports received by the Department of Commerce through the Bureau of the Census, in co-operation with the Steel Founders Society from companies comprising over two-thirds of the commercial castings capacity of the United States. Total bookings reported in April amounted to 90,968 tons or at the rate of 93.9 per cent of shop capacity as against 148.2 per cent of capacity shown by March bookings.

The following table shows the bookings of commercial steel castings for the past four months by 65 identical companies, with a monthly capacity of 96,900 tons, of which 38,300 tons are usually devoted to railway specialties and 58,600 tons to miscellaneous castings.

BOOKINGS OF COMMERCIAL STEEL CASTINGS

	Total		Railway Specialties		Miscellaneous Castings	
Month 1923	Net Tons	Per Cent of Capacity	Net Tons	Per Cent of Capacity	Net Tons	Per Cent of Capacity
January	100,605	103.8	47,879	125.0	52,726	90.0
February	90,152	93.0	39,845	104.0	50,307	85.8
March	143,564	148.2	76,409	199.5	67,155	114.6
April	90,968	93.9	39,610	103.4	51,358	87.6

Lumber Movement Decreases

Following several weeks of declining volume of new business the sawmills reporting to the National Lumber Manufacturers Association recorded a decrease of about 25,000,000 ft. in orders for the first week in May, as compared with the preceding week, due in part to fewer mills reporting. Shipments fell off by 32,000,000 ft. and production by 26,000,000 ft. Taken in connection with the fact that as compared with the same week of 1922 new business again shows a decrease, the question is raised in some quarters as to whether the so-called builders' and buyers' strike against increasing labor costs has not temporarily checked the building movement. Shipments are slightly larger than at this time last year and production is much larger. In consequence of the emphasis that has been placed on ample production and facilitated shipments, accumulated orders for 1923 to date are less than 600,000,000 ft. in excess of production and less than 200,000,000 ft. more than shipments.

Railways Report New Freight Cars

According to the Car Service Division of the American Railway Association, new freight cars installed by the carriers from Jan. 1 to April 15, 1923, totaled 44,302, while 1,077 new locomotives were placed in service during the same period. Of the new freight cars installed, 19,867 were box cars, 17,096 were coal cars and 1,299 were stock cars.

Federal-Aid Road Costs Not Higher Than Others

Washington Correspondence

Costs of highway construction on federal-aid projects compare favorably with those on roads constructed by states, counties or municipalities, the U. S. Bureau of Public Roads' figures show. The claim has been made that the demands of federal inspectors are such that contractors submit higher bids on federal-aid work. In some instances it has been claimed that the full benefit of federal aid to communities thus is lost. A survey of figures in possession of the Bureau of Public Roads shows that that is not the case. Comparisons which are fairly typical of the average situation are as follows:

Average cost of pavement on nine Virginia federal-aid projects, $2.95 per square yard; average figures on four comparable state or county projects, $2.99 per square yard. Class A concrete on 48 Virginia federal-aid projects averaged $25.33 per cubic yard; the average cost of 20 comparable state and county projects was $25.42 per cubic yard. The average cost of concrete paving on 24 Iowa federal-aid projects was $4 per square yard, whereas the average on four comparable county or state projects was $4.16.

Rock excavation on ten federal-aid projects in Oregon was done for $1.76 per cubic yard. The average cost on 52 state and county rock excavation projects was $1.67 per cubic yard. The average cost of Class A concrete on nine Oregon projects was $29.33, whereas the average paid for that type of pavement on 69 state and county projects was $29.15. In Rhode Island, the average cost of ledged rock excavation on seven projects was $4.42. On a similar number of comparable state projects it was necessary to pay $3.73. In the same state, the respective figures for gravel foundation were $2.26 and $2.30.

New York High Court Upholds Dwelling Tax Exemption

The Court of Appeals at Albany, N. Y., has upheld the constitutionality of the state law which exempts new dwellings from taxation for ten years after April 1, 1923. The court affirmed the opinion of the Apellate Division, First Department, which reversed the decision recently made by John M. Tierney, justice of the State Supreme Court, to the effect that the exemption of dwellings was unconstitutional (see *Engineering News-Record*, March 29, 1923.)

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 303 to 407, are the following large projects:

Grain elevators, Bulgaria, to MacDonald Engineering Co., Chicago, Ill., $10,000,000.

Rebuilding and repairing railway tracks, West Toronto, Ontario, by day labor, $2,500,000.

Apartment, Washington, D. C., to Weller Constr. Co., $2,000,000.

Apartment, Brooklyn, N. Y., to G. M. Seglin, New York City, $2,000,000.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 303 to 407, are the following:

Four 20,000 kw. turbo units for power plant, Detroit, Mich., for Public Lighting Commission, $1,247,000.

Hotel, Jamestown, N. Y., for Hotel Jamestown, Inc., $1,225,000.

McGovern Subway Bid Low

Unofficial figures indicate that for the construction of the Broadway-Fourth Ave. subway, New York, for which bids were opened by the Transit Commission May 22 Patrick McGovern, Inc., New York, was low with a total of $5,995,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 3; the next, on June 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb...........	$3.64	$4.30	$4.50	$3.40	$3.55	$4 20	$3.85	$4.10	$3.75
Structural rivets, 100 lb.............	4.40	5.00	5.25	3.75	4.25	5.15	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb......	3.54	4.25	+3 70	3.32½	3.45	3.85	3.65	4.10	3.50
Steel pipe, black, 2½ to 6 in. lap, discount......................	49%	50%	45%	59½%	53-5%	36%	35.2@47.6%	40%	32.76
Cast-iron pipe, 6 in. and over, ton...	+62.50@63.50	—55.00	63.00	60.20	60.50	69.00	60.00	70.00	60.00
Concreting Material:									
Cement without bags, bbl.........	2.70@2.80	—2.80	2.25	2.20	2.39	2.85	2.71	2.90	2.68
Gravel, ¾ in., cu.yd................	2.25	1.90	2.25	2.00	1.75	1.90	2.15	1.25	1.50
Sand, cu.yd.........................	1.25	1.24	+1.95	2.00	1.00	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd..........	1.75	2.00	2.50	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft..........................	65.00	42.00	53.00	60.00	45.75	44 00	41.00	31.00	90.00
Lime, finishing, hydrated, ton.......	18.60	23.50	22.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.......	3.00@3.25	1 50	2.50	1.50	1.50	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000......	23.50	14.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block......................	Not used	.0893	.115	.1032	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block......................	.1573	.0893	.115	....	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.......	1.16	—1.24	—1.35	+1.37	1.29	1.39	1.24	.86	1.38
Common Labor:									
Common labor, union, hour........	.75	.35	....	......	....	.50@.55	.56¼	....	......
Common labor, non-union, hour....	....	.30	.30@.50	.72½	.35@.50	.35@.50	.50	.50@.62½	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 81¼c.; building laborers, 75c.; minimum for pick and shovel men, 50c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.91). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Mill quotations on steel structures now $2.50 per 100 lb. for third quarter deliveries; $2.60 demanded for small shipments in the current quarter. Bars, however, quoted as low as $2.40, f.o.b. Pittsburgh, for delivery in third quarter. Bulk of structural buying is at the $2.50 base. The postponement of building projects has had the effect of diminishing the volume of new business at mills. No tendency, however, has yet been shown, on the part of buyers, to hold up shipments on orders already placed. Considerable material is already booked for delivery in the current quarter.

An advance of 20c. per 100 lb. is reported on steel bars in Dallas, together with a rise of 5c. per cu.yd. in sand, due to higher labor costs. Both Atlanta and Dallas report declines of 2c. per gal. in linseed oil, due to improvement in seed supply; Chicago, however, quotes advance of 2c. per gal. Atlanta reports drop of $1 per ton in cast iron pipe and 5c. per bbl. in cement, during week; Minneapolis quotes decline of $1 per M. ft. in Douglas fir timbers. No other important price changes reported during the week.

Conditions in the New York building trades may be outlined briefly, as follows: Possibility of general strike, June 1, lessened by decision on the part of unions to let each craft negotiate separately with employers; calling strikes only in those trades where advance of $1 per day is refused.

Stone carvers on strike for wage advance from $10.50 to $12.50 per day.

About 2,000 bricklayers on strike on jobs covered by the Mason Builders' Association. Unions demand contract with employers for $12 per day for two years. Employers offer contract with bricklayers granting $10 per day until the end of 1926, with bonus of $2 per day for the rest of the current year.

Brick yard laborers in the Raritan River district on strike, demanding advance from $3.05@$3.70 per day to $3.50@$4.25.

General strike of painters averted. Wage scale advanced to $10 per day, from $9. Five-day week as well as other demands affecting health of operators, granted by employers.

A Consolidation of Engineering News and Engineering Record
McGraw-Hill Company, Inc.—James H. McGraw, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren, *Editor*
Frank C. Wight, *Managing Editor*

Volume 90 NEW YORK, MAY 31, 1923 Number 22

Concrete and Clay Brick

THE extensive tests on concrete and clay brick made at Columbia University and reported in abstract in this issue are a most valuable contribution to the knowledge of the behavior of material. Preliminary information regarding these tests was placed before the brick committee of the American Society for Testing Materials last June, but a specification based on the facts reported was rejected by the committee as premature. It is no secret that the concrete brick people charged that this action was dictated by the clay brick interests, which are predominant among the producers on the committee, because of the apparent better showing of the concrete product. Whether or not that is true there is no escaping the facts as set forth in the Columbia tests. The behavior of concrete and clay in brick piers is strikingly different. The concrete brick, bound together with cement mortar, act almost as a concrete monolith while the bond between clay brick and mortar sets up obvious planes of weakness. In consequence, the individual brick strength is no criterion of pier or wall strength where concrete and clay brick are being compared. The A. S. T. M. committee, in its report to the coming convention, can hardly avoid reference to this fact nor can it avoid taking one of the alternative steps of incorporating it into specifications or controverting the apparent conclusions of the Columbia tests.

Another Warning

FOLLOWING in the regular succession of flood visitations which have come to our cities in recent years, the Hot Springs flood of two weeks ago repeats the prior warnings that every community ought to consider its own flood danger and provide against it with the least possible delay. No loss of life was involved in this latest case, fortunately; but flood fatalities are somewhat a matter of chance, and their absence at Hot Spring is of no great significance. Repetition of the same flood might mean a large death-list. In any event the property and business damage was decisive in this case as in others. The losses were sufficient to warrant a very large expenditure on flood-prevention measures. Under the conditions existing at Hot Springs preventive measures are particularly urgent. A narrow gap must pass the flood flow from a basin in which precipitation can concentrate quite rapidly, and the city built in the gap is under a quite obvious threat. Nothing was needed but an abnormal downpour of rain to bring about a destructive flood under these topographical conditions. Such floods have come to Hot Springs several times in the past three or four decades, according to the report which we printed last week (p. 922), but the 1923 flood was much the most extreme. Valuable information will be added by this occurrence to the growing record of flood facts, and evidently it puts new emphasis on the need for very careful advance planning against the flood hazard. It exemplifies anew that moralizing about floods after they have happened is poor comfort and will not restore a dollar of loss. Gradually there is building up in the public the realization that extraordinary precipitation may occur at any time and, so far as is yet known, almost anywhere. Our weather observers have not yet managed to tell us what regions are especially susceptible to cloudburst rainfall and flood, and what regions (if any) are immune. From present facts the only safe conclusion is that every community has a flood hazard and that contrary to local beliefs this hazard may be very serious. A community can protect itself only through timely study of flood contingencies and flood-prevention possibilities.

Getting Acquainted

MUTUAL co-operation and understanding between the engineering school and the industries to which it furnishes human material are most necessary if both are to prosper. Such a desirable end is furthered by the conferences which were initiated at Pennsylvania State College some years ago. At the latest of these, held last week, a hundred or more representatives of the leading industries of Pennsylvania met with the engineering faculty in discussion of the problems of engineering extension work and the summer employment of students. Part of the value of such conferences lies in the interchange of views on the formal subjects presented for discussion, but an equally great part is played by the better acquaintance that is thus developed, the better appreciation of the industries' needs by the teachers and the better appreciation of the college's facilities and intentions by the prospective employers. At State College last week one outstanding hopeful note may be mentioned. The industries there represented are by no means demanding that engineers be turned out of college merely as fuel to feed the human machine of industry. Rather did they accent the long look ahead and urge that the men be trained to think and to work, having faith that men so trained can soon learn the technique of whatever line they follow. So many industrialists in similar conferences have overemphasized the selfish and narrow view that it was refreshing to find some of the leading men in a leading industrial state in opposition.

Public Works Development

IN DIRECTING attention to the relation between the onerous tax burden and public improvements, Prof. A. N. Johnson, in his remarks abstracted last week (p. 917), stimulated thinking on a troublesome and complex subject. It is a very necessary subject to think about, most so for engineers, who as a class are directly affected by progress or lag in public-works construction. Within a generation or two there has been tremendous progress in developing public services, and their costs have been piling up almost unnoticed. Suddenly we have come to a realization that the costs have mounted higher than we taxpayers are prepared to approve. But there is no possibility of reduction of present costs, except through increasing the efficiency of administration and eliminating the many extravagances and wastes that still surround municipal activities. This, naturally, must be a matter of time. On the other hand, the repressive effect of the present discontent with high taxes upon further development of public-works construction is immediate. While in some fields of work, as road paving, full activity continues, with general approval, the main fields of municipal development are handicapped. One remedial measure was indicated in Prof. Johnson's remarks: Careful planning of what public works are needed for some time ahead, and consistent adherence to the program so developed. And as he also pointed out, the engineering community has an essential part in helping forward such planning, by study of the costs and needs of public services.

Egypt, Politics and Irrigation

THAT Egypt is still the Nile and the Nile Egypt is shown by portions of the new constitution of Egypt, signed by the King on April 19. After much discussion, certain disputed clauses as to British and Egyptian sovereignty in the Sudan were replaced by others leaving the points at issue undetermined until the status of the Sudan is determined by Anglo-Egyptian negotiations. Presumably questions of Nile waters allocation between Egypt and the Sudan are directly or indirectly involved, along the lines indicated by H. T. Cory, consulting engineer, in his minority report on Nile problems, abstracted at length in *Engineering News-Record,* April 21, 1921, pp. 679 and 869. Naturally, Egypt wishes the storage and control of the Nile in the Sudan so handled as to insure it the largest possible amount of water for Egyptian irrigation. Large questions concerned with river control and utilization by the construction of huge reservoirs on the Blue and the White branches of the Nile are involved. These questions have been long in controversy. Whether Egypt under its new democratic constitution, wrung from the King by the force of public opinion, will be fairer or as fair to the Sudan as was Egypt under British rule is an interesting subject for speculation which cannot be gone into here. That the land of the Pharaohs is at last under a constitution that provides for the compulsory education of both sexes, and representative government with a chance to pass legislation over the King's veto, is nearly as marvelous as the almost numberless dynasties of old, the Nile and the centuries of irrigation in Egypt. The final outcome of the Egypt-Sudan claims to the Nile waters in the Sudan and of the associated river utilization and control problems will continue for decades to hold the interest of the hydraulic and irrigation engineer.

Camouflaging Traffic Obstructions

WAR taught us the striking lesson that to conceal any structure its lines must be broken up by dividing the surface into sharply defined sections of contrasting color. Inconsistent as this method seems, its effectiveness is beyond question. Now — in spite of the lesson so learned—a similar method of painting traffic obstructions has been adopted in an attempt to do the opposite thing—to make them conspicuous. First, railroad crossing gates were painted in alternate black and white stripes, and now the columns of New York's elevated railway which obstruct the street traffic have been similarly painted. The loss of outline is not so obvious at many railway crossings because the background is frequently quite uniform, but if anyone doubts that such painting will obscure the object so painted he should see how effectively the outlines of New York's black and white elevated railway posts are lost in the medley of colors that form their background. We call attention to this for the benefit of highway men throughout the country who have similar problems to meet. Possibly some of the men who made a study of camouflage during the war can suggest the correct method of painting such obstructions. From our own observation we would suggest a uniform coat of bright orange. It is more conspicuous at night than red and is less liable than white to match any color in the background.

A First Step in Code Enforcement

IN ITS formulation of some rules of professional conduct, noted in last week's issue of *Engineering News-Record,* the American Association of Engineers has taken a logical step forward in its scheme of codifying professional practice. There are two ways in which professional codes of ethics may be developed. One way, adopted so far by the national engineering societies, is to write down some basic principles—similar in inclusiveness and tone to the commandments handed down to Moses—and by publication in the year book of the society give notice to the members of their obligations toward their fellows. The other way, followed by the Institute of Consulting Engineers and the American Association of Engineers, is to set up some basic rules and then to interpret these rules as they apply to specific cases, with the intention of thereby developing a body of what may be called common law which in time will be so broad as to cover any possible situation that arises.

The A. A. E. has now gone further. It has taken its interpretations, forty-four in number, and has reduced their specific rulings to 45 principles, in most cases of specific application. Thus, instead of the Mosaic commandment they have the direct injunction, with much less chance of misunderstanding when direct violations are in question.

Thus far the procedure of the American Association has been admirable and in advance of its fellow societies. It has recognized the frailty of human nature in applying general rules to its own conduct and has made it less possible to hide infractions behind general clauses. Sooner or later, though, the A. A. E., as well as the other societies, will have to come to even more specific application of its rules. The sure trend is toward an enforcement of personal responsibility of a member to his society's code.

Such personal responsibility, which entails the bringing and the trying of charges, cannot be insisted upon until a detailed set of rules is accepted and understood. The fine generalities of the average code are not sufficient basis for action. Too much is involved in any attack on an engineer's professional honor to permit such an attack without the surest of foundations. For that reason as much as any other—though the overworked idea of professional courtesy also plays its part

—rarely if ever have there been any public expulsions from the major societies.

If the societies follow the idea gradually being worked out by the A. A. E. they all in time will have a body of law—an itemized list of illegal or unethical practices of such extent and in such detail that any infraction may be specified by clause and sentence. With that, not impossibly there may be developed, too, a gradual scale of punishment, starting with reproof or warning and ending with public expulsion from the society. This means some machinery not now existent but its cost and the effort involved will be worth while. Other professions find it feasible. Why will it not work in engineering?

Every engineer hears almost daily about some practice or performance of another engineer which, depending upon the animus of the speaker, ranges from loose interpretation to wilful violation of the accepted codes. It is time such backstairs gossip and the performances which bring it forth should be slowed up. Now there is nothing but a man's own conscience and his reading of the code to stop him from doing as he pleases. Those who would violate such a code are not troubled with conscience and their interpretations are apt to be selfish. The numerous cases which are continually coming up show that something more is needed. No society can stop an engineer from practicing engineering as he pleases, so long as he obeys the law of the country. But a rightly developed engineering society can in time establish definitely what is right and what is wrong in professional conduct and can then seek out those who violate such principles and deny them membership among the right-minded men of the profession. The first step toward such a desirable end is to make specific our ethical codes, now largely glittering generalities.

Sound Conservatism on Sewage Treatment

IN REFUSING to approve the plans for the direct-oxidation process of sewage treatment submitted by the City of Trenton, the New Jersey State Board of Health has put itself on record as still considering that process of sewage treatment in the experimental stage and as believing that a simpler and less costly plan would meet local conditions for "at least ten years and probably for considerably longer." In the first of these positions the board is in agreement with the opinions of engineers generally and in the second with a principle followed by some of our leading state boards of health and deserving of general adoption. The attitude of the board is so well stated in the preamble and resolutions which constitute the denial of the permit that we reprint the document elsewhere in this issue.

The board's recommendation of plain sedimentation might have been based on three grounds besides those mentioned in the resolution: (1) Sedimentation is all that the New Jersey-Pennsylvania agreement for zoning the Delaware River requires for Trenton sewage; (2) so far as reasonably possible every state health board should consider all the sanitary and public-health needs of a community before sanctioning the expenditure of money for any purpose on sanitary or public-health grounds, in order to make sure that money so spent would not yield larger and better results if devoted to some other purpose; (3) ground 2 is all the more important when a city submitting plans for sewage treatment is doing so under compulsion from the state board of health, which is true in the Trenton case to the extent of years of prodding by the board, sharpened and strengthened last year by a court order at the board's instance requiring Trenton to stop polluting the Delaware within eighteen months. This prodding and court order make the New Jersey State Board of Health a partner in placing the burden of sewage-works construction and operation on the taxpayers of Trenton. The board therefore should make sure that the burden is no heavier than local conditions demand, and rightly refuse to accept plans drawn to fulfil an idealistic conception of sewage treatment but providing, to meet that ideal, a method of disposal which the board regards as still in an experimental stage.

There are strong reasons for thinking that an investigation of Trenton's needs for various public improvements and for higher standards in some branches of its municipal service would produce returns of far more benefit to the citizens of Trenton than would result from the extra cost of sewage-works beyond sedimentation. To use only one illustration, and that in a field far more closely related to public health than sewage treatment: The latest annual survey of typhoid in the cities of the United States having a population of 100,000 or more showed Trenton with next to the highest typhoid death rate in 1922 of the cities in the list, being overtopped by Nashville only. This is a matter to which the city authorities of Trenton and the State Board of Health should give attention before plunging the city into heavy capital and operating charges for sewage treatment.

We are firmly convinced that a number of American state boards of health have made a serious error in their attempts to compel cities and towns to build sewage-works without first considering whether other sanitary works and more efficient local health department service should not come first. New Jersey, through its old State Sewerage Commission, its later State Board of Health and its present State Department of Health, has driven hard on sewage disposal, invoking the courts twice (Phillipsburg and Trenton cases) to compel cities to treat sewage, in both cases where nuisance rather than health was the only justification for action, but never, that we can recall asking the courts to compel a city to purify its water supply or take any well considered steps to cut down a high typhoid rate—like the 15.9 per 100,000 at Trenton in 1922.

Because of this misdirected past zeal—misdirected if relative sanitary and health values and the law of diminishing returns are weighed and balanced—the stand taken by the New Jersey State Board of Health in the Trenton sewage-works case is particularly gratifying. If the authorities, taxpayers and citizens of Trenton, with the aid and leadership of the local press, will perceive the significance of the denial of the Trenton sewage-works permit and act accordingly the dawn of a new municipal era in Trenton may soon appear. In any case the stand of the State Board of Health of New Jersey is commended to the attention of any board elsewhere which is acting on the principle that its jurisdiction over water and sewage treatment plans ends with judgment as to whether the plans will be sufficient instead of extending to their possible over-elaborateness and the city's needs for more vital improvements or services.

An Interview:

With HENRY W. HORST
President Henry W. Horst Co., General Contractors, Rock Island, Ill.

Business Methods in Highway Contracting

By C. S. HILL
Associate Editor Engineering News-Record

Procedure in Securing Contracts and in Conducting Construction Estimating, Planning and Cost Keeping Processes

HIGHWAY contracting is the business of producing specified road structures at a reasonable profit. It involves three broad activities: (1) Getting the contract; (2) planning and executing the work; and (3) accounting. These activities involve engineering, purchasing, maintaining and salvaging equipment, recording progress and performance, keeping and analyzing costs, developing personnel, and many subdivisions. All are essential elements of a *continuing business* which is the conception of contracting that must be held by any organization whose practice carries any useful lesson.

Organization Plan—The organization of this company is designed, as the chart, Fig. 1, shows, to carry on a general contracting business. Building construction and highway construction are the main activities and the organization plan provides that both shall be directed in about the same manner. There is a headquarters force having general direction of all projects and a field organization for each project or separate operation. Every activity not limited strictly to the locality of the job is a headquarters function. Accounting, purchasing, engineering and personnel work are specifically headquarters functions.

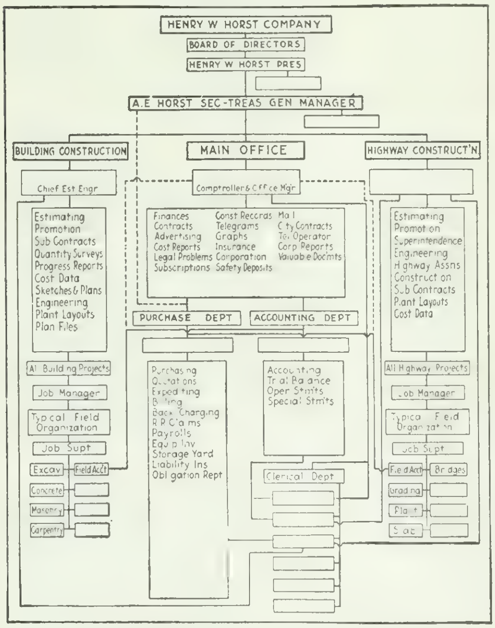


FIG. 1—ORGANIZATION CHART OF THE HENRY W. HORST CO., GENERAL CONTRACTORS

Accounting practice is a controlling operation and requires separate consideration. Purchasing involves not merely buying at the best prices and the clerical and accounting processes in connection, but getting transportation and delivery, checking quantities and quality, and storage and stockkeeping. Personnel work begins with clean and comfortable bunkhouses and good meals and extends to commissary stores, recreation buildings, and accident prevention. Fostering organization loyalty is vital and requires purpose and effort by the executives and department heads and it cannot be secured if these officials are indifferent. Engineering is the task of getting contracts and executing the work.

Headquarters planning does not mean that the field organization is without authority. Once the plans are determined and the field superintendent is on the work he is responsible and is not meddled with unless he fails in performance. His requisitions and reports keep headquarters in close touch and all its departments are at his service and, by the same token, all have an eye to the efficiency of his operations. He is the field executive under watchful and co-operative supervision by headquarters and relieved also by headquarters from all functions which are not specifically field activities.

Getting the Contract—Highways being public works, getting contracts calls for less personal promotion than when private works contracts are sought. It is important, however, to make every effort to get the record of the organization before the highway official, to impress on him the skill of its technical direction and the responsibility and integrity of its executive personnel—to sell the firm. Unless the bid is lowest, this selling effort does not land the contract but it helps to get the good will of the road official and when a contract is landed it eases all negotiations and establishes good relations from the beginning. Of course it goes without saying that the contractor by his work must bear out his professions of responsibility, skill and integrity.

Technical skill is an essential element in getting profitable contracts and as a general business proposition a contract which does not pay a profit is not worth getting. To be at all certain of a profit it has to be known what the work will cost. This requires close and intelligent estimates, and these are technical tasks and are the duty of the engineering department, drawing on the other departments, on the field superintendents and on the executive officers for help and advice.

Great detail and precision characterize the procedure of making a good estimate. The first step is a study of the plans and specifications; this cannot be a quick, perfunctory examination but must be a careful reading (a double reading is well) of every detail. Then the field of the operation requires intensive study to determine distances; sources of materials; transportation facilities; locations for unloading yards; plant sites; character of excavation; water supply; detour routes; local labor conditions, team supply and markets; living accommodations, and other conditions that may affect the cost of the operation. Until this preliminary information is in hand, the work of estimating cannot be taken up intelligently.

It is helpful to precede itemized estimating with a total cost estimate based on a general unit, as mile of road or cubic foot of building, using costs on record representative of the work under consideration. A fairly accurate figure is thus obtained which is a guide to the estimator in his detail computations which now begin.

General expenses are first. It is best to use a list of all possible general expenses and cross out the items not entering into the cost of the work being estimated. Labor and material are then taken off for each item specified and are given prices as each item is considered. In pricing each item of work, the estimator needs to visualize the particular operation in the light of past experience and of his study of the plans and specifications and his field survey. Listing the items, determining the amounts and setting unit prices are the skilled processes of estimating. All others are calculating and checking operations.

Extensions and numerical calculations from the estimator's data are best made by one person and checked by a second. Every rule for numerical precision in such operations is followed. When calculations and summations are completed they are reviewed by the estimator who scrutinizes items and totals and makes any changes or corrections his judgment advises. An estimate of cost by parts is then made and compared with the general estimate. Finally the estimate and all data in connection go to the general manager and are reviewed by him in conference with the estimator. With the bid made and the contract secured an official estimate is made out for record and cost accounting purposes.

Estimating is of first consideration in contracting. Unless prices are right contracts will not be obtained and profits cannot be earned, and, without both, business cannot continue. To set right prices, costs must be known and accurate accounting and cost keeping are necessary to a knowledge of costs. Even with the best possible records of past costs, estimating future costs involves enough hazard to make neglect of careful accounting a positive danger. With experience and good judgment, vigilance in preventing omissions and a good record of previous costs, prices can be set which, with good management, will bring a profit and no less prices should ever consciously be made.

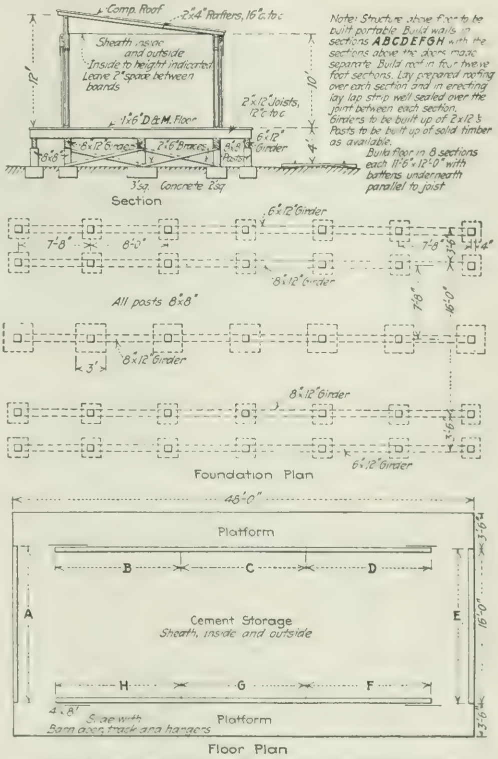

Comp. Roof
2"x4" Rafters, 16" c. to c.
Sheath inside and outside
Inside to height indicated
Leave 2" space between boards
12'
10'
4'
2"x12" Joists, 12" c. to c.
1"x6" D & M. Floor
8"x12" Girder
2"x6" Braces
8"x8" Posts
6"x12" Girder
8"x8"
3' sq. Concrete 2' sq.
Note: Structure above floor to be built portable. Build walls in sections ABCDEFGH with the sections above the doors made separate. Build roof in four twelve foot sections. Lay prepared roofing over each section and in erecting lay lap strip well sealed over the joint between each section. Girders to be built up of 2x12's. Posts to be built up of solid timber as available.
Build floor in 8 sections each 11'-6"x12'-0" with battens underneath parallel to joist
Section
7'-8"
8'-0"
3'-6"
4"
All posts 8"x8"
7'-8"
16'-0"
3'
8"x12" Girder
6"x12" Girder
Foundation Plan
46'-0"
Platform
B
C
D
A
E
Cement Storage
Sheath inside and outside
H
G
F
4'-8"
Slide with Barn door track and hangers
Platform
3'-6"
16'-0"
3'-6"
Floor Plan

FIG. 3—STANDARD DESIGN FOR CEMENT HOUSE

Planning and Execution—Good work is invariably planned work and planning is not an individual task but an organization task. With the preliminary field study notes (a second specific field study is made if necessary) and the information and plans provided by the highway department, a paper layout is made. The

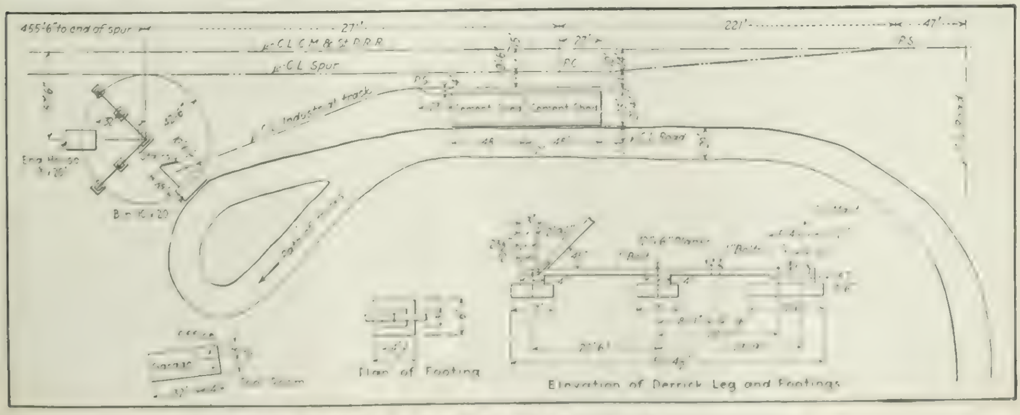


FIG. 4—EXAMPLE OF ACTUAL PLANT LAYOUT FOR ROADBUILDING

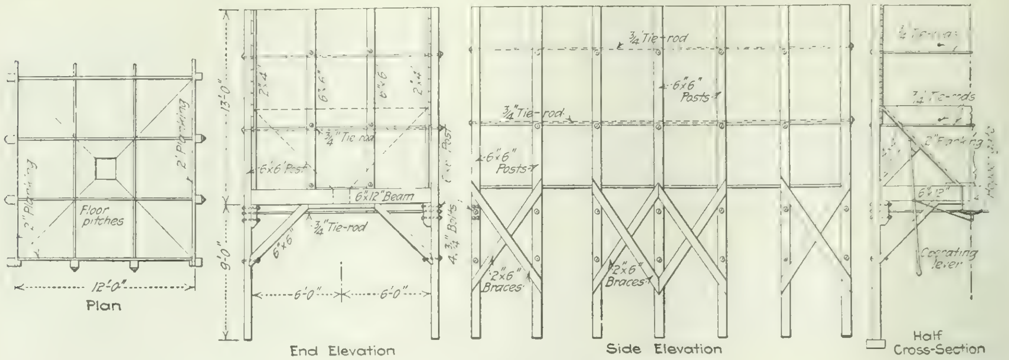


FIG. 4—STANDARD DESIGN FOR ELEVATED BINS

work is divided into sections; starting and completion dates are set; haulage routes are selected; progress schedules are determined; plant locations and shifts are decided; plant and yard layouts are planned and equipment is selected taking into account all possible contingencies of weather, transportation, labor, materials supply, etc. This planning is done by the engineers of the highway division in conference with the executive officers, other division heads and the field superintendents.

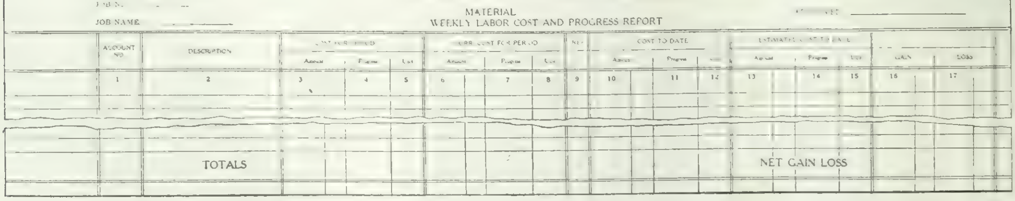
A co-ordinated plan results from this procedure. Engineering, financing, purchasing, construction and accounting are all fitted into their places. Stock and equipment on hand have consideration. The whole directing staff of the organization knows the job and each department knows the demands it has to meet. The field organization is then assembled and instructed in the plan and the parts they have to perform. In brief, work is undertaken according to a definite plan and every responsible head from the foreman up knows the plan and what he has to do to carry it out.

An actual plant layout is given by Fig. 2. It is not elaborate in detail but contains all the essential data for the field installation. So far as practicable standard plans are used for structures as the cement house, Fig. 3, and the elevated bins, Fig. 4. It should be noted, however, that there is no insistence on standard designs if the local conditions make other designs better or cheaper. The firm is not in business to develop standards. It has them and where they fit their use saves time and cost. In general this same principle actuates every other operation of construction. Definite plans, as has been said, are laid down and ordinarily they meet the situation, but if conditions develop which unfit the original plans for the work they are modified without hesitation if the gain is worth the expense. In brief it is not the intention to plan initiative and responsibility away from the field superintendent and his staff.

A typical field organization consists of a field superintendent, an accountant responsible to the general accountant, and foremen of grading, plant, concrete and bridges responsible to the superintendent. Generally there is a master mechanic, with crew, in charge of equipment maintenance and repair. The plant foreman is in charge of concrete production while the slab foreman directs concrete placing and finishing. If the job is one calling for commissary and bunkhouse service the organization is extended, but whatever its extension all division heads are responsible to the superintendent. He is the field executive.

Accounting—Definite dollars and cents information of details of operation are as essential in highway contracting as in any other business. Accounting for construction involves very particular attention to costs. In handling original records, banking, bills and vouchers, payrolls, collections, etc., the usual accounting procedure applies. The regular books of accounts used are: A combination cash book and control; contract, job work, creditors', customers' and general ledgers; and a construction record. The last book is kept in addition to the regular books of accounts to arrive at costs of labor and materials on a contract as checked against the official estimate.

Two purposes are had in recording costs. One is to secure the same distribution in the records and the



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REPORT No. ______
SHEET ______ OF ______
JOB No. ______
JOB NAME ______

HENRY W. HORST COMPANY
GENERAL CONTRACTORS
HORST BUILDING ROCK ISLAND, ILLINOIS
MATERIAL
WEEKLY LABOR COST AND PROGRESS REPORT

DATE ______ 192__
[illegible] ______ 192__
[illegible] ______

	ACCOUNT NO.	DESCRIPTION	COST FOR PERIOD			[illegible] COST FOR PERIOD			[illegible]	COST TO DATE			ESTIMATED [illegible]				
			Amount	Progress	Unit	Amount	Progress	Unit		Amount	Progress	Unit	Amount	Progress	Unit	GAIN	LOSS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		TOTALS											NET GAIN LOSS				

FIG. 5—WEEKLY COST PROGRESS REPORT

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original estimate so that comparison is possible. The other is to get cost-progress records which are closely concurrent with actual operations. From daily labor distribution is summarized a weekly cost and progress report to give the weekly profit or loss and the weekly cost to date. These reports are prepared in the field office and forwarded regularly to headquarters. Fig. 5 shows the form of the weekly cost-progress report. It is virtually a complete current cost record of the particular operation it covers.

Equipment—Attention to equipment costs is important. It is desirable to know not merely what the cost altogether of equipment is, but what each piece of major equipment costs. Minor equipment (costing less than $100 a unit) costs are lumped. A rental value and a depreciation charge are assigned to each permanent equipment unit and an account of its earnings is kept. Equipment is classified as plant for: (1) Excavation, rolling and grading, (2) unloading material, (3) hauling materials, (4) mixing and placing concrete, and (5) water supply; and accounts are kept separately for permanent and temporary units covering repairs, erection, fuel, light and power, and general expenses. Generally speaking, a financial and service history of each equipment unit is sought.

Equipment requires close supervision. It represents a large investment and the rate of depreciation is rapid. Good maintenance when working, safe storage and protection when not working, and close calculation to keep the periods of idleness few and short are absolute requirements in managing equipment. Watchfulness is aided by individual records, for no unit can be laid up long, with depreciation charges mounting and no rental coming in, without the fact being noted and steps being taken to get the machine assigned to work, or rented out or disposed of by sale or exchange. Salvage is another important operation. Lumber and other materials, small tools and supplies, and scrap metal are collected and put in shape for further use or for subsequent sale.

Construction accounts properly kept are working tools. They are used to estimate future costs in making bids, to check the efficiency of work in progress and to guide the selection and management of equipment. Analysis, comparison and combination of the original records are essential to the fullest use of cost records. The discussion of motor truck haulage by A. E. Horst in *Engineering News-Record*, April 12, 1923, p. 658, is an example of the possibilities of such analysis and combination.

As an aid in accounting and to indicate standard procedures by all departments a printed "Field and Office Manual" is provided. This contains sections on engineering, accounting, purchasing, field office, building construction, highway construction and forms for records and accounts. There are some hundreds of pages in this manual, which makes obvious the reason for not presenting details. They may be quite different to suit different organizations and varying classes of work but general principles are always true. Unless contracting is made a real business it is, in the long run, bound to be only a partial success.

(The next article in the series, to be published in an early issue, will explain approved methods of carrying on winter construction of concrete roads.—EDITOR.

Road Maintenance and Traffic Counts

By H. G. Hotchkiss, Jr.

Former Deputy Commissioner of Highways, Albany, N. Y.

A TRAFFIC census has been taken at least every other year for a number of years by the New York State Highway Commission. The counts have been made during August at representative points on various routes throughout the state to show the amount and class of traffic for 12 hours from 7 a.m. to 7 p.m. The counts show, as might be anticipated, that traffic has increased tremendously between 1909 and 1922 and that the horse traffic has decreased to less than 2 per cent; and that bus and truck traffic has increased 225 per cent in 5 years.

AVERAGE COST OF MAINTENANCE OF VARIOUS TYPES OF PAVEMENT, CLASSIFIED AS TO THE AMOUNT OF TRAFFIC

(1908 to 1922 Inclusive)

Vehicles per 12-Hour Day	Miles Maintained		Cost per Mile per Year Pavement Only	Total Cost
Gravel Waterbound Pavement				
Less than 500...	110 76		$584	$737
500 to 1,000	31 49		721	924
1,000 to 2,000....	6.62		675	872
Over 2,000....	0.60		824	983
Total....	149.47	Average..	$622	$785
Waterbound Macadam				
Less than 500....	1,111.72		$551	$658
500 to 1,000	763 26		652	843
1,000 to 2,000....	360.12		692	897
Over 2,000....	38.51		881	1,110
Total....	2,283.61	Average..	$615	$766
Bituminous Macadam Penetration Method				
Less than 500....	947.41		$303	$429
500 to 1,000....	1,050.61		355	499
1,000 to 2,000....	798.03		409	612
Over 2,000....	317.09		646	889
Total....	3,113.14	Average..	$382	$547
Bituminous Macadam Mixing Method on Macadam Base				
Less than 500....	12.87		$375	$473
500 to 1,000	5 90		513	612
1,000 to 2,000....	7.48		302	484
Over 2,000....	17.89		544	913
Total....	44.14	Average..	$449	$673
Bituminous Macadam Mixing Method on Concrete Base				
Less than 500....	7.66		$ 99	$300
500 to 1,000....	22.65		146	231
1,000 to 2,000....	30.39		146	298
Over 2,000....	29.02		229	336
Total....	89.72	Average..	$169	$293
Hassam Pavement and Second Class Concrete				
Less than 500....	47.79		$532	$759
500 to 1,000	84 71		495	675
1,000 to 2,000....	57.97		545	768
Over 2,000	21 88		[illegible]	728
Total....	212.35	Average..	$517	$724
Brick Pavement				
Less than 500....	31.35		$165	$414
500 to 1,000....	64.33		99	199
1,000 to 2,000....	62.69		109	219
Over 2,000....	87.77		279	493
Total.	246 14	Average	$174	$337
First-Class Concrete Pavement (1:2:4 Mix or Better)				
Less than 500....	114.61		$ 62	$172
500 to 1,000	158 28		54	152
1,000 to 2,000....	199 46		76	226
Over 2,000	98 28		149	402
Total	570 63	Average	$80	$230
Total of above types				
Less than 500....	2,384 17		$422	$543
500 to 1,000	2 181 23		438	[illegible]
1 000 to 2,000....	1,522 76		422	618
Over 2,000....	611 04		495	735
Total	6,699 20	Average	$433	[illegible]

In reviewing this change and development in traffic the cost of upkeep on the various types of pavement relative to the traffic has been checked. This check covers 6,699.2 miles, which were segregated as to type of pavement and grouped as to volume of traffic, and covers the five-year period, 1918 to 1922 inclusive.

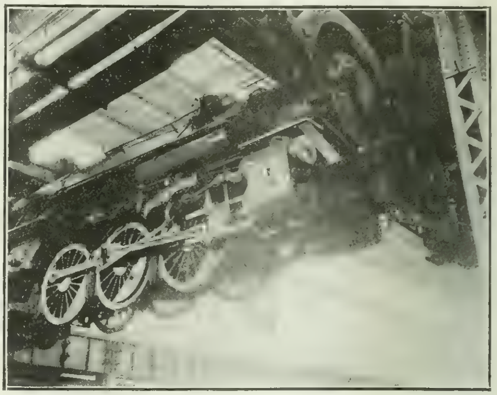
Erie Improves Its Erecting Shops at Hornell, N. Y.

Large Gap Type Locomotive Handling Crane Makes Transfer Table Unnecessary and Speeds Up the Engine Movements

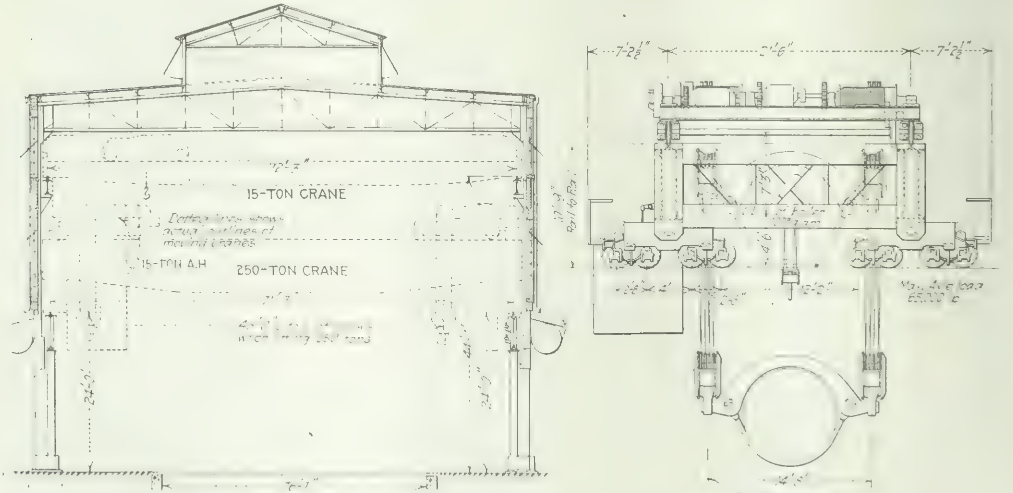
TO IMPROVE the layout and to increase the capacity of its transverse locomotive erecting shop at Hornell, N. Y., the Erie Railroad Co. has resorted to a novel arrangement of traveling cranes.

The present seven-pit erecting shop is being enlarged by a nineteen-pit extension, the ten pits in the machine shop and the transfer table that served both shops are to be done away with, and all locomotive handling facilities concentrated in the enlarged erecting shop. The present 120-ton traveling crane is to be replaced by one 250-ton, 8-motor, double-trolley, gap type locomotive handling crane which will operate over the entire length of the enlarged twenty-six pit shop. Each trolley of the gap type crane has a capacity of 125 tons and has an auxiliary hoist of 15 tons capacity. The large crane is to be supplemented by two 15-ton electric traveling cranes which, contrary to the usual practice, will operate above it.

The old shop was originally designed for a 120-ton crane operating with the rail 40 ft. above the floor level. Later the crane runways and columns were reinforced so that they would carry two 150-ton cranes. In the new shop the crane runway is designed for a 250-ton gap crane operating with the rail 24 ft. above the floor level. At this level the gap crane gives locomotives lift-over service the same as the one in the old shop with the runway 40 ft. above the floor. In both the new and the old shops the column spacing is 21 ft. It is planned to change the runways and columns in the section of the old shops so that the 250-ton gap crane will be used in both new and old buildings. Very careful analysis of the columns and runways in the old building showed that the columns could be cut to place the craneway at the 24 ft. level without reinforcing the section in any way, and that the crane girder as originally designed and later reinforced for a 150-ton crane, was sufficient for the 250-ton crane load. This was due to the fact that the wheelbase on the 250-ton crane was 10 ft. greater than on the 150-ton crane. The requirements of the shorter column were such as to make them ample for the 250-ton crane load.


LOCOMOTIVE RAISED FOR TRANSVERSE MOVEMENT
The relative position of the two crane runways is shown on the columns in the background.

The advantages of this new layout, other than the increase in the area of the machine shop and the elimination of the transfer table, are twofold. In the first place the use of a gap type locomotive handling crane results in a considerable economy in the structural steel

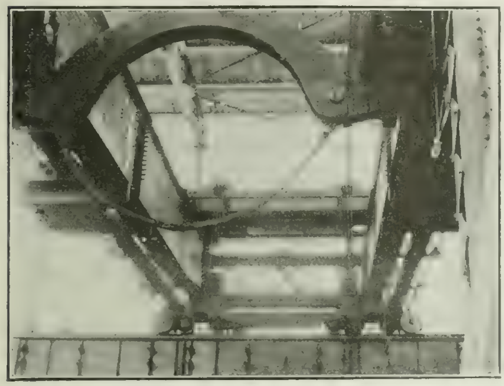


Engine ... Cross-Section

End Elevation of 250-Ton Crane

CROSS-SECTION OF THE NEW ERECTING SHOP

required for the columns supporting the crane runway due to the reduction in the necessary height of such a runway as compared with the height of runway for a suspended type crane. Also, as the new crane will be able to lift the heaviest engines in the Erie service, drop pits will no longer be necessary. In the second place the advantages from an operating viewpoint are that with the small cranes operating above the large crane, materials can be moved from end to end of the shop without interfering with the operation of the large crane. The use of the traveling crane in place of the transfer table for all engine movements will reduce the time required for this operation from 38½ min. to 4½ min.



GENERAL VIEW OF THE GAP TYPE CRANE
Showing in the foreground the boiler sling of the forward trolley, and in the background the two main hoists of the rear trolley and the 15-ton auxiliary hoist.

The work is being done under the direction of C. H. Splitstone, superintendent of construction and surveys, Erie R.R. Co., New York City.

Mechanical Agitation for Sewage Activation Plant at Wakefield, England

Plans for an activated-sludge plant making use of paddles instead of compressed air for agitating the sewage of Wakefield, England, have been approved by the Ministry of Health, and construction has been started. The town has been authorized to borrow £15,000 for extending and remodeling its Agbrigg plant, at which the activated-sludge process will be installed. The plans have been adopted on the recommendation of John Haworth, general manager of the sewage-works of Sheffield. Mr. Haworth terms this a "bio-aeration" method of sewage treatment. According to the London *Surveyor*, "two screening and heavy gritting chambers" will be placed at the end of the outfall sewer. Each of the chambers will be "provided with a power-driven screen and mechanical grit elevator, and four preliminary settling tanks, storm overflow weir, one aeration tank (in two compartments), sixteen paddle wheels, main driving shaft and paddle power house containing worm reduction gears and motors." At the end of the aeration tank there will be installed "four vertical-spindle electrically-driven centrifugal pumps" for lifting "the sewage and activated-sludge" to four Dortmund settling tanks. The activated sludge will be delivered to eight sludge drying beds.

Engineers Engaged in Highway Work

FROM a recent questionnaire sent to all state highway departments by the employment department of the American Association of Engineers, it was learned that (excluding Pennsylvania) 7,046 engineers are on the various staffs. North Carolina has 800, New York 700, Illinois 534, Missouri 500, California 424, Iowa, 250, West Virginia 242, Oregon 240, Virginia 200, Kentucky 200, Wisconsin 180 and Michigan 175. More than 2,000 additional engineers are needed for this season's program which will total $352,000,000, not including Michigan, Pennsylvania and South Carolina, whose programs for highway work had not yet been completely formulated.

ENGINEERS ON STATE HIGHWAY WORK, AND MONEY INVOLVED IN 1923 EXPENDITURES

States	Engineers on Highway Staff	Approximate Expenditure for Road Work
Alabama	102	$3,500,000
Arizona	60	6,000,000
Arkansas	15	10,000,000
California	424	12,000,000
Colorado	60	5,000,000
Connecticut	25	1,000,000
Delaware	66	2,500,000
Florida	65	3,500,000
Georgia	77	3,500,000
Idaho	31	2,000,000
Illinois	534	30,000,000
Indiana	117	7,500,000
Iowa	250	10,000,000
Kansas	40	3,000,000
Kentucky	200	6,000,000
Louisiana	76	7,000,000
Maine	31	2,190,000
Maryland	115	3,450,000
Mass	240	9,000,000
Michigan	175	App pending
Minnesota	105	10,000,000
Mississippi	58	4,000,000
Missouri	500	2,500,000
Montana	47	2,100,000
Nebraska	60	2,000,000
Nevada	85	2,500,000
New Hampshire	37	2,500,000
New Jersey	136	16,000,000
New Mexico	100	3,500,000
New York	700	35,000,000
North Carolina	800	15,000,000
North Dakota	40	2,000,000
Ohio	50	20,000,000
Oklahoma	60	8,000,000
Oregon	240	10,000,000
Pennsylvania		
Rhode Island	44	2,500,000
South Carolina	135	
South Dakota	80	4,000,000
Tennessee	54	7,300,000
Texas	33	26,000,000
Utah	55	2,000,000
Vermont	32	2,000,000
Virginia	200	8,000,000
Washington	100	4,500,000
West Virginia	242	12,000,000
Wisconsin	180	20,000,000
Wyoming	70	2,500,000
Total	7,046	$352,040,000

The average turnover of personnel for a year is 44 per cent with a maximum of 140 per cent in California and minimum of 3 per cent in New Hampshire. Wisconsin had 130 per cent, Washington 105 per cent, Rhode Island 102 per cent, Pennsylvania, Oregon and Iowa 100 per cent each. In several states wholesale discharge of nearly the whole staff of the department has taken place for political reasons. In Arizona, for instance, after a change in administration, 90 per cent of the 1,200 men were either ousted or quit. Idaho has had a similar experience. In five states applicants must be residents while in ten the state prefers its own citizens.

The remainder (with the exception of Pennsylvania which did not reply to this question) indicate no discrimination against non-residents.

Cantilever Highway Bridge Across the Ohio at Ironton

Main Span of New Toll Bridge Is 725 Ft. and Anchor Arms 350 Ft. Each—Was Locally Financed—Rapid Progress Made in Construction—Hydraulic Jacks Assist Erection

By J. F. Jackson
Consulting Engineer, Milwaukee, Wis.

Unusual conditions of promotion and financing were necessary preliminaries to the construction of the new Ohio River cantilever bridge between Ironton, Ohio, and Russell, Ky., which was opened in April, 1922, and a view of which is shown in Fig. 1. The city of Ironton has a population of 14,000. Russell is very much smaller, but is an important division point on the Chesapeake & Ohio Ry., and many railway employees live in Ironton. Ferry traffic has been heavy for several years and there was need of a highway bridge to afford adequate transportation facilities. How to get the project financed was a problem in human engineering, a problem of a kind which is too seldom mentioned in articles on engineering work. Briefly, public interest was awakened, plans and estimates were secured, a local company with 2,600 stockholders was organized, passage of a bill by Congress was secured, a permit from the War Department was obtained, and a contract was let, all in nine months.

In September, 1920, when the Chamber of Commerce at Ironton decided to investigate the bridge problem, E. B. Adams, the secretary, wrote to twenty-three bridge companies and engineering firms explaining the situation and stating that local interests could finance a project of about $700,000. As an outcome of the negotiations, after eliminating unsatisfactory replies and negotiating with two or three prominent bridge companies, the bridge committee of the Chamber of Commerce finally authorized the Wisconsin Bridge & Iron Co., Milwaukee, Wis., to determine the best location and to prepare plans, specifications and estimates. At this point the writer was engaged by the company for consultation on the work. It must be remembered that before organizing a company or obtaining a charter the bridge committee wanted to know if the project was feasible and what would be the cost. Speedy work was necessary so that foundation work could be begun and completed during the approaching low-water season.

Upon the completion of general plans and estimates the cost was found to be higher than the amount the bridge committee thought could be raised. This matter was adjusted by changing several hundred feet of the more or less temporary approaches to timber construction and by minor changes in hand-railing. The Ohio approach viaduct extends to the anchor pier, but at the Kentucky end there is a 200-ft. through-truss span between the anchor pier and viaduct approach.

An estimate having been made, the bridge committee initiated a campaign to sell stock in a company to be organized to build a bridge on definite plans and for a definite sum of money subject, of course, to various contingencies. Through organizing ability and public spirit $778,000 were subscribed by 2,600 stockholders in about three weeks. The Ironton & Russell Bridge Co. was then organized, with E. J. Merrill as president and E. B. Adams as secretary. There remained an almost endless amount of red tape to be untangled before a contract could be entered into, but in the meantime the Wisconsin Bridge & Iron Co. was authorized to make the necessary surveys, maps and plans required by the U. S. Government and to do other engineering work in connection with the project. The authorization to construct the bridge was signed by the Secretary of War on June 29, 1921. A contract having been entered into with the Wisconsin Bridge & Iron Co., work on the bridge was started without delay.

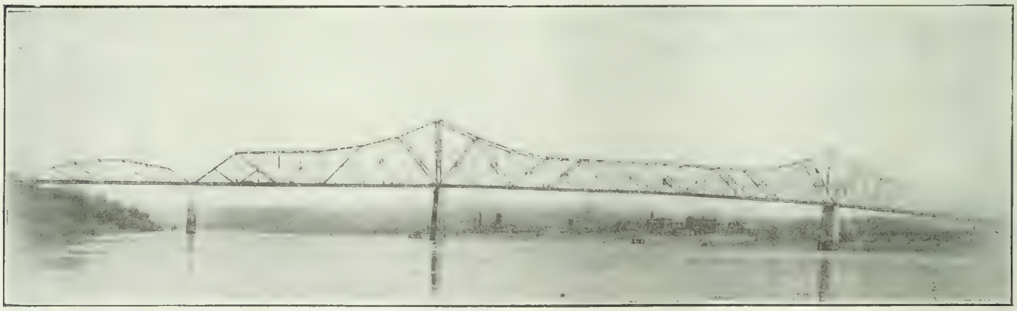


FIG. 1—HIGHWAY BRIDGE OVER OHIO RIVER AT IRONTON, OHIO; 725-FT. CANTILEVER SPAN

Piers—The first step was the construction of the four river piers, the contract for which was let to the Dravo Construction Co., Pittsburgh, Pa., on July 25, 1921. There were some interruptions by sudden rises of the river, but the work was finished Oct. 26, 1921, just ahead of high water. Fig. 2 shows one of the main river piers, each of which contains about 2,500 cu.yd. of concrete. The use of two shafts connected by a reinforced web for the upper part of piers was a means of saving concrete, or rather placing the bulk of concrete where it would do the most good, as compared with the more usual rectangular plan of piers. The exact depth to solid sandstone was not known and could not be determined by the time estimates were demanded, but our assumed depths of 8 to 9 ft. below low-water proved to be fairly correct.

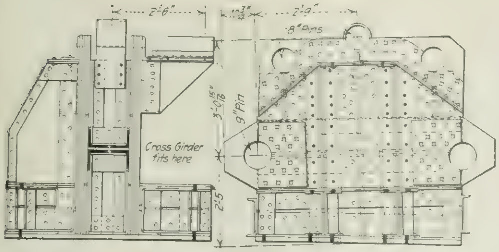


FIG. 3—BEARING SHOE WITH FIVE PIN CONNECTIONS

General Location and Layout—The Ohio River at this point is about 1,000 ft. wide at low water, with banks about 1,600 ft. apart at 50 to 55 ft. above low water. A clearance of 40 ft. above high water was required over the navigation channel. The stage of water is subject to great and sudden variation, and the floods of 1885 and 1913 rose 65 ft. above low water. A location crossing the river nearly at right angles was adopted, with grades of 4 per cent on the approaches and shore spans. Determination of the general character of the structure was the next step, giving span lengths and pier locations which would be approved by the government engineers and by river transportation companies. Other bridges on the river have spans of 500 to 775 ft. and the new dams have navigation passes 700 ft. in width.

For preliminary studies, contour maps of the river bottom were made and floats were sent downstream, their direction and speed being shown on the maps. The low-water navigation channel lies near to the north shore and this determined the location of the north pier within close limits. Since there is a fairly straight river channel from two miles above to half a mile below the bridge site, it was believed that we could get approval of a center span 700 ft. in the clear or 725 ft. c. to c. of piers. Further study showed that a good looking and economical layout could be obtained by a symmetrical cantilever of 1,425 ft. total length, with 4 per cent grades on the anchor arms and the adjacent 200-ft. shore spans (see *Engineering News-Record,* Oct. 13, 1921, p. 613).

Live-Loads for Design—Determination of live-load and design of the floor system was the next step, and it was considered advisable to provide for possible future electric railway traffic. Railway bridges are often kept in service long after their design loads are exceeded. A short highway span may sometimes have to carry the live-load for which it was designed. In fact since the advent of heavy trucks and road rollers, the suspenders, floorbeams and especially the floor stringers of old highway spans are apt to be exceedingly light and shaky. The use of short panels and light stringers, which are a source of vibration and injury to the floor itself, whether it be of wood or concrete, is a serious fault still committed in many recent structures, short and long. In the Ironton bridge the panels are 29 ft. 2 in. on the anchor span and cantilever arms, and 31 ft. 3 in. on the suspended span. This long panel design with deep stringers has resulted in a very rigid floor system of great local load capacity and a truss of more than adequate strength and absolutely without any skinny or shaky members.

The bridge was proportioned for the following loads, the live-load being assumed to move across the bridge in either direction for position of maximum stress in each member:

1. Full dead-load including all steelwork and wood floor-figuring lumber at 4½ lb. per foot board measure.

2. Live-loads for floor members and primary truss members based on a maximum combination of the following loads over a space the full width of the roadway and sidewalk for a length of 90 ft.: (A) A concentrated load of two 45-ton street cars on the 10-ft. space next to sidewalk; (B) a load of 30 tons uniformly distributed over the remaining 16 ft. of roadway and sidewalk to cover trucks, automobiles, wagons and foot passengers; (C) an 18-ton road roller placed anywhere on the roadway.

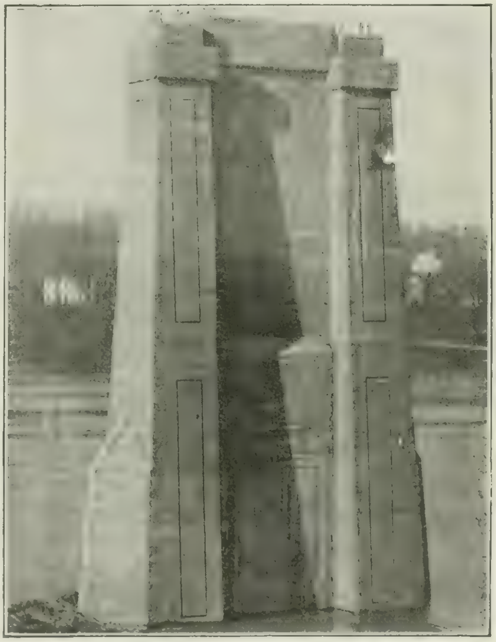


FIG. 2—DUMBBELL PIER OF OHIO RIVER BRIDGE
In the upper part the web is 36 in. thick and the shafts are about 8½ ft. square.

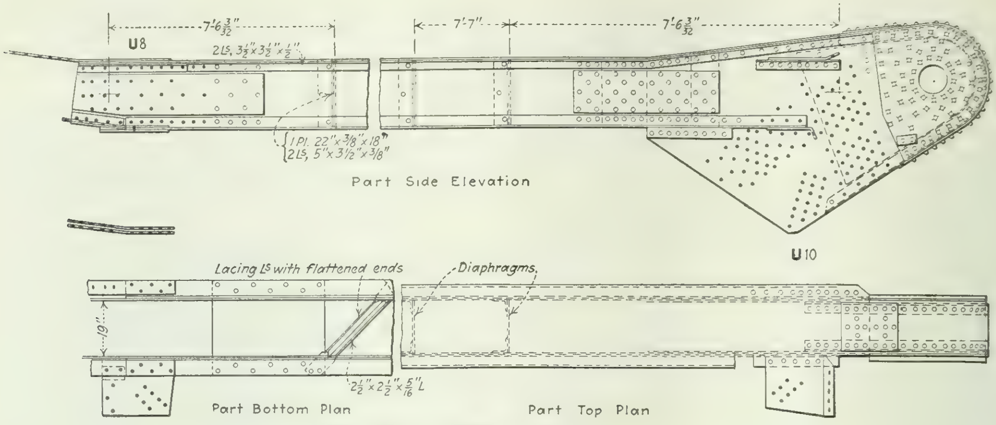
3. Live-load for main web members same as above, preceded or followed by a uniform load of 800 lb. per lineal foot.

4. Live-load for main chords; 1,400 lb. per lineal foot.

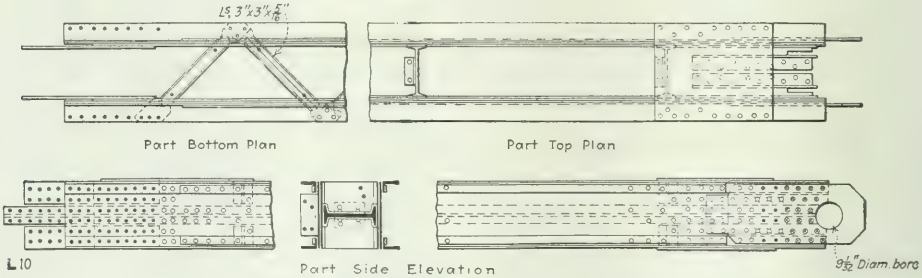
5. Wind forces were taken at 500 lb. per lineal foot moving, 350 lb. on bottom laterals and 150 lb. on top laterals.

Design of Bridge—The cantilever trusses are spaced 29 ft. c. to c., giving room inside for a 20-ft. roadway and a 6-ft. walk. Anchor spans are 350 ft. each, cantilever arms 175 ft. each, and the suspended span 375 ft., making a total length of 1,425 ft. The truss depth is 100 ft. at the towers, 50 ft. in the suspended span and 45 ft. at the shore ends of the anchor arms. The total weight of steel in trusses and floor system is about 2,100 tons.

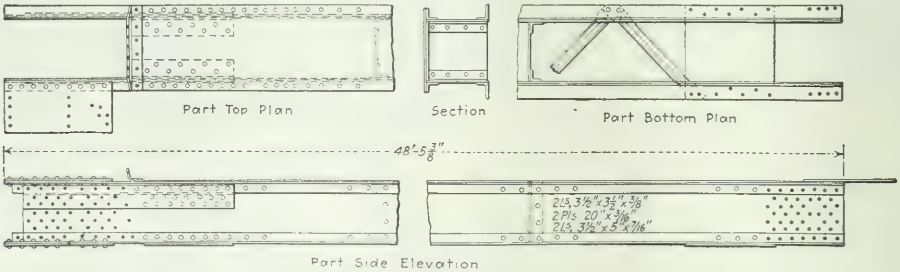
Some novel ideas and important matters of detail embodied in this bridge should be mentioned. In order to reduce the amount of field riveting, to facilitate erection and to avoid secondary stresses, the vertical post, bottom chords and inclined end posts are connected to



TOP CHORD MEMBER U8-U10



BOTTOM CHORD MEMBER L10-L12



TYPICAL DIAGONAL MEMBER

FIG. 4 TYPICAL TRUSS MEMBERS OF ANCHOR ARMS

the main bearing shoes by five pins, as shown in Fig. 3. Pins are also used at top of vertical posts and at top of inclined end posts for the same reasons. The rest of the structure is riveted. Typical truss members are shown in Fig. 4.

Particular attention is called to the numerous diaphragms in heavy compression members. In the chords and end posts these diaphragms are spaced about 7 ft. 3 in. on centers, and are used in H-sections as well as in ordinary box sections. Some use of diaphragms was also made in long tension members made of two 12-in. or 15-in. channels. Note may be made of the use of 3 x 3 x $\frac{5}{16}$-in. single-intersection angle lacing on heavy members. The ends of the angles are flattened out and connected with three rivets, as shown. A more effective use of material for column lacing would be hard to find. Some smaller flattened angles having only two rivets at each end were also used. These lacing angles were also connected to batten plates at ends of truss members. Where cover plates formed part of the section on compression members these cover plates were tied in to the plates forming the riveted joint by means of angles, so that the cover plates could be counted on to carry their share of the load.

Long truss members of unusual stiffness resulted from the consistent application of the principles outlined above. There was no need to handle them "tenderly" in shop or field. This fact inspired confidence and pride on the part of shop and field workmen and speaks for itself in the completed structure. Some excess of metal was used at various points, such as cover plates on end posts and top chords of anchor arms, pri-

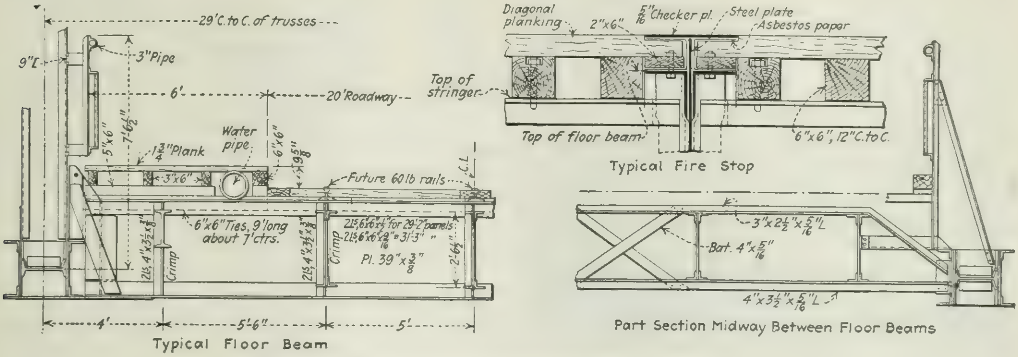


FIG. 5—FLOOR FRAMING AND TIMBER DECK

marily for the sake of appearance, but on the whole the metal is placed where it will do the most good, keeping in mind great load-carrying capacity, stiffness, ease of maintenance, and long life of the bridge.

Floor—In the floor construction, shown in Fig. 5, the 10 x 3-in. oak plank were sized, shiplapped ½ in. and laid diagonally on 6 x 6-in. yellow pine cross-ties spaced 6 in. apart. These ties were painted with creosote and the tops covered with strips of tar felt. This construction provides for future installation of an interurban track and makes a floor of great strength. It will dry out readily after rains and so prevent rot. The sidewalk floor is of 2-in. pine.

Cross-ties are supported on the four deep stringers and one 15-in. I-beam under the walk, as shown. The five stringers are tied together at their centers and to the bottom chords by a cross strut. The long bottom laterals are also connected to the bottom flanges of stringers. No vibration can get a start in construction such as this, which is designed to carry heavy street cars and road rollers. Fire stops of steel extending entirely through the floor are spaced 175 ft. apart.

Erection—Some special points may be noted in connection with the erection of the steelwork. Materials were delivered by rail on each side of the river, as required. It will be seen from Fig. 7 that the anchor arms, 350 ft. long, were each supported by three heavy steel bents on small concrete piers. These falsework bents, as well as the truss members, were raised by means of stiffleg derricks of 12 tons capacity with booms 95 ft. long. Booms were provided with a 20-ft. extension of about 3 tons capacity. These derricks traveled inside the trusses and were fastened to each successive floor beam as the work progressed. The boom could be turned backward between stifflegs in order to put in top lateral bracing.

After the completion of the anchor arms and cantilever arms, each half of the 375-ft. suspended span was built out in the usual way from the suspension points to a junction at the center. The projection over the main piers was 362½ ft. The work was done in March and some rather high winds were experienced, but the cantilever was so stiff and steady that no anxiety was felt by the erection men. For the first time in cantilever erection hydraulic jacks instead of wedges were used to control the position of bottom chords at suspension points, as shown in Fig. 6. Each jack was of 500 tons capacity. Each forward movement of the jack was followed up by shins. These jacks worked like a charm and were not expensive. The toggle joints in the top chord were operated by 125-ton hydraulic jacks arranged to produce a pull downward.

To further facilitate the connection of bottom chords at the center of the suspended span, links formed of pin plates about 6 ft. long and having slotted holes with the slot 2½ in. longer than the diameter of the pins were used. The pins and links were of sufficient size to take the dead load. After the suspended span was swung the pin plates were reamed and riveted to take up the live-load tension.

The bridge was built in 274 days counting from the time ground was broken for piers until the bridge was opened for traffic, April 23, 1922. Great credit is due the organization of the Wisconsin Bridge & Iron Co. for the high-grade work of its engineering, shop and erection departments. The Dravo Construction Co. did

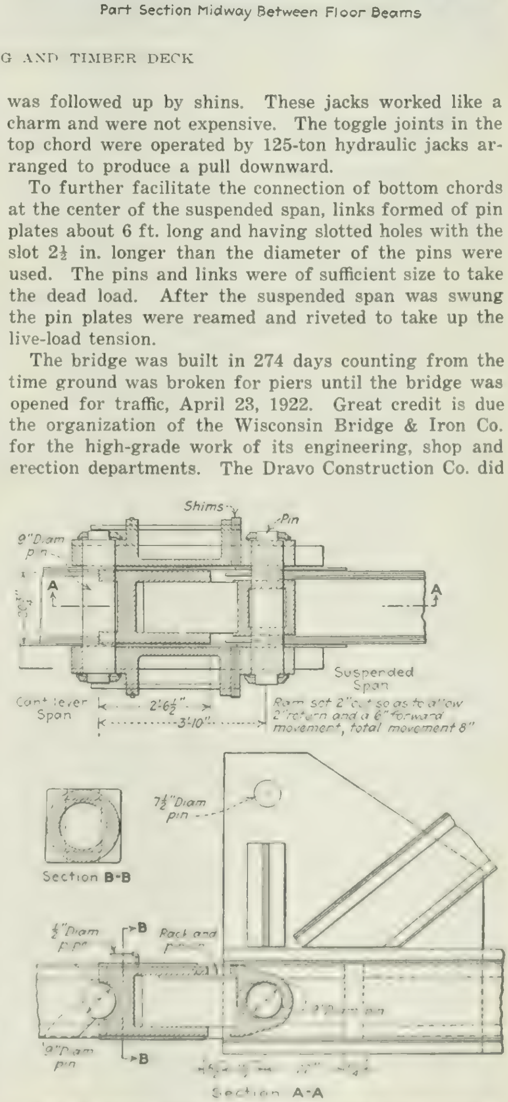


FIG. 6—HYDRAULIC JACK FOR CHORD CONNECTION

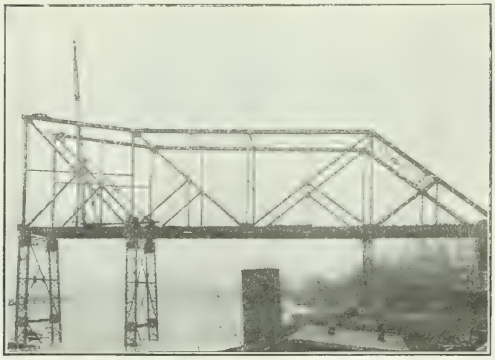


FIG. 7—ERECTING ANCHOR ARM ON STEEL FALSEWORK

rapid and splendid work on the substructure, as noted above. The engineers chiefly responsible for the design of general plans and details of this cantilever believe that it shows some rational advance in the art of assembling materials into a large-span highway bridge to meet all possible or probable needs of the future as far as they may be foreseen.

Chicago Adopts Zoning Ordinance for Entire City

Four Classes of Use and Five of Volume Districts—Control by Building Commissioner and Board of Appeals

A ZONING commission for the city of Chicago was appointed by the mayor in July, 1921, in accordance with a law passed by the Illinois legislature in June of that year. After numerous public hearings and conferences with civic and other organizations the commission drafted an ordinance which, with some amendments, was adopted by unanimous vote of the city council on April 5, 1923. This commission of twenty-two members is composed of municipal officials, business men, engineers and architects; its chairman is Charles Bostrom, city building commissioner; secretary, Charles H. Wacker, president of the Chicago Plan Commission; chief of staff, H. T. Frost; consultants in zoning, Edward H. Bennett and Wm. E. Parsons. This ordinance is now in force.

Use Districts—For the purpose of regulating the location of trades and industries and buildings for specified purposes, the entire city is divided into four classes of use districts. Existing uses which do not conform to the class of district in which they are located are permitted to remain but restrictions are imposed as to future changes or expansion. The classes are:

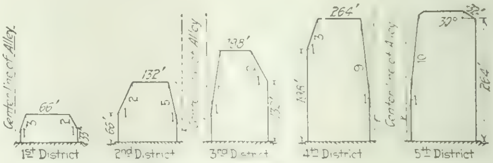
1. Residence districts, in which private residences, churches, schools and parks are permitted, but no business, commercial or manufacturing establishments are allowed.

2. Apartment districts, for the same use and restrictions as No. 1 but permitting also apartment houses, hotels (without store fronts), public libraries, hospitals, private clubs and similar buildings.

3. Commercial districts, which have the same use and restrictions as Nos. 1 and 2, but other regulations are: (a) retail business places, garages, offices, storage buildings, banks, theaters and similar activities may be located anywhere in the district; (b) light and unobjectionable manufacturing plants located within 125 ft. of a residence or apartment district may be prevented from operating at night; (c) such activities as dyeing and cleaning establishments, large food products manufactures, coal yards, ice plants, milk distributing stations and large stables must not be located within 125 ft. of a residence or apartment district.

4. Manufacturing districts, which are regulated as follows: (a) unobjectionable activities, even if on a large scale, are permitted in any part of such a district; (b) those which create dust, gas, smoke, noise, fumes, or odors must be at least 400 ft. from a residence or apartment district; (c) nuisance types of activities such as fertilizer, glue, cement and starch manufacturing, petroleum refining and tanning must be at least 2,000 ft. distant from a residence or apartment district.

Volume Districts — For regulating the heights of buildings and the percentage of lot area that may be occupied by a building, five classes of volume districts have been adopted, with restrictions as shown in the accompanying table. These districts are classified as follows: (1) areas devoted to private residences, two-flat buildings and similar uses where existing buildings have ample yard space and do not cover a large proportion of the yard area; (2) where the tendency is towards three-story apartment buildings; (3) where the tendency is toward tall apartment buildings and apartment hotels; also business and manufacturing sections outside of the central district; (4) warehouse and office buildings in sections close to the central district; (5) downtown district.



NEW BUILDING HEIGHT LIMITS FOR CITY OF CHICAGO

Diagrams for the five volume districts. Dotted lines indicate the alley building line for 55 ft. nearest to street intersection.

Height of Buildings—The limits of height for different classes of buildings are shown by the table and graphically in the accompanying diagram. Buildings are required to set back from the street lines and alley lines above certain heights, so as to provide for adequate light in the streets and for adequate light and air along the rear and sides of high buildings. Church spires are not included in these regulations, nor does the ordinance prevent the erection of grain elevators, gas holders or similar structures in excess of the prescribed limits of height and volume. When a building in a volume district No. 2, 3, or 4 fronts on a park or other open space or upon a street more than 120 ft. wide, the height of street front may be increased 33⅓ per cent of the height specified for such building in the ordinance.

Tests Show Differences Between Clay and Concrete Brick

Concrete Brick Piers Prove Stronger in Proportion to Individual Brick Strength Than Clay Brick Piers

EXTENDED tests into the comparative value of clay, sand-lime and concrete brick masonry have been made by the testing laboratories of the Department of Civil Engineering of Columbia University, under the direction of Prof. Albin H. Beyer and William J. Krefeld of that department. The tests are published in Bulletin No. 2 of the Department of Civil Engineering, Columbia University. According to that report the investigation indicates (1) the ratio between the compressive strength of masonry and the compressive strength of brick varies with the kind of brick even when the compressive and transverse strengths of the brick are the same and all other variables are maintained constant; (2) the ratio between the elastic limit and the ultimate strength of masonry varies with the kind of brick in otherwise similar masonry; (3) the loss of strength with heights of pier is not the same in masonry composed of different kinds of brick.

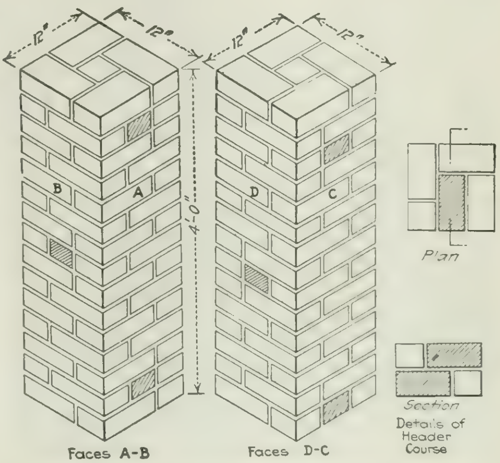


FIG. 1—DETAILS OF 40-IN. PIERS SHOWING BOND

Tests were made on three kinds of common building brick, clay, sand-lime and concrete, and the selection of the material and the tests were both made with the cooperation of the Bureau of Buildings of the City of New York. In all, 135 masonry piers were tested, all 12 in. square. Of these 115 were 40 in. high, 20 were 84 in. high. In building the piers an effort was made to secure uniformity in bonding, quality of mortar, thickness of mortar joints and workmanship. All piers were built by experienced bricklayers, using a 1:3 portland cement mortar with no lime addition. The piers varied in age from 28 to 92 days.

The brick comprised down-draft, repressed common clay; up-draft repressed common clay; Hudson River soft mud clay, sand-lime brick approved by the Bureau of buildings of New York City; concrete brick made by Peerless brick machines, fed by a continuous concrete mixer and stored for two days in curing tunnel, 1:5 mix; concrete brick, same type made with 1:4 mix; concrete brick of special wet mix with 1:7 mix; concrete brick of special wet mix with 1:5 mix; concrete brick 1 cement, 2½ cinders and 5 parts sand; and finally a series of eleven different experimental mixtures of concrete brick with variable content. The physical properties of the individual brick are shown in Table I.

TABLE IA—PHYSICAL PROPERTIES OF CONCRETE BRICK USED IN PIER TESTS.

		At 30-Day Pier Age		At 90-Day Pier Age		Percentage of Absorption in			
Series	Composition of Brick Expressed in Parts of Cement, by Volume	Compressive Strength, Lbs./sq.in.	Modulus of Rupture, Lb./sq.in.	Compressive Strength, Lb./sq.in.	Modulus of Rupture, Lb. sq.in.	30 min.	4 hr	48 hrs.	Remarks
A-VI	5 of sand passing ¼-in screen	1,383	300	1,388	366	6.60	9.14	9.86	Cured two days in damp chamber, then stored in air.
A-VII	4 of sand passing ¼-in screen	2,678	486	2,610	467	10.12	11.50	11.83	
A-VIII	7 of sand	1,923	524	1,892	512	4.12	8.30	9.81	Cured four days in damp chamber, then stored in open air.
A-IX	5 of sand	2,545	630	2,529	547	3.54	8.18	9.61	
A-X	5 of sand, 2½ of cinders	2,462	492	2,508	522	3.10	8.19	11.20	
C-II	6 of sand	1,853	437	..	.	5.01	10.47	10.81	Cured four days in damp chamber, then stored in open air
C-III	4 of sand	3,446	638	.		3.35	7.61	9.26	
B-III	Miscellaneous	4,704	824	.				8.79	
B-IV	Mixtures not recorded at request of manufacturer	4,086	751					9.60	
B-V		2,544	538	.	..			10.88	..
B-VI		3,598	709	.				8.65	.
B-VII		2,329	530	.				10.83	
B-VIII		1,827	377	.				11.78	
B-IX		2,737	553	.				9.21	
B-X		2,056	471	..				10.27	
B-XI		1,500	325	..				12.29	
B-XII		3,176	621	.				9.02	
B-XIII		1,150	274	.				12.71	

Note All valves are the average of five to ten individual tests

TABLE IB—PHYSICAL PROPERTIES OF CLAY AND SAND-LIME BRICK USED IN PIER TESTS

		At 30 Day Pier Age		Percentage of Absorption in		
Series	Kind of Brick	Compressive Strength, Lb./Sq.In.	Modulus of Rupture, Lb. Sq In.	30 min	4 hrs.	48 hrs
A-I	Clay	3,245	898	6.71	12.58	13.29
A-II	Clay	4,460	1,578	1.21	3.26	5.29
A-III	Clay	3,450	730	12.80	16.97	17.36
A-IV	Clay	5,010	654	10.68	12.48	13.38
B-I	Clay	3,577	504			18.41
B-II	Clay	5,592	706	.....		16.52
C-I	Clay	2,819	746	15.56	15.98	15.98
A-V	Sand lime	4,474	750	5.41	11.29	13.79

Note All values are the average of ten individual tests

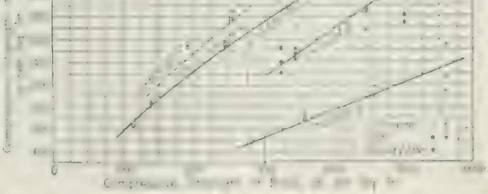


FIG. 2—COMPRESSIVE STRENGTH OF PIER AND OF BRICK FOR 40-IN. HEIGHT AND 30-DAY AGE

TABLE II—COMPRESSIVE STRENGTH OF CLAY AND SAND-LIME BRICK IN 12 x 12-IN. PIERS

			Pier		Bricks			Ratio			
Series	Kind of Brick	Height	Average Compressive Strength, Lb./Sq.In. (1)	Average Compressive Strength of Mortar, Lb./Sq.In. (2)	Average Compressive Strength, Lb./Sq.In. (3)	Average Transverse Strength, Lb. Sq.In. (4)	Absorption in 48 hrs. (5)	(a) (1) ÷ (2) (6)	(b) (1) ÷ (3) (7)	(c) (1) ÷ (4) (8)	Age of Pi
A-I	Clay	40-in	1,409 1,538	1,915 2,520	3,245 3.245	898 898	13.3 13.3	0.736 0.610	0.434 0.474	1.57 1.71	30 90
A-II	Clay	40-in	2,187 2,473	2,292 3,473	4,460 4,460	1,578 1,578	5.3 5.3	0.954 0.712	0 490 0.554	1.39 1.57	29 90
A-III	Clay	40-in	1,475 1,690	2,487 2,449	3,450 3,450	730 730	17.4 17.4	0.593 0.690	0.428 0.490	2.02 2.32	29 91
A-IV	Clay	40-in	1,841 2,136	2,089 2,459	5,010 5,010	654 654	13.4 13.4	0.881 0.869	0.367 0.426	2.81 3.27	29 90
B-I	Clay	40-in.	966	1,879	3,577	504	18.4	0 514	0.270	1.92	26
B-II	Clay	40-in	1,307	1,819	5,592	706	16.5	0.719	0.234	1.85	30
C-I	Clay	40-in	628	2,119	2,819	746	16.0	0.296	0.223	0.84	31
A-V	Sand-lime	40-in	1,794 2,034	2,441 2 412	4,474 4,474	750 750	13.8 13.8	0.735 0.842	0.401 0.454	2.39 2.71	29 92
B-III	Mixture of Clay B-I and B-II	40-in.	1,165	1,368	4,584	605	. .	0.852	0.254	1.93	30
A-I	Clay	84-in	1,255 1,421	2,698 2,998	3,245 3 245	898 898	13 3 13 3	0 465 0.474	0 387 0 438	1 40 1.58	31 90
A-II	Clay	84-in	1,750 1,908	2,610 3,160	4,460 4,460	1,578 1,578	5.3 5 3	0 670 0.604	0.392 0.428	1.11 1.21	28 91
A-III	Clay	84-in.	1,386 1,520	2,942 2,786	3,450 3,450	730 730	17 4 17 4	0.471 0.545	0 402 0 441	1.90 2.08	28 92
A-IV	Clay	84-in.	1,597 1,984	2,007 1,643*	5,010 5,010	654 654	13 4 13.4	0 796 1 207‡	0.319 0 396	2.44 3.03	29 96
A-V	Sand-lime	84-in	1,810 2,157	3,137 2,298	4,474 4,474	746 746	13 8 13.8	0 577 0.939	0.405 0.482	2.43 2.89	28 92

* Defective Specimens.

The bricks were laid in the bond shown in Fig. 1 with a 1:3 portland-cement mortar joint averaging 0.4 in. thick, with mortar tested from 1,730 to 2,363 lb. per square inch at 28 days. The results of the compression tests are indicated in Tables II and III.

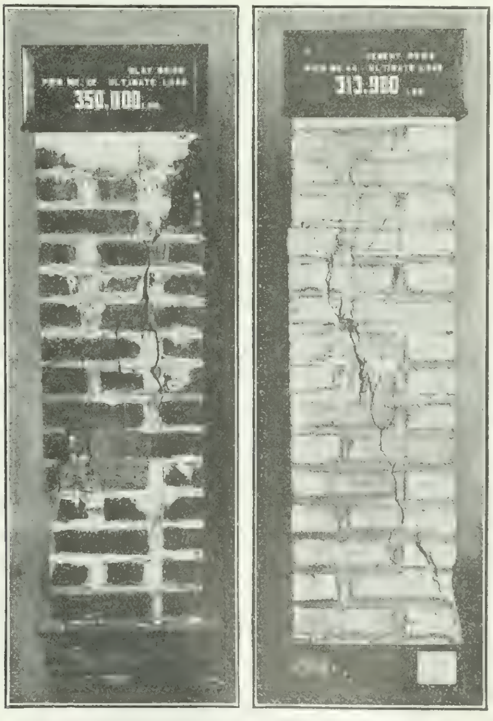


FIG. 3—TYPICAL FAILURES OF CONCRETE AND CLAY-BRICK PIERS

For clay brick no definite relation between modulus of rupture and ultimate compression strength was found. The highest ratio obtained was 0.354 for a down-draft common clay brick, having an ultimate compression strength of 4,460 lb. per square inch and a modulus of rupture of 1,578 lb. per square inch. The average ratio of the modulus of rupture to compression strength in the clay and sand-lime brick was 0.21. For the concrete brick a more or less definite relation was bound to exist between the modulus of rupture and ultimate compressive strength, following the curve $T = 116\ B^{0.78}$, where T is the modulus of rupture or transverse strength of the brick in pounds per square inch and B the ultimate compressive strength in pounds per square inch. The ratio of modulus of rupture to compressive strength decreases as the latter increases.

The relation between the ultimate compressive strength of the piers to the ultimate compressive strength of the brick is shown for 40-in. 30-day piers in Fig. 2.

The behavior of the concrete brick masonry and the clay brick masonry under compressive load at or near ultimate load is shown in Fig. 3. The concrete-brick piers failed in general in diagonal shear as shown in Fig. 4, the resulting fractures resembling very closely the characteristic cone-shaped fractures obtained with monolithic concrete piers.

The paper states: "The characteristic phenomenon of failure in clay-brick piers cannot be fully explained by any theory of diagonal shear. When these are tested to destruction in compressing, the first visible surface sign of incipient failure is a sort of minute vertical crack either in the mortar or near the middle of a brick in line with the mortar joint or both. This crack lengthens and becomes more pronounced as the load increases. Several of these cracks may develop simul-

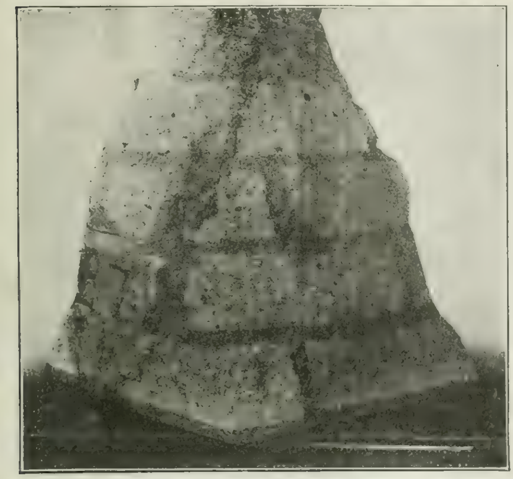


FIG. 4—TYPICAL FRACTURE OF CONCRETE-BRICK PIER

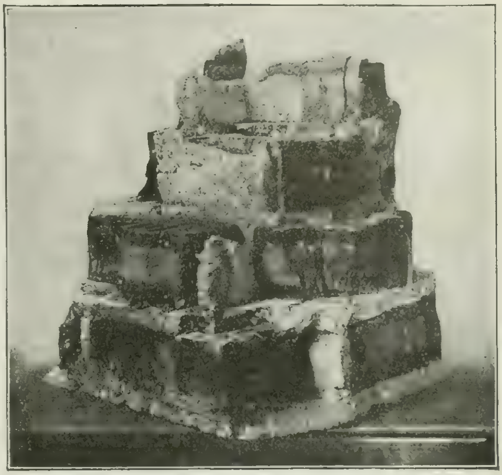


FIG. 5—TYPICAL FRACTURE OF CLAY-BRICK PIER

taneously or else in rapid succession on the four faces of the pier. In most cases failure was confined to the middle two-thirds of the height of the pier. In general the failure in these clay-brick piers occurred not as a monolithic unit but appeared to be a progressive disintegration of the individual brick units and of the mortar and bond between them."

The effect of age upon pier strength was also investigated. The results from clay brick and sand-lime brick were so irregular as to make it difficult to determine an average curve, but it would appear that the difference in pier age from thirty to ninety days resulted in increase in strength of 13 per cent. For concrete brick piers the increase was about 15.8 per cent.

As to effect of height clay-brick piers of 30 and 90 days are reduced in strength as height of pier is doubled, but the loss is less for concrete brick piers.

Investigations into elastic limit indicated that for both clay and sand-lime brick piers the ratio of elastic limit to ultimate strength is 0.47; for concrete-brick piers 0.57 and for some monolithic concrete piers 0.52.

In conclusion the report states that assuming average conditions a concrete brick having an average compressive strength of 1,500 lb. per square inch will, if laid in 1:3 portland cement mortar, form a masonry which will have an average compressive strength of 1,210 lb. per square inch and an elastic limit of 690 lb. per square inch. A clay brick of a compressive strength of 3,000 lb. per square inch will develop an ultimate compressive strength of 1,270 lb. per square inch and an elastic limit of 590 lb. per square inch.

The average modulus of elasticity of clay and sand-lime brick was found to be 1,403,850 and for concrete brick 1,733,200.

TABLE III—COMPRESSIVE STRENGTH OF CONCRETE BRICK IN 12 x 12-IN. PIERS

			Pier		Bricks					Ratio			
Series	Kind of Brick	Height	Average Compressive Strength, Lb. Sq.In. (1)	Average Compressive Strength of Mortar Lb. Sq.In. (2)	Average Compressive Strength, Lb. Sq.In. (3)	Average Transverse Strength, Lb. Sq.In. (4)	Absorption in 48 hr.	Average Age of Pier in Days	Average Age of Brick in Days	(a) (1) ÷ (2)	(b) (1) ÷ (3)	(c) (1) ÷ (4)	Weight of Masonry Lb. Cu.Ft.
A-VI	1 Cement, 5 Sand	40-in.	1,030 1,318	2,230 2,604	1,383 1,388	300 366	9.9 9.9	28 91	81 144	0.462 0.506	0.745 0.950	3.43 3.60	121.2
A-VII	1 Cement, 4 Sand	40-in.	1,784 1,955	2,682 3,280	2,678 2,610	486 467	11.8 11.8	28 90	250 312	0.665 0.596	0.666 0.749	3.67 4.12	125.1
A-VIII	1 Cement, 7 Sand	40-in.	1,490 1,647	1,960 2,450	1,923 1,892	524 512	9.8 9.8	28 95	61 128	0.760 0.672	0.775 0.871	2.84 3.22	125.6
A-IX	1 Cement, 5 Sand	40-in.	1,806 2,159	2,222 2,542	2,545 2,529	630 547	9.6 9.6	28 95	96 161	0.812 0.849	[illegible] 0.854	2.87 3.95	128.9
A-X	1 Cement, 5 Sand, 2½ Cinders	40-in.	1,569 2,008	2,586 2,331	2,462 2,508	492 522	11.2 11.2	29 92	94 157	0.607 [illegible]	[illegible] [illegible]	[illegible] [illegible]	123.8
C-II	1 Cement, 6 Sand	40-in.	1,346	2,099	1,853	437	10.8	33	62	[illegible]	0.726	3.08	
C-III	1 Cement, 4 Sand	40-in.	1,840	2,442	3,446	638	9.3	32	62	[illegible]	0.534	2.88	
A-VI	1 Cement, 4 Sand	84-in.	1,140 1,358	2,659 2,864	1,383 1,388	300 366	9.86 9.86	31 90	81 144	0.429 0.474	[illegible] [illegible]	[illegible] 3.71	
A-VII	1 Cement, 4 Sand	84-in.	1,832 2,078	2,377 3,206	2,678 2,610	[illegible] [illegible]	[illegible] [illegible]	28 92	250 312	[illegible] 0.648	[illegible] [illegible]	[illegible] [illegible]	
A-VIII	1 Cement, 4 Sand	84-in.	1,394 1,469	2,836 2,277	1,923 1,892	[illegible] [illegible]	[illegible] [illegible]	28 90	61 128	0.492 [illegible]	[illegible] 0.776	2.66 2.87	
A-IX	1 Cement, 4 Sand	84-in.	1,930 [illegible]	[illegible] 2,290	2,545 2,529	[illegible] [illegible]	[illegible] [illegible]	29 89	96 161	[illegible] [illegible]	0.758 [illegible]	[illegible] 3.93	
A-X	1 Cement, 4 Sand	84-in.	[illegible] [illegible]	[illegible] [illegible]	2,462 2,508	492 [illegible]	11.20 [illegible]	28 [illegible]	94 [illegible]	[illegible] 0.744	[illegible] [illegible]	[illegible] [illegible]	

* Defective specimens

American Water Works Association Holds Convention

Abstracts of Papers Read at the Detroit Meeting May 21-24—Pumping Equipment, Financing New Extensions, Water Treatment, and Construction of Memphis Supply

Proper Equipment for Pumping Stations

By Arthur L. Mullergren
Consulting Engineer, Kansas City, Mo.

I PREDICT that in less than ten years the reciprocating type of pump will be almost entirely superseded by the centrifugal pump for practically any condition of service. The steam-turbine-driven centrifugal pump has now reached an overall economy that will exceed the vertical triple-expansion engine flywheel pumping engine under favorable steam conditions. The central electric power stations use this type of prime mover exclusively and have used them long enough to demonstrate their reliability and economy. These stations have now reached an overall thermal efficiency of 18 per cent and it is expected that 20 per cent will be reached shortly. Larger boiler units are being installed with higher steam preservers and higher superheat.

Omaha, Neb., has recently contracted for the installation of a 50-m.g.d. 280-ft. head steam turbine centrifugal pump with a guaranteed duty of 189,000,000 ft.-lb. per 1,000 lb. of steam based on 250 lb. steam pressure at 150° F. superheat and 70 deg. cooling water. This duty is exclusive of the condensate pump and the hurling water pump for the hydraulic air ejector, which two pumps are direct connected on one shaft to a 24-brake-horsepower steam turbine operating non-condensing. The duty included, however, all other auxiliary equipment used by the pump, condenser and turbine. The non-condensing steam turbine for driving the auxiliaries mentioned is used to secure a proper heat balance in the station. Consequently, the total station duty will not be affected and may possibly be improved.

Electric Driven Pumps — Since the development of the central station to its high degree of efficiency and the extensive transmission systems emanating from such stations, there are conditions where electric-motor-driven pumping plants would show a considerably higher duty per dollar of annual charges than a very highly efficient steam plant. This is particularly true in the smaller installations and where electric power is available at reasonable rates. Where synchronous motors can be used, central stations are offering attractive rates to the water pumping plants, as this type of motor assists in correcting the power factor of the transmission system, and the hours for pumping can be, in a great many cases, arranged to suit the central station. Motor-driven centrifugal pumping units have been installed that have shown a combined overall efficiency of 82 per cent, which is a very good showing when we consider that the mechanical efficiency of a vertical triple-expansion flywheel pumping engine is about 93 per cent. Reliability of service is one of the principal reasons that electric drive has not been more generally adopted. However, with the duplicate or loop transmission lines and interconnected central stations, practically as great a reliability as the self-contained plant will be secured. Furthermore, emergency equipment operated independently by an inexpensive steam- or oil-engine installation may be provided, thus insuring absolutely continuous service, and by carrying the fixed charges on this emergency equipment together with the small amount of operating expense that may be incurred in its operation, plus the regular operating expenses and fixed charges of the electric-driven plant, the annual charge of the entire installation may be considerably under the annual charge of a highly efficient steam plant.

Diesel Oil Engine—The Diesel Oil Engine has been developed to a very high state of efficiency and reliability. The investment in this type of equipment is very high but so is the fuel economy, such engines reaching a thermal efficiency of 35 per cent..

In stations having 10 m.g.d. capacity and above, and with coal costs around $6 per ton, the high-pressure steam-turbine-driven centrifugal pump will ordinarily show the best duty per dollar of annual charges. In plants below this capacity, each particular installation would require a thorough investigation and a careful balancing of all costs, before a definite type of plant could be decided upon. It is generally recognized that in plants of 3 to 5 m.g.d. capacity the cross-compound flywheel pumping engine will make the most favorable showing. In regard to thermal efficiency, this may be very true, but it would not hold in every case if the duty per dollar of annual charges was considered.

Discussion—J. N. Chester, Pittsburgh, Pa., the only member who discussed this paper, dissented from Mr. Mullergren's opinion that reciprocating pumps will be replaced by centrifugal units. For a 15-m.g.d. plant, under a 100-ft. head, with coal at $4 a ton, Mr. Chester would use a cross-compound pump, and for higher heads but otherwise like conditions, triple-expansion pumps. If coal should fall in price the steam-driven centrifugal pump would be favored. The falling price of electric current and the rising wage of labor with labor difficulties added, point to the electric-driven pumps—but in every case local conditions must govern in the choice of pumping plant.

In a separate paper F. L. Adams reviewed at length "The Use of Constant and Variable Speed Motors for Driving Water and Sewage Pumps." He dwelt upon the advantages of brush-shifting over slip-ring motors which he said are so great in point of economy that in a short time brush-shifting would pay for itself. But he did not claim that brush-shifting is best for all conditions, although it is for many.

* * *

New Water Supply for Memphis, Tenn.

By James R. McClintock
Of Fuller & McClintock, New York City

A NEW artesian water supply for Memphis, Tenn., with air-lifts both for raising the water from the wells and to give partial removal of carbonic acid, aerators for further decarbonation, mechanical filters for iron removal, low-lift pumps to supply aerators and high-lift pumps delivering direct to the distribution system, a reservoir and other elements is now well under construction with the writer's firm as engineers. The improvements will cost about $2,800,000. The first group of twenty-three wells will have an estimated capacity of about 1 m.g.d. It is expected that the well system can be extended to produce 75 m.g.d. or more which would supply the city for thirty years to come. The fourteen existing artesian wells will be given up, except for a reserve supply, as they sometimes discharge troublesome quantities of sand, and have other drawbacks.

The Wells—The wells are located about 500 ft. apart, having 12-in. casings and 50 ft. of 10-in. Cook strainer. Cast-iron pipe will be used for collecting the water from the wells, while for the air lines to the air-lifts wrought-steel pipe with welded joints will be used, with Dresser couplings every 350 ft. for expansion joints and with flanged joints for all valves and couplings. The reservoir and equalizing basin will be of reinforced concrete and will have a total capacity of about 10,000,000 gal. By walling off one corner a 1,000,000-gal. compartment is secured for equalizing the flow from the wells.

Pumping and Compressing Plant—Four air compressors, each with a capacity of 2,700 ft. of free air per minute against a gage pressure of 100 lb. will supply the air-lifts. To deliver water to the aerators, centrifugal pumps, driven by water turbines supplied from the high-lift pumps, will be used, each unit having a nominal capacity of 9 m.g.d. There will be two 16.5 m.g.d. steam turbine driven centrifugal pumps and two 15 m.g.d. (but designed to deliver 16.5 m.g.d. when necessary) horizontal cross-compound crank-and-flywheel pumps, delivering water direct to the mains under 200 lb. pressure. The intention is to use the last-named units most of the time.

Aerators and Filters—There will be 40 aerator units distributed in groups of 10 each, consisting of coke-filled troughs, one above the other. (See *Engineering News-Record*, May 17, p. 874 for details of preliminary studies and outline of design.) The iron-removal plant is essentially a group of mechanical filters with a total capacity of 18 m.g.d., a net area per filter of 825 sq. ft., or about 360 sq. ft. per m.g.d. of rated capacity.

* * *

Financing Water Main Extensions in Municipally-Owned Works

By Caleb Mills Saville
Manager and Chief Engineer, Water-Works,
Hartford, Conn.

AS BETWEEN two common methods of financing water main extensions used where the aim is to avoid the injustice of placing the burden of extensions into new territory on consumers in old territory, the author has concluded that the assessment method is much more equitable than the guarantee-revenue method, for municipally-owned plants. Financing extensions from the tax levy has little or no sound basis, unless it be done in lieu of taxation to meet the cost of fire protection furnished by the city without charge. Even then public utility decisions are against such scrambling of accounts, and generally unite in holding that a water department should receive cash for what it supplies to the city and in return should pay cash for what the city supplies to it.

The word extension is taken to mean the installation of a water pipe of size sufficient to provide proper domestic and fire protection service for the immediate locality, with the water department assuming all cost in excess of the above which is necessitated for the good of the service.

The guarantee method is proper if the payment in rates or otherwise received from the extension is sufficiently large to cover not only the proper portion of all maintenance and operating charges of the water department service but also to pay interest and depreciation on the extension. It is not proper if the guarantee is so small that either water is given away or the burden of the investment is carried by the consumers as a whole.

In some municipal instances the water rates would never meet the conditions named as proper but the administration goes serenely on, and when the income of the department becomes too small to meet expenses rates are raised. In the opinion of the author the best and surest remedy for this condition is governmental regulation of municipally-owned utilities as well as of those under private operation.

With a privately operated utility it seems proper to use the guarantee method, as the profit in the water rates should be sufficient to finance the extension after full development of the locality. With a publicly-operated utility run substantially at cost there appears to be no argument for the use of this method unless it be for an amount in addition to water rates and sufficient to pay interest and amortize principal in a given term of years. This solution logically leads to the assessment method of financing water main extensions.

Some other objections to the guarantee method for use in municipally-operated plants are: (1) Difficulty in getting all abutters in a street to be participants in the guarantee; (2) increased return in property valuation to all abutters on the extension at the expense of those who are willing to undertake the burden; (3) the fact that through over-enthusiasm as to development it may be many years before a return is available sufficient to extinguish the guarantee; and (4) such a combination of conditions that the property may never return an income from water sufficient to meet the guarantee on the cost of the extension, even excluding cost of water supplied.

In the application of the method of special assessment the following conditions should be observed as equitable and reasonable:

1. The water department should determine whether the extension is required by public convenience and necessity and when so decided should establish a definite means for assessment based upon the average cost of laying a water main of proper size to supply both domestic and fire protection service to the street in question.
2. The water department (for the municipality) should pay that proportion of the cost which is for general benefit, usually from one-fourth to two-thirds the cost of the extension.
3. Two methods seem applicable for payment of the assessment: (a) A frontage tax against all abutting property which may be served by the extension; (b) an "entrance fee" for the privilege of connecting with the water main, based on lot frontage.
4. The assessment should be payable in a lump sum or in installments during a fixed term of years.

* * *

Use of Acids with Alum and Importance of pH Concentration

By John R. Baylis
Chemist, Filtration Plant, Baltimore, Md.

A GREAT increase in the amount of alum necessary for coagulation at the Baltimore filter plant in 1922 is attributed to the production of organic emulsoids by an increase in certain micro-organisms attributed to the flooding of an additional area due to increasing the capacity of the Loch Raven storage reservoir on the Gunpowder River. With the hopes of finding a cheaper method of treatment, experiments using acids with alum to change the pH to near the optimum point were conducted. A uniform method of procedure that duplicated plant conditions was adopted for experimental work. In the absence of any standard of clarity for filtered water a turbidity of 0.5 was set as the maximum limit.

The zone of maximum removal of alumina from the water is between pH of 5.6 and 6.6. The optimum pH for best precipitation of the suspended matter was found to be about 5.5. That is, there is a maximum removal of turbidity for a given amount of alum at this value. Under ordinary operating conditions prior to 1922, there was a slight increase in the amount of alum necessary for proper clarification as the pH increased to 7 from 5.5, and a rapid increase as it went higher. The conditions in 1922 caused the rapid increase to start at a pH below 6 instead of 7. This was lower than the pH produced by the addition of alum. The use of acids to reduce the pH to 6 or less effected a great saving in alum. Several acids tried, such as hydrochloric, nitric and sulphuric, were equally effective. Sulphuric, on account of its cheapness, was the only one tried on a large scale. The study of colloidal chemistry is urged as an aid to the solution of coagulation difficulties. The amount of alum necessary for clarification may vary widely with apparently no change in any of the ordinarily found constituents of the water.

It is clearly shown that alkalinity determinations should be made with the use of an indicator that will give a pH of about 5.5 instead of the much lower value given by methyl orange, erythrosin, or lacmoid. Methyl red has been adopted for such use in the laboratory of the Montebello filters. It may be purchased in any form desired and can be used by unskilled workers.

Sulphuric acid was tried on a plant scale and found to be practical and economical (see *Engineering News-Record*, Aug. 31, 1922). Had it been used the entire period in 1922 when it would have been economical there would have been a saving of approximately $[illegible] in the cost of coagulants.

[Mr. Baylis's paper appeared in full in the *Journal of the American Water Works Association*, May 1923.—EDITOR.]

Iodine Treatment of Water Supplies for Prevention of Goitre

By Beekman C. Little
Superintendent of Water Works, Rochester, N. Y.

The Water Bureau and Health Bureau of Rochester believe that they have evolved a plan for successfully treating and preventing goitre. Simple goitre is generally recognized as a swelling of the neck due to the enlargement of the thyroid gland. In North America, goitre is endemic in the whole of the Great Lakes region and in the basin of the St. Lawrence and the Northwest Pacific region.

Iodine is a natural constituent of the normal thyroid gland. It is essential to normal thyroid activity. The amount of iodine required is exceedingly small, but when this amount is absent, the thyroid gland seeks by increase in size and surface to make up for this lack in iodine, and goitre is the result. In fact, goitre has been described as an adaptation to "iodine deficient" nutrition. It follows therefore that the treatment for goitre now pretty generally practiced is the giving of very small dosages of iodine. An accredited prescription is: one ten-thousandth of a gram of iodine taken daily over a period of from 15 to 20 days given twice a year.

In the recommendation of our plant in Rochester Dr. Goler, the health officer, makes, among other, the following points: "We always have in Rochester among our children, more than 2,000 cases of preventable goitre. We may prevent this goitre by the addition of minute quantities of iodine to the drinking water—two ten-thousandths of a gram to the gallon—in the form of sodium iodide. It will only be necessary to dose the water twice a year, for two weeks. This would require daily 13.3 lb. of iodide of soda for two weeks, or 372 lb. at $4.80 per pound, or $1,785 a year."

The Water Bureau at Rochester has already started this treatment of the water. At one of our reservoirs, from which is drawn all of the water entering the city mains, we have dissolved daily, for a period of two weeks, 16 lb. of iodide of soda, a slightly greater amount than at first suggested. (The iodine was lowered into the incoming water in two 8-lb. bags.) Our consumption of water during this period was approximately 25 m.g.d. In the laboratory of the Health Bureau, and checked up by chemists in the University of Rochester laboratory, it was found that the iodine content in the water increased from one part in a billion parts of water before the experiments, to 20 parts in a billion. Next fall the dose will probably be increased as it is planned to get about 50 parts of iodine to a billion parts of water.

Discussion—Walter Sperry, Grand Rapids, Mich., said that the school children of that city are getting the consent of their parents to take iodine in chocolate at intervals. Mr. Little said that iodine is being given to school children elsewhere in chocolate and also in the water supplied in the school buildings.

* * *

Water-Works Pumping Station Design

By Charles B. Burdick
Of Alvord, Burdick & Howson, Engineers, Chicago, Ill.

Fundamentally there is no reason why the water-works station should not present the same attractive appearance as the city hall but an ornate design justified in a city hall or a courthouse would be out of place in a pumping station. Rather it should represent the masculine in architecture without undue pretention; be strong and permanent in its lines and materials; be frankly adapted to its purpose; and present an appearance agreeable to the eye.

Permanence—Water-works construction is now sufficiently standardized so that it is possible to lay out pumping plants subject to enlargement in such manner that the buildings may be useful indefinitely. In the ordinary water-works plant, steam operated, the main entrance, offices, and possibly a laboratory may be grouped and will need little further expansion. The engine room and the boiler room, after providing for the present and the immediate future, may be expanded along parallel lines without necessarily spoiling the architectural symmetry. It is wise to be liberal in selecting dimensions. This tends toward permanency.

Centralization of Business End—If the water is filtered, it is desirable in small pumping stations to centralize the "business end" of all the station operations on account of facility in supervision. This is not always possible when filtration is added to an old water-works. In the layout of a new plant, however, it is practicable to so co-ordinate the expansion of pump room, boiler room, filter plant, coagulation basin, and clear well, that each may be enlarged in an orderly manner with convenience of access between the operating parts and the administrative center of the group. Basins and reservoirs may expand, if necessary, forward from the building, utilizing a space covered over by lawn. Plants in cities up to 100,000 population, or somewhat more, may thus be designed without the necessity for separating the pumping and filtration plants.

Fireproof Construction—The modern water-works station should be the last building to burn in any community. Many water-works stations are practically fireproof except for the roof construction, windows, and the doors. It is practicable to build stations today without using a stick of wood, and at moderate costs as compared to wood. Millwork has increased in price to such extent that there is little difference between wood and metal frames, and concrete and tile construction is generally used for roofs in the most modern stations.

Building Materials—For underground structures or for other structures more or less concealed and protected from the weather, concrete gives excellent service. Where exposed to view or subjected to the action of the elements, it is not proving a satisfactory building material. Wherever possible it is wise to so design reservoirs that they may be filled over and sodded, thus protecting the concrete from the expansion and contraction of hot sun and winter cold, and incidentally better protecting the water from extremes of temperature.

For superstructures, brick and stone are the most satisfactory materials for exteriors, terra cotta may be useful upon the interior or exterior. Upon the interior the surface should be clean and non-absorbent. For floors concrete is satisfactory only in the cheaper structures where it may be successfully used if covered with a heavy non-absorbent paint especially adapted to concrete. In the better stations terrazzo or tile is justified.

Walls, particularly where damp, as in the pumping pits should be faced with a non-absorbent substances such as enamel brick built at least head high. Above this plane pressed brick is satisfactory. At present a rock plaster is available almost as hard as stone which can be worked into very attractive panel designs at moderate cost.

For the roof, exposed steel trusses are generally used with steel purlines and a roof covering of reinforced concrete or tile. To prevent sweating in cold weather a double ceiling is desirable. This may be accomplished by rock plaster on metal lath hung from the purlines. Thin concrete roofs usually become a nuisance at certain times from dripping. A single thickness of 5 in. is usually sufficient to prevent the serious collection of drops. A double ceiling completely eliminates the trouble and costs comparatively little more. Skylights and ventilators must be guarded with gutters for satisfactory results.

Architectural Co-operation—It would be well if all engineers would utilize the services of an architect in the planning of conspicuous engineering works. A good architect possesses a knowledge of orderly arrangement and of the selection and grouping of materials not possessed by most engineers. On many classes of structure the architect should be and is the master builder and the engineer is properly a subordinate. Upon such special structures as water-works buildings the engineer must be the master builder, but he is wise if he fully utilizes the services of one skilled in architectural design. This must be done by co-operation, the engineering plans and the architectural plans should be worked out together step by step, as a unit.

The water-works manager should not ignore public approval relating to his work and his plant. Self-respect engenders respect from others. Capable operators say that employees take better care of their machinery and are more contented when working in attractive surroundings. A good plant is an important element of good service. The time has come when water-works designers can safely plan for the future and build for permanence.

* * *

Estimating Bills When Meters Fail to Register

By W. C. Hawley

Chief Engineer and General Superintendent, Pennsylvania Water Co., Wilkinsburg, Pa.

THERE are few more perplexing duties which the water-works manager is called upon to perform than estimating what is the proper and just amount of water to be charged for when the meter has stopped registering. Fortunately a very small percentage of the meters in service fail to register and again, fortunately, in the majority of such cases there is little difficulty in making a bill to which there can be no reasonable objection on the part of the consumer, but there are, occasionally, cases for which it is extremely difficult to find a satisfactory solution.

It is important that the fact that a meter is not registering should be discovered at the earliest opportunity. The meter reader should therefore be given instructions to pay particular attention to this matter. In case the registration for the period is less than ordinary he should open a spigot and watch the 1-ft. hand to see if the meter is registering. The meter books, when returned to the office after reading, should be carefully inspected and all suspicious readings should be listed, and inspectors sent to make check readings. This will be found worth while not only in picking up meters which are not registering and have been overlooked by the meter reader, but in the elimination of mistakes in meter reading, and thus saving trouble over incorrect bills.

In cases where the rate of registration has not been uniform it may be advisable to use as a basis the rate of registration for the period immediately preceding the billing period or to use, at least as a check, the rate for a period of three or four weeks after a new meter, or the old meter repaired, has been set. If there is a material difference between the rates of registration immediately before and after the period to be billed it may be best to use the average of the two rates as the basis for billing if the two periods were of about equal length. If they were not, probably the best solution will be made by the use of squared paper, using the horizontal scale for time and the vertical scale to represent either the meter readings or registration. By prolonging the lines into the period for which the registration is to be estimated until they intersect, we can find the probable date when the change in rate of registration took place, and thus determine approximately the periods during which each rate of registration occurred and the total amount.

* * *

Miscellaneous Matters

Question Box—Flushometer water closets aroused much interest. Dow R. Gwinn said that the Terre Haute Water Co. does not allow flushometers. In one case an exception was made but the company held fast to its rule for a ⅝-in. service pipe from the main to the curb (laid at its expense). The plumber had already put in a 1¼-in. service pipe from the curb to the house for the property owner. It was agreed to let this be used but on it the house owner installed a 40-gal. tank so pipe-connected that its upper portion serves as an air cushion when the closet is flushed. It has given satisfaction. W. C. Hawley, Wilkinsburg, Pa., reported the use of a similar device. J. N. Chester, Pittsburgh, argued for services and meters as large as any customer desires but with a service charge based on the size chosen. W. S. Cramer, Lexington, Ky., has found that a service charge of $1.50 per quarter will not deter the use of flushometers but a $3 charge will. A speaker interested in the sale of flushometer valves stated that thirty per cent of all decent water closets put in have been of the flushometer type. This type may need a larger service but it conserves water, he said.

Briefer Mention—Meteorological observations by water departments up to the full range of the general run of Weather Bureau stations, were urged by Scotland B. Highland, Clarksburg, W. Va., where such observations are conducted by the Water Board, including the maintenance of automatic recording gages on each main tributary in the water shed. Frank C. Jordan, Indianapolis, urged co-operation between water companies or departments and city departments in general. He cited such co-operation between the Indianapolis Water Co. and the fire, health and school departments of that city, the joint activities including means to finance domestic plumbing installations in small houses. The use of a portable air compressor mounted on a Ford truck, for breaking concrete pavement and other purposes was described by F. C. Amsbary, Champaign, Ill. The outfit, including pavement-breaking tools, cost $1,723. Its feasibility for so small a place is due to leasing it to local contractors.

In a paper on "Unaccounted For Water," J. N. Chester, Pittsburgh, reviewed data showing figures from an average of 27 per cent reported in 1916 (*Journal* N. E. W. W. Association) to approximately 38 per cent at Norfolk, Va., and Knoxville, Tenn. In the Pittsburgh rate case 33 per cent was allowed. Mr. Chester has found the combination of the pitometer and the geophone useful in locating leaks.

Laying water mains and service connections in the same trench but above the sewers when the latter are in rock is practiced in New York City for economy, said W. W. Bush, but the water pipe is not laid until some months after the sewers. From Cleveland Mr. Ruggles reported that water and sewer pipes are laid in trenches 5 ft. apart, except that in rock services are laid on a shelf above the sewer.

Whether the service pipes from main to curb should be laid when the main is put down or at least before the street is paved brought out a variety of opinion, but of those who spoke there seemed to be a majority against compelling service installations in the streets before actual connections to houses are to be made. This was based on the uncertainty of both the time and the exact location of the house connection and the large idle and sometimes wasted investment that may result when services are made before houses are built or connected.

Algae growths was a question-box topic that brought many to their feet. W. S. Cramer, Lexington, Ky., said that in treating water with copper sulphate bays and ponded areas should not be overlooked. At the inlet of a small stream to a reservoir he applies copper sulphate by means of a bag of close weave attached to a paddle wheel driven by the stream.

Boundary Commissioner Arthur A. Stiles

Through an error in the United States Supreme Court order, the name of Arthur A. Stiles was given as Arthur L. Stiles in the assignment as commissioner of the Supreme Court to determine the boundary between Texas and Oklahoma. The error was repeated in the article describing the boundary survey work in *Engineering News-Record*, Apr. 19, 1923. It is here corrected as a matter of record.

From Job and Office

Hints That Cut Cost and Time *For the Contractor and the Engineer*

Lining Coal Bunkers with Concrete

By C. M. Daily

Engineer-in-Charge Supply and Purifying Section, Division of Water-Works, St. Louis, Mo

STEEL coal bunkers having elliptical bottoms were erected in the Baden boiler room of the St. Louis water-works in 1920 and heavily coated with asphaltic paint. The bunkers were built so close to the roof that the roof girders passed through them. After two years' service the roof girders, steel sides and bottoms of the bunkers were beginning to corrode. It was decided in March, 1922, to cover the inside of the bunkers and the roof girders with gunite. The surface was cleaned with a sand blast and holes were drilled and tapped in the sides and bottoms of the bunkers 4 ft. c. to c. Stud bolts were screwed in the holes with the heads extending about ¾ in. from the plates. Over the entire bunker surface to be protected a triangular mesh reinforcing wire weighing 28 lb. per 100 sq.ft. was laid and wired to the stud bolts, after which 1½ in. of gunite was applied in three coats. The roof girders were wrapped with the reinforcing wire and covered with gunite applied the same as on the bunker. Cement gun No. 0 was used for the purpose.

GUNITED COAL BUNKER, ST. LOUIS WATER-WORKS

It was found necessary to cover the bunkers with tarpaulins to prevent sand grains from rebounding and injuring the machinery in the boiler room; this made the work exceedingly difficult and uncomfortable for the nozzle man

The cost of covering 10,650 sq.ft. of surface was:

	Cents per Sq. Ft.
Labor, sand-blast	4.0
Labor, drilling	3.9
Labor, wiring	3.24
Shooting gunite	12.1
Miscellaneous and overhead	5.9
Wire	2.28
Bolts	.18
Cement	4.56
Sand	1.18
Total	37.34

The costs of labor items are high, due principally to the care exercised in preventing sand grains from rebounding, and also to the presence of roof girders which pass through the bunkers. When work was first started, experienced machine men were employed, but after a short time it was found much cheaper to break in new men who were willing to learn than to use the old men who were not accustomed to this particular type of work.

While the cost of 37.34c. per square foot seems high it is much cheaper than placing forms inside of the curved surface and pouring the concrete, as was done in similar bunkers a few years before at one of the other pumping stations.

Simplified Pumping Station Records

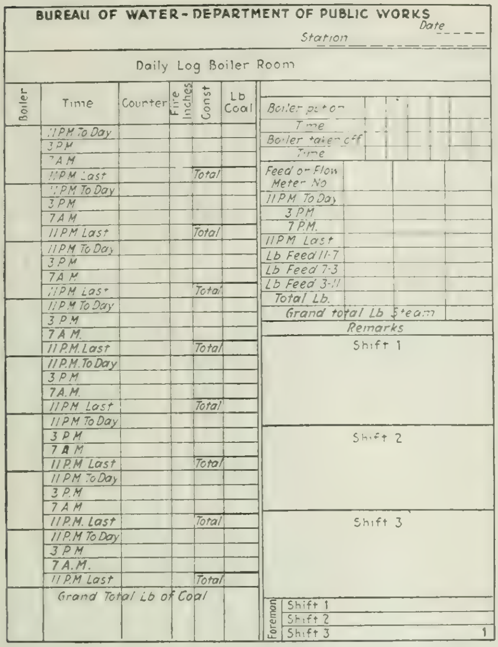
By H. R. Cady

Mechanical Engineer, Bureau of Water, Philadelphia

IN A modern pumping station, particularly one having steam-driven pumps, there are so many different and varying pressures, temperatures and possible measurements of weight or volume that if care is not exercised to select readings having particular significance, and susceptible to modification by varying operating methods, a mass of figures having no real value may be collected. Too numerous readings, not definitely correlated with operating efficiency, are only a little better than no records and are costly to obtain.

In the Philadelphia Bureau of Water, where formerly a rather complicated pumping station log was in use, the simple 8½ x 11-in. sheets reproduced herewith provide all desired information on work done, units in service and fuel consumed. The sheet for pump and generator units covers combined pumping and generator stations and stations having either motor-driven pumps or steam-driven units of plunger or turbo-centrifugal type.

To bring station operations down to a basis which may be easily and quickly grasped, daily station work is expressed in terms of duty in foot-pounds per 100 lb. of coal. To localize somewhat the lack of efficiency, evaporation of water per pound of coal is figured and also slip of pumps. Slip as applied to centrifugal pumps is a misnomer but the figure called slip in that case is really an expression of capacity deficiency based on what the pump will do if kept in good condition and operated properly. The three values mentioned together with quantity of water pumped, are posted daily in the offices of the chief engineer and the superintendent of pumping stations. Posting on graphic charts is done by means of short glass headed pins of different colors. At the end of each month the average values of evaporation and duty are plotted on a similar graphic sheet and these prints are sent to all engineers in order to permit comparison of results. Since this chart is progressive the last one of the year is kept for a per-



BUREAU OF WATER - DEPARTMENT OF PUBLIC WORKS
Date ____
Station ________

Daily Log Boiler Room

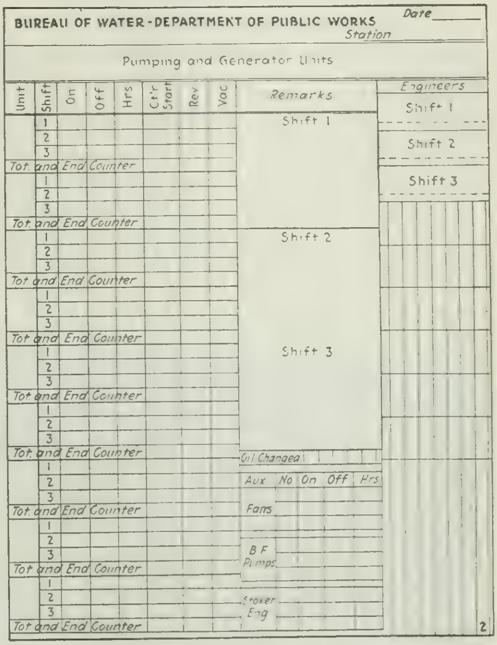
Boiler	Time	Counter	Fire Inches	Const	Lb Coal
	11 P.M. To Day				
	3 P.M.				
	7 A.M.				
	11 P.M. Last			Total	
	11 P.M. To Day				
	3 P.M.				
	7 A.M.				
	11 P.M. Last			Total	
	11 P.M. To Day				
	3 P.M.				
	7 A.M.				
	11 P.M. Last			Total	
	11 P.M. To Day				
	3 P.M.				
	7 A.M.				
	11 P.M. Last			Total	
	11 P.M. To Day				
	3 P.M.				
	7 A.M.				
	11 P.M. Last			Total	
	11 P.M. To Day				
	3 P.M.				
	7 A.M.				
	11 P.M. Last			Total	
	11 P.M. To Day				
	3 P.M.				
	7 A.M.				
	11 P.M. Last			Total	
	11 P.M. To Day				
	3 P.M.				
	7 A.M.				
	11 P.M. Last			Total	
	Grand Total Lb of Coal				

Boiler put on
Time
Boiler taken off
Time
Feed or Flow Meter No
11 P.M. To Day
3 P.M.
7 P.M.
11 P.M. Last
Lb Feed 11-7
Lb Feed 7-3
Lb Feed 3-11
Total Lb.
Grand total Lb Steam

Remarks
Shift 1
Shift 2
Shift 3

Foreman
Shift 1
Shift 2
Shift 3

1



BUREAU OF WATER - DEPARTMENT OF PUBLIC WORKS
Date ____
Station ________

Pumping and Generator Units

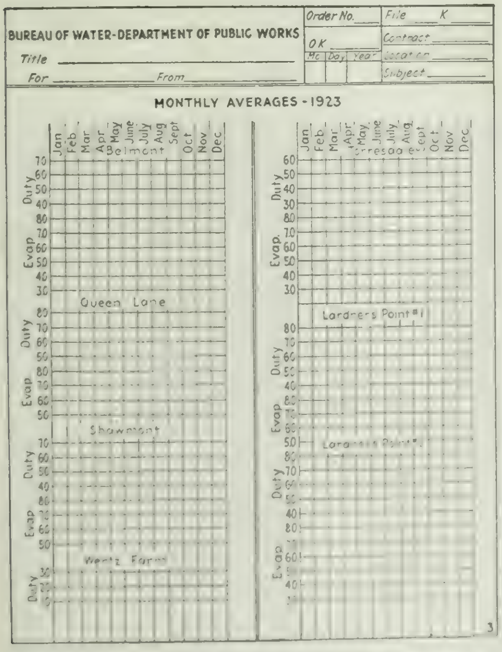
Unit	Shift	On	Off	Hrs	Ctr Start	Rev	Vac
	1						
	2						
	3						
Tot. and End Counter							
	1						
	2						
	3						
Tot. and End Counter							
	1						
	2						
	3						
Tot. and End Counter							
	1						
	2						
	3						
Tot. and End Counter							
	1						
	2						
	3						
Tot. and End Counter							
	1						
	2						
	3						
Tot. and End Counter							
	1						
	2						
	3						
Tot. and End Counter							
	1						
	2						
	3						
Tot. and End Counter							
	1						
	2						
	3						
Tot. and End Counter							

Remarks
Shift 1
Shift 2
Shift 3
Oil Changed

Aux	No	On	Off	Hrs
Fans				
B F Pumps				
Stoker Eng				

Engineers
Shift 1
Shift 2
Shift 3

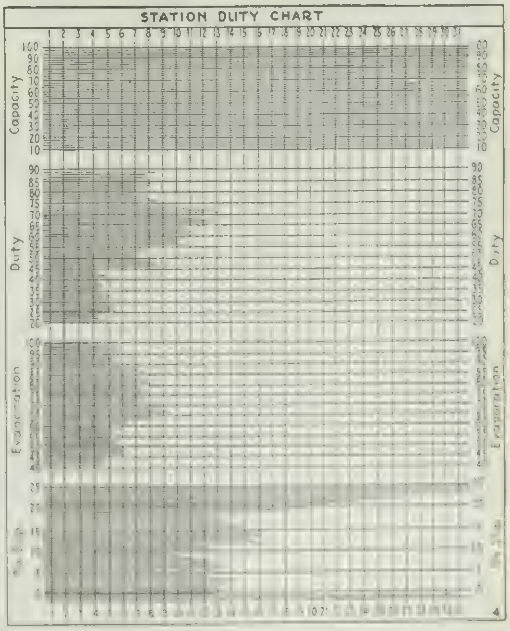
2



BUREAU OF WATER-DEPARTMENT OF PUBLIC WORKS
Title ________
For ________ From ________
Order No. ____
OK ____
Mo | Day | Year
File ____ K ____
Contract ____
Location ____
Subject ____

MONTHLY AVERAGES - 1923

3



4

PUMPING STATION RECORD FORMS AND CHART BUREAU OF WATER, PHILADELPHIA, PA.
The original three tabular record sheets are 8½x11 in., and of the graphic sheet about 11x17 in.

manent record, but daily charts are not preserved unless required for the study of some particular question.

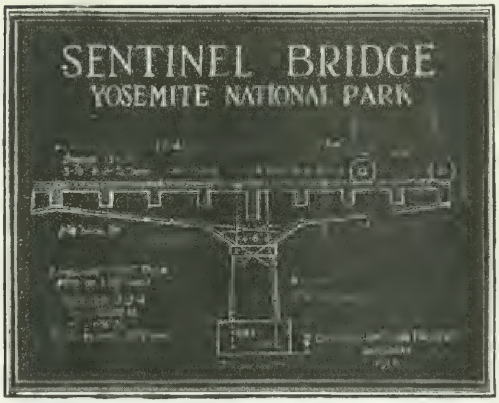
As a basis of comparison, a duty based on results of various parts of station equipment has been calculated.

From Job and Office

Hints that Cut Cost and Time

Bronze Tablets on Bridge Preserve Data on Structural Details

ELABORATION of an idea first adopted by the National Park Service in 1918 in Yosemite National Park has led to embedding in bridges over the Merced River bronze plates showing the stress diagrams and giving load information upon which the bridge design was based. Use of bronze plates was first made in 1918 when one was placed upon the new power house building. The original plates were set merely for informative purposes and carried the names of the Secretary of the Interior, director of the National Park service and superintendent of the park at that time, as well as the names of the designers and builders and references to acts of Congress appropriating funds for the plate.



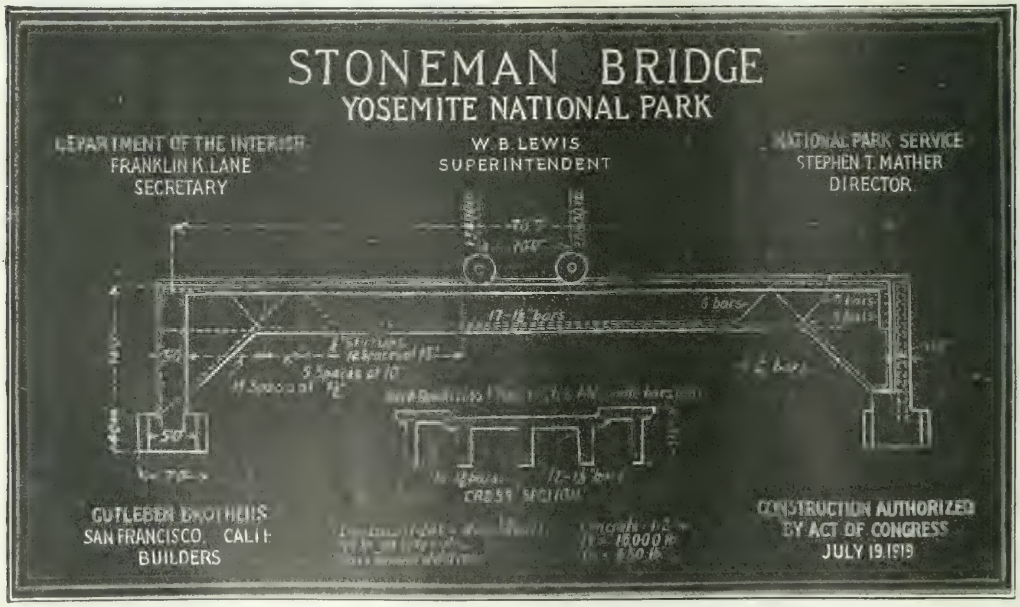
This idea was enlarged upon in the construction of two or three bridges later on. The accompanying photographs indicate clearly the character of data included on the bronze tablets. The suggestion to place the bronze tablets came from Gutleben Brothers, the contractors who built the Sentinel bridge as well as the Stoneman bridge, both of which are structures several years old.

The superintendent of Yosemite National Park asserts that the idea has not been uniformly followed out in subsequent bridge construction but asserts that the idea has a great deal of merit inasmuch as in the marking of large bridge structures which will stand for many years stress and structural details are imperishably preserved whereas original drawings might become lost or destroyed.

The plates are made of bronze about 8 x 10 in. and are placed in such position on the structure that they can easily be seen by those who cross the bridge.

An Emergency Standpipe Works Successfully at Waltham

DURING the fall of 1922 it was necessary to empty and repair the concrete standpipe of the Waltham, Mass., water-works system, and George Brehm, director of public works was confronted with the necessity of providing an equivalent head of water on the city mains while the standpipe was empty. The elevation of the only other source of supply, the old city reservoir, was



BRONZE BRIDGE PLATES GIVE DESIGN DETAILS

In the upper view is shown the plate on the Sentinel Bridge and in the lower view that on the Stoneman Bridge.

From Job and Office
For Contractor and Engineer

205 ft. while the recent development of outlying sections of the city required a head of not less than 235 ft. To provide this head an 8-in. wrought iron pipe was tapped into the 24-in. feed pipe that normally supplied the standpipe and was run up onto the embankment of the old city reservoir. Here the pipe was run up into the air to an elevation of 276 ft. and then turned out over the reservoir so that the discharge would fall clear of the embankment. The pipe was securely guyed against wind pressure. The pumps were then started and kept running twenty-four hours a day, the speed being regulated to maintain enough pressure to keep a slight overflow from the 8-in. pipe. This method of maintaining the pressure in the mains was continued for a month with complete success.

Street Signs of Bracket Type Installed at Portland, Ore.

THE CITY of Portland, Oregon, has installed 110 new street signs covering about forty city blocks in the west side business district. Two signs are placed at each intersection on diagonally opposite corners. The sign consists of a 3-in. galvanized-iron standard surmounted by two arms at right angles, each made up of two plates of No. 14 gage ingot iron placed back to back and spot-welded on the ends. Street names are readable from four directions. White letters are raised upon a background of blue. The sign plates are placed at a height of 8 ft. above the sidewalk.

Where city light posts are suitably located the signs are bracketed to the post at the proper height. Where the standards are used they are held rigidly in place by being embedded in 2 ft. of concrete. The bottom of the standard is split by a 6-in. slot and edges are flared out in order to secure a firm anchorage in the concrete base. They are set about 2 ft. back from the face of the curb.

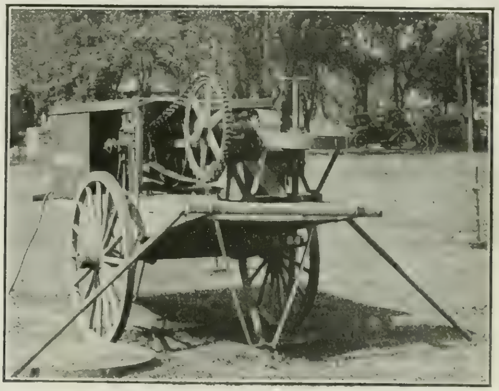
BRACKET STREET SIGN 8 FT. ABOVE PAVEMENT

The contract for standards and sign plates was awarded to the Coast Culvert & Flume Co. of Portland. The price bid by this company on the plates, of which there are 440, was $338.30 f.o.b. Denver, Colo. The price on the 3-in. posts, 110 in number, was $6.30 each, which included the four-way mounting for the sign plates attached to the tops of the posts. The special brackets used on light posts were made in the municipal shop at a cost of about $5 each.

It is expected that the use of these signs will be extended to other parts of the city, especially throughout its central part.

Electrically-Operated Valve Opener for Pumping Station Gates

FOR operating the one hundred valves in the pipe lines leading from the pumping station of the Detroit water-works a two-wheeled hand push-cart valve opener has been in successful operation for more than a year. The valves are equally divided between the 42- and 48-in. sizes and formerly were opened or closed by hand. A 48-in. valve requires 40 minutes' time of two men to make the 225 turns, but with the present motor-driven opener these large valves can be closed in 7 minutes, a decided advantage when a serious break has occurred. Bypass valves are always closed by hand.



DETROIT PUMPING STATION VALVE OPENER

Triple reduction from motor to valve stem effected by belt, chain and bevel gear permits closing a 48-in. gate in 7 minutes.

The machine consists of a 5-hp. motor driving a 4-in. belt connected to a pulley on a jackshaft which is supported by pulley hangers. The jackshaft carries a sprocket driving through a chain the large sprocket wheel shown in the center of the picture (reproduced herewith), which in turn drives the bevel gear reduction unit carrying the gate key. The latter slides up and down on a feather key through the horizontal gear so that it may easily be dropped over a gate stem, after which the two supporting legs at front and rear are blocked up to level the platform.

All stems are made with 2-in. square heads for socket wrenches. The anchor rods prevent side motion although they are not often needed, according to Harry W. Gould, superintendent of the pumping station.

Current is furnished to the three plugs located at convenient points around the pumping station yard. The locations of these plug-in points and all the valves are noted on a map in the station on which are "open" and "shut" markers, changed as the valves are operated. As the first of the three reductions is by a belt which can slip the valves start without jerking. A counter on the large bevel gear enables the operator to shut off the current 2 or 3 turns before the final open or closed position is reached although no harm would ensue, the belt simply slipping. The final seating turns are made by hand.

The valve opener was devised by H. B. Kenney, formerly assistant superintendent, and built in the shops of the water department.

Slide Rule Solution of Cosine Formula

By D. L. Bissell
City Engineer's Office, San Diego, Calif.

What I consider a much simpler method of solving the cosine formula by slide rule than that given in *Engineering News-Record,* April 26, p. 759, is contained in the following paragraphs. Referring to the accompanying figure:

Set the index of the sine scale to 415, then on the A scale opposite 30 deg. 20 min. read 210, representing the altitude of the triangle. On the *A* scale opposite 59 deg. 40 min. (the complement of 30 deg. 20 min. and the third angle of the right triangle *BDC*) read 358, the third side of the triangle *BDC*.

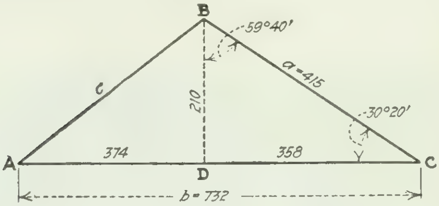


FIGURE FOR SOLVING COSINE FORMULA

Then, on the tangent scale set the index to 374 (732 − 358). Over 210 on the *D* scale read the angle *CAB*, 29 deg. 20 min. Set sine of 29 deg. 20 min. to 210 and on the *A* scale read 428 +, the required side.

Diagram for Designing Tunnel Roof Slabs

By Richard P. Wallis
The Lundoff-Bicknell Co., Cleveland, Ohio

The accompanying diagram was recently prepared by the writer to aid in the study of the economics involved in the location of a reinforced-concrete service tunnel contemplated for a certain large industrial plant. In this particular plant it was proposed to convey the various utility services, such as heating mains and returns, water supply, electrical lines and low-voltage circuits, by tunnel from the central power plant to the various units in the group. A cross-section 6 ft. wide and 6 ft. 6 in. high was established as a standard for this tunnel. The lines of pipe were supported on iron racks so no direct load from this source is carried by the roof.

As the topographical features of the area occupied by this group contain many eminences and depressions it was evident from the first that it would prove uneconomical to establish a uniform construction for the tunnel in all locations. The nature of the soil is such that the pressure on the side walls varies but little for different depths and accordingly the principal pressure to guard against is that caused by the hydrostatic pressure of the ground water. The tunnel was therefore designed with a constant cross-section with the exception of the roof slab which varies for different depths and was well waterproofed with integral waterproofing at the same time provision being made for carrying away whatever groundwater there might be present by parallel lines of drain tile laid at each side of the tunnel.

From Job and Office

Hints that Cut Cost and Time

For ease in comparing the necessary roof construction for different depths of tunnel the four important factors, total thickness of slab, area of steel required per lineal foot of tunnel, number of ⅝-in. round rods and the spacing of these rods were reduced to functions of *D*, or the distance from the surface of the ground to the top of the tunnel roof slab, and platted as curves on the accompanying diagram.

The various assumptions upon which these curves are based are as follows: The concrete is proportioned as a 1:2:4 mix capable of developing a stress of 2,000 lb. at 28 days with unit stresses of 16,000 and 650 lb., respectively, for steel and concrete. The weight of the soil was found to average 100 lb. per cu.ft. and the concrete 150 lb. A live-load of 35 lb. per sq.ft. was assumed as superimposed on the surface of the ground. This is about the maximum load likely to be caused by a gathering of people. As will be noted from the above this diagram applies only to those locations where the probable live-load will not exceed that limit. Under roads or in other locations where subjected to concentrated loads special construction must be resorted to to meet the individual requirements of location.

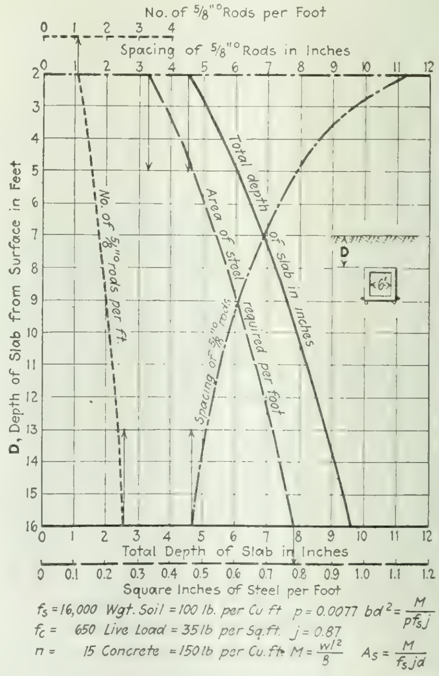


DIAGRAM TO FACILITATE DESIGN OF PIPE TUNNELS

The limits of depth selected for the diagram are from 2 to 16 ft., the former being the minimum amount of earth necessary to support vegetation and the latter representing about the maximum depth set by the re-

From Job and Office

For Contractor and Engineer

quirements of the service lines contained within the tunnel.

The use of ⅝-in. round rods as reinforcing for the roof slab was assumed in the preparation of this diagram. Any other size rods might have been adopted in this connection but the size selected represents a conservative mean as regards availability and ease in handling.

No attempt was made to vary the design of the roof slab for local variations of depth as this practice, while possibly economical as regards the quantity of concrete and steel necessary, only leads to endless confusion and increased cost in the actual construction of the work in the field. Different units of tunnel were, however, arbitrarily considered as having the same roof section area, the section selected in each case being that capable of sustaining the maximum load. The determination of the length of such units is influenced by the relation of the grades established by the pipes and the surface of the ground.

It becomes possible by the use of this diagram to estimate with considerable speed and accuracy the quantity of concrete and steel required for various tunnel layouts. To increase the facility with which reference may be made to the various curves the base line for each curve is shown in the same convention as the curve itself.

The use of this diagram is simple. Suppose for example that the maximum depth assumed for a section of tunnel is 10 ft. It is only necessary to enter the diagram on the horizontal line corresponding to 10 ft. on the vertical scale, continuing until intersecting curve marked "Total depth of slab in inches." Referring this intersection to the horizontal scale corresponding to this curve the value is read off as 7.9 or 8 in. This value of 8 in. includes 1 in. of fireproofing below the steel. The corresponding values obtained for "Area of steel," "Number of ⅝-in. round rods," and "Spacing of ⅝-in. round rods" are 0.636 sq.in., 2.1 rods and 5.8 or 5¾ in., respectively.

Determining Height of Tower Panels When Diagonals Are Parallel

By A. L. Frost

Boston, Mass.

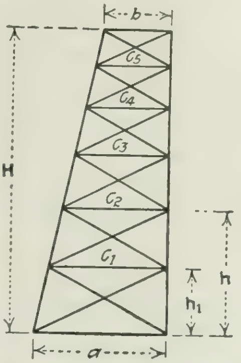
When for the sake of appearance, or for other reasons, it is required that the diagonals of a tower or bent be parallel, the problem is that of dividing a trapezoid (or an isoceles trapezium) into n panels in such a way that the diagonals shall be parallel. For instance, let it be required to divide the bent shown in the accompanying figure into six panels.

To effect this we use the following formulas, where n is the number of panels:

$$c_1^{n} = a^{n-1}.b$$
$$c_2^{n-1} = c_1^{n-2}.b$$
$$c_3^{n-2} = c_2^{n-3}.b$$
[illegible] $= c_3^{n-4}.b$, and so on

The height h corresponding to any horizontal c can be determined from

$$n = H \frac{a-c}{a-b})$$



TOWER WITH DIAGONALS PARALLEL

For most practical purposes it will be sufficiently accurate, after computing the first horiztonal from

$$c_1^{n} = a^{n-1}.b$$
$$\text{or } c_1 = \sqrt[n]{a^{n-1}.b} \qquad (1)$$

to determine h_1 from

$$h_1 = H\left(\frac{a-c_1}{a-b}\right) \qquad (2)$$

After drawing c_1 and the first diagonal, which determine the first panel, the remaining panels can be found with sufficient accuracy graphically.

Thus, if $a = 6$ ft., $b = 4$ ft.; $H = 18$ ft., $n = 6$, we have by substituting in (1)

$$c_1 = \sqrt[6]{6^5 \times 4} = 5.608$$

Substituting this value for c_1 in (2)

$$h_1 = \frac{18(6-5.608)}{6-4} = 18\,\frac{0.392}{2} = 3.528, \text{ i.e.;}$$

$$h = 3 \text{ ft. } 6\tfrac{3}{8} \text{ in.}$$

Hold Plate-Girder Abutments by Brackets

In ORDER to hold the yielding abutments of a deck plate-girder railway bridge of 34-ft. span near Vienna, Austria, downward-projecting steel brackets have been attached to the bottom flange of the girders close to each abutment, and the abutments blocked against these brackets to hold them from movement. The case is reported by L. Herzka in *Der Bauingenieur* of Nov. 15. The abutments showed movement soon after the bridge was built, which was a number of years ago, and ultimately the span at the bridge seats was shortened 16 in. A system of timber struts was wedged between the abutments to hold them. This strutting was effective, but when the timberwork was weakened by decay a more permanent bracing system was decided upon. The four main girders were, therefore, fitted close to each abutment with brackets riveted to the bottom flange and projecting 6 ft. down. The face of the bracket is about 12 in. away from the face of the abutment. Timber wales bearing against a lagging of planks to distribute the pressure to the masonry are wedged tightly against the brackets. The strength of the brackets is proportioned for a thrust of 13 tons each, an amount computed from the theoretical active earth pressure against the abutments. This bracing system was installed early in 1922 and according to measurements made in the following fall proved entirely effective in preventing movement of the abutments. An analysis of the action of the brackets under load on the bridge showed that not only are the bending moments in the girders greatly reduced, but the effect of the live load on the stability of the abutments is eliminated by the increased outward thrust of the brackets.

Disapprove of Direct-Oxidation Process for Sewage of Trenton, N. J.

THE resolution disapproving the plans for treating the sewage of Trenton, N. J., by the direct-oxidation process and advising a less costly method, but giving the city a month for further consideration and a chance to resubmit the plans as for an experimental plant, adopted by the New Jersey State Board of Health on May 1, 1923, ar given in full below, together with a table of comparative costs prepared by the Engineering Bureau of the Department:

WHEREAS, On March 23, 1922, the Board of Commissioners of the City of Trenton by stipulation in the Court of Chancery agreed to adopt a plan for the disposal of sewage and other polluting matter from the City that shall be approved by the Department of Health of the State of New Jersey; and,

WHEREAS, The City of Trenton to comply with this stipulation submitted to the Department of Health in December, 1922, for its approval, plans for the construction of a sewage treatment plant which involves a method of sewage treatment known as the direct oxidation method of sewage treatment, which includes the installation of mechanical fine screens, apparatus for the application of pulverized lime to the screened sewage, cells for the application of electricity to the lime sewage, and a tank or thickener for the sedimentation of the effluent from the cells; the final effluent to be discharged into the Delaware River through submerged outlets; and,

WHEREAS, This Department is of the opinion that the Direct Oxidation method of sewage treatment is still in an experimental stage and has not been demonstrated as a practical and continuous method for the treatment of sewage; and,

WHEREAS, This Department is of the opinion that the expense of the system as proposed for the City of Trenton is considerably in excess of the requirements of the existing situation, and believes that the City of Trenton could employ a less costly method both as to first cost and cost of maintenance as indicated in a table prepared by the Engineering Bureau of the Department, appended hereto; and

WHEREAS, this Board further believes that a plant for the treatment of sewage by sedimentation only, if properly constructed and operated, should suffice to handle the sewage of Trenton without further treatment for at least ten years and probably for considerably longer, or in lieu thereof that a satisfactory treatment of the sewage of Trenton could be had by the use of mechanical fine screens, apparatus for the application of pulverized lime to the screened sewage, and a tank or thickener for the sedimentation of the lime sewage, the effluent then to be discharged into the Delaware River from the system: therefore,

BE IT RESOLVED, That the plans be returned to the City of Trenton with the statement that this Board refuses to approve this method of sewage disposal for the City of Trenton, but that the City of Trenton be given one month in which to give this matter further consideration and if they desire to do so, to re-submit the plans. which will then be considered by this Department as an experimental plant.

COMPARISON OF COSTS OF DIRECT OXIDATION AND SEDIMENTATION METHODS

Municipality	Average Dry-Weather Sewage Flow Gal. per Day	Method of Treatment	Information as to Cost	Cost of Construction	Annual Charges for Capital, Labor, Etc. Uniform Capital at 7½ Per Cent*	Labor, Power, Maintenance, Supplies	Total	Cost per Million Gallons Capital	Operating	Total
Trenton	18,000,000	Direct oxidation	G. A. Johnson's report to City of Trenton, 1922	$1,063,000	$79,725	$125,910	$205,635	$12.13	$19.16	$31.29
Trenton	18,000,000	Sedimentation (Imhoff tank)	Supt. of Albany sewage-works. Construction cost as of 1914; operating cost as of 1921.	582,788	43,709	60,641	104,350	6.65	9.23	15.88
Phillipsburg	970,000 As of March, 1922	Direct oxidation	Dept. report	164,535	12,340	....	....	34.85	35.06	69.91
Phillipsburg	700,000 As of March, 1923	Direct oxidation	Contract to operate for $12,000 a yr.†	164,535	12,340	12,000	24,340	48.30	46.96	95.26
Phillipsburg	2,000,000	Direct oxidation	Dept. report	164,535	12,340	17,447	29,787	16.90	23.90	40.80
Phillipsburg	2,000,000	Sedimentation (Imhoff tank)	Supt. of Plainfield sewage-works. Construction cost as of 1916; operating cost as of 1922.	43,408	3,255	6,000	9,255	4.46	8.21	12.67

* For the sake of uniformity and simplicity, Col. George A. Johnson's 7½% capital charge is used all through this column, although the compilers of the table felt that a lower rate should be used for tanks, etc., than for the machinery in the Trenton estimates.

† The sewage-works at Phillipsburg, N. J., are now being operated by the Direct Oxidation Disposal Corporation for a payment to the company of $1,000 per month, the contract covering a period ending Dec. 31 of this year—EDITOR.

Co-ordination of Land Development Needed

IN AN address delivered recently before a land settlement conference at Berkeley, Calif., Frank Adams, director of irrigation investigations for the University of California, discussed in detail the various factors which must be taken into consideration in planning the development of new irrigation projects. One phase of his address gave attention particularly to the need for better co-ordination of development agencies. In this connection he said:

Certain areas in California are now suffering from what has probably been an inevitable and perhaps a necessary lack of co-ordination of development agencies overlapping the same areas such as reclamation districts, irrigation districts, drainage districts, and levee districts.

Irrigation districts are created on vote of the electors, normally with the approval of the state engineer and their financing is controlled by the Bond Certification Commission. Reclamation districts are formed on petition of holders of title representing one-half or more of the land to be included and reclamation taxes are levied according to benefits by the county supervisors after assessment by distinterested commissioners. Drainage districts may be formed either by the county supervisors or similarly to the formation of irrigation districts. Levee districts are formed by the supervisors on petition of a majority of the landowners and assessments are levied by the supervisors on an ad valorem basis as determined by the county assessor. On top of all this, for instance, comes the Sacramento and San Joaquin Drainage District whose boundaries are fixed by the Legislature and in which assessments are levied according to benefits by the state reclamation board.

It is presumed, when any of these various agencies that control the management and financing of such enterprises have laid upon the land expenses for drainage or reclamation or irrigation or protection from overflow, that they have given due consideration to obligations already imposed or for which the power to impose existed. Nevertheless, the acute situation resulting from the overlapping of assessments found in certain sections of the State would, in all likelihood, be more favorable to the landowner if the efforts and the agencies in charge were more nearly co-ordinated. Certainly, in the interest of successful land settlement, this overlapping should be more carefully considered in advance in the future than it has been in the past.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

How Can We Stop Duplication of Orders?

Sir—We think a non-cancellable contract would be a great help toward stabilizing the building supply market. Some factories make a practice of booking large orders from speculative jobbers and then raising prices on account of the large volume of business on their books, while this output has actually not been sold to the consumer at all.

The cement industry has recognized this evil and corrected it to a large extent. If other lines would follow their lead it would help very much to stabilize material prices. G. W. COOPER,

A. & W. Cooper, Dealers in Builders' Supplies.

Detroit, May 21.

Sir—I have read with considerable interest your editorial on the question of duplicating orders with the privilege of cancelling in the event that materials were not needed. It seems to me that your stand on this subject is quite correct. A great many contractors adopt this policy with the idea that they will be in a position to underbid their competitors without any cost or risk to themselves. Should the work not come to them, which is usually the case, they still hold to their advantage, thus keeping their competitors from securing the materials which the manufacturer or supply dealer is holding for the first contractor.

If the policy that you are advocating were adopted, the manufacturer and building material dealer would always be in a position to advise definitely whether prompt delivery could be made on any order placed with them.

Nashville, May 14. E. G. HOLLADAY,

E. G. Holladay Co., Building Construction, Nashville, Tenn.

Sir—I had the pleasure of reading your recent editorial on "How Can We Stop Duplication of Orders." While the points you have raised are deserving of serious consideration and the lack of mutuality in the so-called contract under which materials are now customarily purchased by local dealers and contractors is obvious, the most potent fact governing duplication of orders is one to which no allusion is made. I refer to the fact that, so far as my experience goes, there is no considerable number of manufacturers of building materials, and I presume this refers as well to manufacturers in other lines, which limits the orders booked to production capacity. To put the case from a little different angle, I will hazard the guess that any reputable contractor in New York City, having need for 25,000 bbl. of cement to be delivered at the rate of 1,000 bbl. per week for the next 25 weeks, can obtain without difficulty unreserved acceptance of his order under those terms from practically any over-sold cement mill within shipping radius of New York.

Nor have I referred to cement mills because they are unusual offenders in this particular. I believe their practices in this, as in many other matters, to be rather above the ordinary. If a contractor wished a million board feet of lumber or a proportionally large supply of brick or lime it would ordinarily be sold to him under specific terms as to delivery without the slightest regard to whether or not delivery could actually be made according to these terms.

From the standpoint of the writer, relief from the present day menace of the duplicate order can most readily be secured by the development of business ethics to a point where the buyer can know that when he receives the acceptance of an order under specific terms of delivery he has received a document which the vendor can and will honor. But, as matters now stand, the ordinary contractor and the small distributor have no means at their disposal for determining whether, in fact, a manufacturer is or is not oversold, and are forced to do business with full knowledge of the fact that, in practice, the average manufacturer will accept almost unlimited orders without regard to whether he can make delivery. It is only when deliveries fail to arrive that the buyer knows that the market is oversold, and in an effort to secure the materials that he needs aggravates the situation by duplicating and reduplicating orders in the hope that he can find a merchant who will sell something that he has, instead of something that he hopes some time to produce.

There are not, in my judgment, 10 per cent of the contractors or distributors in this country today who would ever duplicate an order if the manufacturers by whom orders are accepted would validate their sales by making only such as they know can be shipped under the terms of the orders as accepted. J. L. HARRISON,

U. S. Bureau of Public Roads.

Washington, D. C., May 19.

Sir—Relative to the question of duplication of orders on manufacturers to insure adequate deliveries for construction work, it has been our practice only to protect ourselves for the work we have in contemplation for the immediate future. We have endeavored at all times to carry on our program of work in connection with the manufacturers so that orders will be bona-fide and this procedure has resulted in a mutual understanding which, I think, has been of advantage to both parties. A. J. HAMMOND,

Chief Engineer for James O. Heyworth, Engineer and General Contractor.

Chicago, May 23.

The Pan-American Railway

Sir—In spite of its futility, this project keeps cropping up, as it is one which appeals to the imagination, and although the fallacies have been repeatedly pointed out, it hardly seems wise to let the article published in your issue of May 10 pass without some comment. This seems especially necessary now, at a time when we may venture with some reason to hope that American engineers will be able to take a larger part in the development of transportation in South America, though in order to do this successfully they must keep their feet firmly planted on the ground. A certain amount of imagination is of course very necessary to all engineers, but it must be tempered by the practical, and I am firmly of the opinion that this project cannot be so classed. It is also true that engineers, especially, must look forward to the future and lay their plans accordingly, but this plan I believe is farther in the future than we can look forward to now, and its advocacy by any considerable body of American engineers or business men will only bring them the reputation of being more or less visionary.

The writer's interest in this subject goes back over thirty years to the time when he met and had the pleasure of entertaining, in Columbia, that Nestor of railroad engineers, Col. Wm. F. Shunk, whose field book in those days was our Bible. Col. Shunk was then making the reconnaissance from Quito to Cartagena for part of the then proposed route of the Pan-American line, and the writer was making his first piece of location with only two assistants. This interest has been sustained by contacts with Latin America, extending over all the time since then, during which the Pan-American project, as such, has not advanced a particle, that is to say, no railroad has been built in any of the territory South of the United States because it might form part of this proposed through route from New York to Buenos Aires. (This may be questioned in regard to one or two lines, but in the writer's opinion it is substantially true.)

Of course as time goes on, all the various countries will probably extend their railroads to their borders and establish through rail communications with their neighbors, but

I am firmly of the opinion that this should be done only to further the development of each country and not in pursuance of any plan of through communication unless this latter policy also fits it.

It appeals to the imagination, of course, to take a practically virgin territory as large as is the continent of South America and lay out the lines of future development on a grand scale so that all future work may be planned with an eye to the complete scheme.

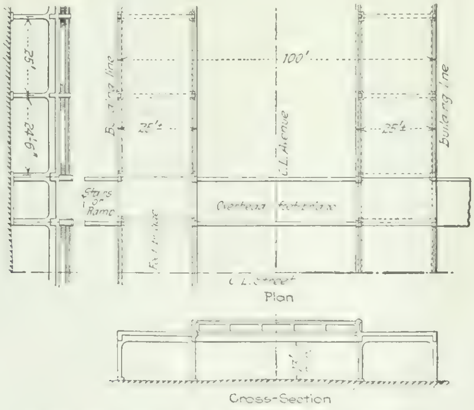
To fully develop all the arguments pro and con in regard to this very large question would take more space than I think you would care to devote to it. It is, however, the writer's opinion, based on a fairly extensive knowledge of South America, that it would be far wiser for those who wish to help in the development of transportation in the Latin American countries, which is the basis of course for all other development, to advocate for each country the development of those lines of communication which will help that particular country, and that without reference to any scheme of a Pan-American railroad. By so doing we will not only show our American practical common sense but be of the greatest help to our neighbors. F. LAVIS,

New York, May 14, 1923. Consulting Engineer.

Elevated Sidewalks of Reinforced Concrete for New York City

Sir—While the improvement in the control of vehicular traffic in New York has greatly relieved what otherwise would be impossible conditions, the problem is far from being solved both as to supplying sufficient roadways for vehicles and as to the protection of the pedestrian from injury or loss of life through the instrumentality of the congestion of vehicular traffic.

The problem is one which cannot be solved by the injection of picayune considerations or the protection of individual interests at the expense of the community at large as the solution must necessarily involve an immense outlay of money and a temporary disturbance of private property with the resulting inconvenience and temporary private loss.



PLAN AND SECTION OF PROPOSED SIDEWALKS

The accompanying sketch showing a proposed solution of the problem for a typical avenue, more particularly Fifth Avenue, contemplates the elevation of the sidewalk to the second floor level on reinforced-concrete construction of the two-way slab type, providing sufficient headroom to permit of vehicular traffic thus widening the driveway to almost one hundred feet. The present roadway need not be disturbed, the side driveways being pitched toward the present gutters. The main driveway could be restricted to through traffic while the side ways would accomodate local traffic. The shops would further have the advantages of having two stories of display thus increasing the advertising value. The column spacing is made 25 ft. to conform to the normal width of a city lot but is amenable to change. The two-way slab proposed for this structure is an economical type of construction and with an open concrete balustrade would have a very pleasing appearance. If desired the slabs could be precast so as to interfere with business and traffic as little as possible during construction. It then would be necessary to cast only the columns and girders in place. At the street crossings overhead footbridges are contemplated which could be precast and set in place, similar to one of like span that has been constructed and is ready to be set in place in connection with the Lackawanna improvement work at East Orange, and in this way would minimize the obstruction to traffic. At 14th, 23rd, 34th, 42nd and 57th St., it would be advisable to eliminate crossing at grade by elevating the cross streets to the elevation of the proposed sidewalks, while at other streets, either ramps, stairs, escalators or moving platforms could be provided to connect the two levels.

While the arcades recently proposed provide the additional driveway space the method would probably be more expensive and would not solve the problem of protecting pedestrian traffic.

With the introduction of additional longitudinal streets such as have frequently been proposed it will be possible to maintain one-way traffic on the majority of them and thus further relieve congestion and eliminate danger of accident both to vehicles and to pedestrians where sidewalks are not elevated. M. HIRSCHTHAL.

Hoboken, N. J., May 10, 1923.

Conditions on the Polish Railways

Sir—The article in *Engineering News-Record* of March 15, 1923, p. 484, about the railway conditions in Poland gives the general characteristics and is very satisfactory. I would like to add, however, that not only was part of the Russian railway system built for military purposes, but also that the German and Austrian Governments had considerable influence in the laying out of these railways. The Russian Government had to be very careful in what it did and often was unable to build private lines for purely local communication.

The shortage of railway systems in the Russian part of Poland is very great and in comparison with the former German and Austrian parts we see that whereas the German part has 5.9 miles and the Austrian part 3.44 miles, the Russian part has only 1.68 miles for each 38.6 surface miles.

Before the war France had 114 cars, Germany 163, Russia 100, Austria 80, while Poland had only 54 cars for each 6.22 miles of line but, thanks to America, Poland has now some thousands of new locomotives and freight cars.

It will be seen that the war with Russia demanded from the railways an intensity of construction unprecedented in peace times when it is realized that the engineers were required to rebuild in a few days some hundreds of miles of standard-gage track for pushing back into the country thousands of captured cars and locomotives from the Russian system.

After the return of part of Upper Silesia, Poland had not only the difficulty of obtaining cars for handling coal, but had to reorganize her transportation system to make up for the parts that had been turned over to Germany.

Under the Versailles Treaty 49,000 cars and locomotives were returned to Poland, and, thanks to the activity of her government and citizens, they are now in fair condition and traffic will move better. For example, the daily number of running freight cars in January, 1921, was 7,160, in the same time in 1922 was 7,375, and now in January, 1923, is 10,054. Also, the number of cars under repair has been reduced to 16 per cent, a much better figure than last year. In addition to this, Poland is now showing considerable activity in building new railways and preparing for future lines. A part of the loan received from France will be used for this purpose and the government is considering the question of separating the railways from the general budget.

Los Angeles, May 3, 1923. Z. GILLEWICZ.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

According to Figures Compiled by Edwin Mitchell, chief accountant of the Colorado Highway department, $19,813,207 has been expended since the organization of the department in 1910.

On May 17 the Two Headings of the Queensboro extension of the New York Subway met under 42nd St. near 5th Ave. Work on this part of the extension was started on Aug. 1 last and it is expected that it will be completed by Jan. 1, 1924.

Governor Pinchot, of Pennsylvania, has signed a measure which he sponsored, providing for a board to confer with similar boards appointed by New York and New Jersey on regulation of flow in the Delaware River. The measure creates a board consisting of nine members (certain state officers) to survey the power possibilities of the state's water, and to formulate a plan for the best development.

City Planning Projects at St. Paul, Minn., are making slow headway, owing to difficulty in inducing the city council to open new streets or widen existing streets where there is protest from the owners. The councilmen are elected at large, and it is stated that when any considerable group of citizens makes protest against a public improvement that improvement is practically doomed. A review of the extensive program of improvements of the City Planning Board was given in *Engineering News-Record* of Nov. 3, 1921, p. 735.

The Constitutionality of the Water Diversion Tax imposed by the state of New Jersey on all water diversions for municipal supply in excess of the amount used in 1907 has been upheld by the United States Supreme Court in an appeal from a similar decision of the courts of New Jersey. Under an act passed in 1907 such diversions are subject to a state tax of $1 per million gallons. The legality of the tax was contested by Newark and Trenton as regards water diverted from the Pequannock and Delaware Rivers since 1907 for which the state sued to collect totals of $18,104 and $14,310.

Operation of Elevated, Surface and underground lines as a unit system with a single fare and transfers is recommended in a report presented May 21 to the Chicago council committee on local transportation by B. F. Kelker, Jr., engineer for the committee. The report proposes the construction of 205 track-miles of elevated railway, 248 of surface lines, 55 of rapid-transit subways and 2½ of subway for surface cars. The total cost is estimated at $372,830,000. The total mileage of single track would then be 366 miles of elevated line, 1,308 miles of surface line, 55 miles of rapid transit subways and 2½ miles of subway for surface cars.

Wabash R.R. Plans Varied Work

Improvements on the 1923 program of the Wabash R.R., exclusive of rails and track work, represent a total expenditure of $1,120,000. Line changes and bank protection along the Missouri River, including relocation at Randolph, Mo., on account of encroachment by the river, will cost $76,000. For shops and engine terminals there is a total of $248,550, including $150,000 for machinery at various points and $46,200 for terminal extensions at Moberly. Freight yard extensions will cost $76,923. For elimination of grade crossings there is a total of $324,000, of which $150,000 is for work east of Calhoun St. at Fort Wayne, Ind., and $70,000 for Hastings St., Detroit. In the $394,000 for bridges and miscellaneous work there is $115,000 for a plate-girder bridge at O'Fallon, Mo.; $160,000 for bridges with steel girders and concrete girders and slabs; $60,000 for enlarging a dock at Detroit, and $28,000 for building an impounding reservoir for water supply at Stanberry, Mo.

Ford Files Application for High Dam Power

The formal application of the Ford Motor Co. for a license, covering the High Dam project at St. Paul, was filed with the Federal Power Commission May 22 by J. H. Manning, the managing engineer for Stone & Webster. This action is in pursuance to the terms of the preliminary permit which the Federal Power Commission granted the Ford company after the hearing held on March 2.

The application for license was accompanied by detailed plans of the development which appear to have met the Commission's approval. Under the law these plans must be approved by the Secretary of War and the Chief of Engineers, as well, because of the relationship between this project and navigation structures. The War Department has been asked to act promptly on these plans as it is hoped to get the out-of-doors portion of the construction completed during the present working season.

Milwaukee Harbor-Rail Committee Assists Harbor Commission

At the request of the Milwaukee Society of Engineers a committee of representatives from the railroads, civic and commercial associations, and the city government has been appointed to prepare a solution of the problem of coordinating the rail and water transportation facilities at Milwaukee. The engineers on the committee are C. F. Loweth, chief engineer of the C. M. & St. P. Ry.; F. W. Hillman, division engineer of the C. & N. Ry.; J. W. Hyatt, engineer of maintenance-of-way, C., N. S. & M. Ry.; and George H. Boyer, W. J. Sando, and R. H. Pinkley of Milwaukee.

Water-Works Meeting in Detroit Is Record

American Water Works Association Has Large Attendance and Successful Program at 43rd Convention

Engineering News-Record Staff Report

With a membership that has now reached about 1,700 and an attendance of perhaps half of the members of all grades, the American Water Works Association assembled for the forty-third time in annual convention, held what from all points of view was considered a record-breaking meeting at Detroit, Mich., May 21-24. Features of the convention were many reports from sub-committees of the Standardization Council; superintendents' sessions; three sessions of the Chemical and Bacteriological Section, which has asked for a change of designation to "division" to save confusion with the geographical sections; a manufacturers' section at which moving pictures were used to show the manufacture of (1) centrifugally-made cast-iron pipe, (2) a 20-in. Eddy gate-valve, and (3) Johnson brass well screens; and entertainment by the Detroit Water Board and the Water-Works Manufacturers' Association.

PAPERS AND REPORTS

About sixty papers and committee reports were presented besides many topics handled through the usual question box. It was this last-named feature, under the leadership of Dow R. Gwinn, Terre Haute, Ind., and the technical committee reports presented under the direction of George W. Fuller, chairman of the Standardization Council, that elicited the most discussion.

The technical proceedings are given attention elsewhere in this issue. The main business features are summarized below.

President's Address—The future of the Association, said W. S. Cramer in his address as retiring president, rests largely with the sections. The work of the Standardization Council is valuable. It is making demands on the funds of the Association which would have been larger had not so much of the expense been borne by its members and the membership of the sub-committees.

Honorary Members—Six honorary members were elected as follows: George H. Benzenberg, Milwaukee; Desmond Fitz Gerald, Brookline, Mass.; R. Hering, New York City; William Mulholland, Los Angeles; J. H. Purdy, for many years superintendent of the American Water Works and Guarantee Co. (now American Water and Electric Co.); and Sir Alexander Houston, director of water examinations, Metropolitan Water Board, London, England.

New Officers—The count of the letter ballot showed that the following had been elected as officers for 1923-1924: President, George W. Fuller, New York City; vice-president, Frank C. Jordan, Indianapolis; treasurer, (re-elected) W. W. Brush, New York City; trustees, C. R. Bettes, Far Rockaway, N. Y., and E. E. Wall, St. Louis. On the Standardization Council it was announced by George W. Fuller, chairman, that Prof. George C. Whipple will be succeeded by W. W. DeBerard, Chicago. The Chemical and Bacteriological Section elected these officers: Chairman, Almon L. Fales, Boston; vice-chairman, Norman J. Howard, Toronto; secretary, Dr. Edward M. Buswell, Urbana, Ill.

Next Convention at Memphis, Tenn.—On the first ballot for the next meeting place of the Association, Memphis, Tenn., and Montreal, P. Q., were far in the lead, with 159 and 148 votes, respectively. Chicago and Detroit had 43 votes each and there were scattering votes for several other places. The second ballot confined to a choice between the two highest cities on the list gave 184 votes to Memphis and 182 to Montreal.

The finances of the Association were shown to be in good shape, with the past year's expenses below the budget allowance, on operating surplus and a $12,000 investment fund. The 1923-1924 budget was fixed at $23,000.

Resolutions—The Association adopted a resolution introduced by Dabney H. Maury, Chicago, urging the Department of Justice to bring to speedy trial the suits against contractors, engineers and others on account of alleged frauds in the construction of army camps during the World War. A resolution urging the city authorities of San Francisco to find some other way to honor M. M. O'Shaughnessy than to name the Hetch Hetchy dam after him in view of the fact that the new Scioto River dam at Columbus, Ohio, was named after Jerry O'Shaughnessy two years ago, was lost.

The Nicholas S. Hill, Jr., cup for the largest percentage of attendance at section meetings during the year was awarded to the North Carolina section for 66.6 per cent of record.

San Francisco Water Supply Is Augmented

To increase the quantity of water supplied to San Francisco from the Calaveras watershed, the Spring Valley Water Co. is reconstructing the Sunol aqueduct through Niles Canyon. The old aqueduct, consisting of about 3 miles of wooden flume and 5 tunnels, whose total length is also about 3 miles, was limited by the size of the flume to a capacity of 21 m.g.d. The present requirement is for 45 m.g.d., but since the tunnels already have a 70-m.g.d. capacity it was decided to rebuild the flume in reinforced concrete of sufficient size to carry 70 m.g.d. The work is already under way and the flume is to be in service in October.

Work is being done on a day-labor basis, under the direction of George A. Elliott, chief engineer, and T. W. Esby, construction engineer of the Spring Valley Water Co.

To supply new resident districts building up at higher levels the Spring Valley company is constructing a reservoir at El. 612, which is several hundred feet higher than any heretofore in service. Only one-half the reservoir is being built at present.

Strauss Bascule Bridge Co. Sues City of Seattle

Claiming breach of contract on the part of the city of Seattle, the Strauss Bascule Bridge Co. of Chicago, to which the city recently paid $45,000 in settlement of claims for alleged infringement of patents, has filed suit for $119,392.14 damages against the city. Of this sum, $100,000 is demanded by the company because City Engineer J. D. Blackwell is accused of having made a "libelous statement" that "The Strauss design is not equal to the city design, and if it were made equal it would cost more than the city design." The sum of $19,392.14 is asked, as representing five-tenths of the savings which the company alleges would have resulted by the construction of a Strauss type bridge across the West Waterway at Spokane St., and which the city had agreed to pay the bridge concern. This saving, the company charges, would have been effected "within the limits of the specifications and standard bascule bridge practice."

Portland Cement Association Expands Work

Further expansion of its promotional activities, through the establishment of four new district offices, was announced at the Spring Meeting of the Portland Cement Association in St. Louis last week. These offices will be located in Birmingham, Memphis, Raleigh, N. C. and Jacksonville, Fla. The institution of these offices is largely due to the expansion of mill capacity in the Southeast.

It was further announced that the association will undertake an elaborate celebration next year of the 100th Anniversary of the granting to Joseph Aspdin in England of the patent on portland cement. Full plans have not yet been worked out but it is intended to ask British cement manufacturers and British engineers to come to this country to participate in the ceremonies. Advantage will be taken of the occasion, as well, to promote the relations between America and Great Britain. Aspdin's patent was granted in October, 1824.

Of technical interest were papers on "Possibility of Improving Hydraulic Cements," by P. H. Bates, of the Bureau of Standards, and one on "Fuel Economy in Cement Mills," by O. Lellep, of the Giant Portland Cement Co. The report of the committee on Accident Prevention showed gratifying decreases in the accident records of practically all the mills. Hereafter a tablet will be awarded annually to the mill showing the best safety record.

This year's annual meeting of the association will be held at the Hotel Biltmore, New York City, Nov. 19-21.

The dinner closing the meeting was made notable by an address by Floyd W. Parsons, of the *Saturday Evening Post* and formerly editor of *Coal Age*, and by a moving picture exhibition by Albert Y. Gowen, formerly vice-president of the Lehigh Portland Cement Co., showing his trip around the world in the motor yacht *Speejacks*. The film, in seven reels, represents but 7,000 ft. of the 92,000 ft. of film taken by Mr. Gowen in his fourteen months cruise. Most notable were his pictures of inaccessible and rarely visited tribes in the South Sea Islands.

Suspension Bridge Truss Fails Under Heavy Load

Temporary Repairs Are Made to Structure Over Ohio River at Steubenville

On May 16 a stiffening truss failure occurred in the highway suspension bridge across the Ohio River at Steubenville, Ohio, when a heavy load was on the bridge. Sharp distortion of the structure developed, subsiding again after the load was removed. Various weaknesses in the construction of the bridge contributed to the accident. Temporary repairs have since been made.

The structure has a channel span of 680 ft. and side spans of 260 ft., with floor hangers spaced 16 ft. The stiffening trusses are interrupted by expansion joints at the center of the main span. The trusses are 20 ft. deep at midspan and anchorages, and about 25 ft. at the towers.

At the time of the accident several heavy cars of cinders were on the bridge. It is reported that the floor of the west shore span suddenly sank about 8 ft., and that of the channel span rose correspondingly. After removal of the cars the structure recovered its normal shape.

An engineer who visited the bridge shortly afterward found no appearance of movement in the tower or cables, although the saddles are housed in and could not be examined. Near midspan of the west shore span, the top chords of the stiffening trusses were broken, one in the seventh panel and the other in the eighth panel from the shore end. The top lateral system in the same region was badly distorted. The bottom chord buckled on a length of three panels between the break and the abutment; the bottom lateral bracing in this region had been cut during some earlier reinforcement operations. The top lateral system in the vicinity of the break in the top chord was greatly distorted.

STIFFENING TRUSS CHORD

The top chord of the stiffening truss is a T-shaped section built up of wide, thin plates and small angles. The top lateral struts are very slender T-shaped sections, while stay-struts at the crossing points of the top lateral diagonals are better designed for compression, being latticed members, but are not part of the lateral system proper. There is practically no effective sway bracing, small curved angle knees connecting the posts and the slender T-struts.

In three panels lying between the break and the abutment, new floorbeams had been inserted at some time in the past between the regular floorbeams. These new beams, suspended directly from the cables, support the stringers at mid-panel. The bottom laterals, however, which interfered with the insertion of these new floorbeams, were cut apart to permit of inserting these beams, being burned off on either side of the new floorbeams. In these three panels the bottoms chord buckled, and at least one of the laterals is badly distorted, showing the need of the lateral bracing.

From the local examination it was concluded that the failure is chargeable primarily to a twisting action occurring under excessive one-sided load, distortion being favored by the weak and lateral and sway systems.

New Jersey Organizes Building Congress

First State Organization to Bring All Elements of Industry Together Formed at Newark

For the first time in the history of the building congress movement a state section was organized when, on May 28 at Newark, the New Jersey Building Congress was formed. The northern part of the state had been considering for some time the organization of a congress but construction men in other parts of the state displayed such enthusiasm for the plan and the opinion was so general that the interests of the entire state were bound up together that it was decided to form a state-wide organization. The formation of subsidiary local bodies in the important cities of the state is to come up for early consideration.

The new congress becomes the New Jersey Section of the National Congress of the Building and Construction Industry. The six basic elements of the industry, promotion, design, construction, labor, materials supply and "general interest," and all parts of the state were represented at the organization meeting. Question was raised and referred to the executive committee as to the advisability, because of their importance in New Jersey, of designating building and loan associations as a distinct element. Committees on codes, arbitration, seasonal employment, standards, surveys and apprenticeship were authorized. Individual dues were set at $15, association and corporation dues at $25, and sustaining, at $100.

TEMPORARY OFFICERS

The following temporary officers, to serve until the next annual meeting next October, were elected: President, Harry T. Stephens, architect, Newark; vice-presidents—Joseph F. Eilbacher, builder, Elizabeth; William Burton, builder, Trenton; Arthur Quinn, labor, Rahway; Henry Sands, labor, Newark; Donald McClave, materials supply, Harrison; E. J. Mehren, "general interest," South Orange; treasurer, Frank E. Quimby, Newark; secretary, S. George Webb, secretary, Building Trades Employers' Association, Newark. Additional elective members of the executive committee are T. Yorke Smith, building and loan association league, Camden; Wesley A. O'Leary, assistant state commissioner of education, Trenton. The chairmen of all committees, to be appointed by the president, will be *ex-officio* members of the executive committee.

Robert D. Kohn, of New York, chairman of the national organization, presided at the meeting.

Test Case on Highway Contract Cancellations in California

The right of the new California State Highway Commission to cancel contracts entered into by the old commission, with or without the consent of the contractor, is being tried out in an action recently brought in the Supreme Court of that state in connection with a contract made between the George Pollock Co. and the former California State Highway Commission for road construction in Monterey County.

San Francisco Material Dealers Acquitted of Charges

Thirty-four building material dealers of San Francisco, prosecuted for refusing to sell materials to contractors who would not support the American plan, were recently acquitted in the California Supreme Court within thirty minutes after the case had been put in the hands of the jury.

The prosecution of this case was "union labor's attack upon the American plan," according to the Industrial Association of San Francisco, which points out that the result is "a victory of nation-wide importance that should redound materially and permanently to the benefit of every community that seeks to free its industry from autocratic class control and to secure the ultimate good of all labor, union and non-union, as well as of industry itself."

In the conduct of the case the defense frankly admitted withholding materials from the enemies of the American plan but contended that this had aided the community and had been done with that end solely in view. The defense showed that the city had prospered tremendously under the American plan—whose benefits had even flowed in the form of steady work and high wages to the men whom the prosecution claimed were agrieved.

"The findings of this jury," the Industrial Association states, "by upholding the doctrine that the general good of the whole community must be put above advantage to any one class, perpetuate the complete industrial freedom which San Francisco fought so long to obtain."

Previous reference to the rise in popularity of the American plan in San Francisco was published in *Engineering News-Record* Sept. 8, 1921, p. 427.

Portland City Council Approves Waterfront Development Plan

The City Council of Portland, Ore., has passed an ordinance adopting the report of O. Laurgaard, city engineer, in which a plan is outlined for developing the waterfront opposite the business district of the city, to cost altogether about $11,163,000. The plan includes a fill made with material dredged from the river channel, the elevation of bridge approaches and the construction of a sea-wall, interceptor sewer, market buildings, terminals and other structures. Special consideration was given to the plan at this time because some such improvement will be highly desirable in connection with laying out the West approach to the new Burnside bridge.

Of the total cost of the project the City of Portland would bear about $800,000, according to the city engineer's report, the balance to be borne by the railroads and by the corporation which it is suggested should be formed to carry out the project. No date has been set for beginning the work.

Interested property owners have organized for the purpose of furthering the project and are urging the immediate construction of the interceptor sewer and the concrete sea wall as the first stage of the project. The cost of this part of the work has been estimated at $2,000,000 and would be assessed to the property benefitted.

Penn State College Holds Industrial Conference

Co-operative Technical Education, Summer Employment, Need for Engineers, Among Topics

The fourth annual conference between the industries of the state and the college of engineering was held at Pennsylvania State College, May 25-26, with about one hundred in attendance. These conferences, under the direction of R. L. Sackett, dean of engineering, are intended to inform the industrial leaders as to the work going on at the college and at the same time to develop ideas to guide the faculty in the conduct of its work. This year the conference overlapped a preceding conference on engineering extension courses and was itself devoted mainly to three subjects: co-operative technical education, summer employment for undergraduate engineers and the prospective need for engineers.

Co-operative instruction was discussed by Dean Sackett in a paper which will be abstracted in an early issue of *Engineering News-Record.* In the floor discussion the trend of opinion was not particularly favorable to this newly-developed form of collegiate training. The main objection by the representatives of industry seemed to be that the alternate school and shop method imposed unnecessary hardship on the industry because of the necessity of treating the students more as students than as workers. This hardship, it was admitted, has lessened as the term of alternation is increased above the two weeks of the first schools of this sort.

SUMMER EMPLOYMENT

Summer employment was advocated both by teachers and industrial men, but the sentiment was in favor of the boy going into the elementary processes for his first two summers, leaving the last summer for organized instruction and work looking toward his general education in the methods of the employing company. This, according to G. H. Pfeiff, of the General Electric Co., is the system in vogue in his company. R. G. Manning, of the Ambridge plant of the American Bridge Co., said the boy seeking summer employment too frequently wants to get into the designing department, whereas his own education as a structural engineer would be better furthered by two summers in the shop and on erection, though probably he would not get out of that much more than his board.

F. J. Chesterman, chief engineer of the Bell Telephone Co. of Pennsylvania, presented an analysis of the personnel of several of the largest telephone companies which showed that the technically trained man got ahead in all branches of that industry much faster than did the non-technical man. The demand for the future engineering graduate is constantly increasing, he thought, but there is a growing place for extension and correspondence school work in the industrial organization itself to take care of the demand for what might be termed the non-commissioned officers of industry.

At Pennsylvania State College this year the demand for engineering graduates is far ahead of the supply. The seniors are picking the most attractive of many jobs offered.

Random Lines

The city council has appointed August J. Van Gemert, bricklayer, assistant city engineer, the appointment coming after a prolonged argument regarding authority to make such appointment.—From a Rochester, Minn., paper.

The union scale for bricklayers at Rochester must be lower than in most places.

* * *

One Way Out

"I see you are going to talk about the transportation problem," said Will Rogers to some business men in convention at New York last week. "The trouble is, of course, that there is a lack of rolling stock since the war. I'll tell you how to solve that. Stop this running around to conventions and stay at home and the railroads won't be so congested."

* * *

"At the suggestion of Secretary Weeks, War Department officials charged with drawing up industrial mobilization plans are working out a 'don't' chart, based on war experience and setting out those things done during the war which it is most desirable to avoid in any future war emergency. Men in civil life who handled the big supply and equipment problems of the war are coming forward, it was learned today, with examples taken from their own experience of things most essential to avoid, based on errors committed during the war."—Washington dispatch.

The seven engineers who came in to help out the war construction program and whom Mr. Daugherty has indicted as criminal conspirators ought to have something to offer.

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"Visionary Side To Be Made More Attractive," reads a headline to an article on apprentices in the News Letter of the Associated General Contractors. That's good news. Heretofore most contractors have thought that only engineers were visionaries.

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There Are Screens and Screens

Rodolph Valentino doesn't like civil engineers. He says they are cramping his style. "What does a civil engineer or a prize-fight promoter know about art," he asks. "That is just what is the matter with so many pictures today. There are too many plumbers, engineers and prize fight promoters trying to tell the directors what to do. These men take the art out of the moving picture production. I know of one instance where a civil engineer killed some of the most wonderful scenes in a production after they had been filmed. He was behind the picture, though, and his word was law. That will ruin pictures."

* * *

A town in Florida has appointed a "mosquito engineer." A lot of frequenters of summer resorts want to know what a mosquito needs of an engineer.—*Detroit News.*

Appenines May Be Pierced by 11¼-Mile Railway Tunnel

According to a recent issue of *Commerce Reports* the Italian State Railway Administration is considering a proposal to construct a tunnel 11¼ miles long on the direct line between Florence and Bologna on which considerable work has already been done by the government. The tunnel would penetrate the Appenines on a line connecting the towns of Pianoro, on the Bologna side, and Prato, on the Tuscan side. The estimated cost of this undertaking is placed at between $30,000,000 and $50,000,000, at present exchange rates.

Tunnel Holed Through on Hetch Hetchy Project

On May 15 the tunnel heading being driven west from Early Intake on San Francisco's Hetch Hetchy water supply project met the heading being driven east from South Fork. This tunnel is about 24,000 ft. in length and is the longest stretch driven from two headings on the mountain division. In view of the precipitous nature of the route traversed by the survey over the tunnel it is notable that the two headings came together with a discrepancy in distance of only 0.8 ft. The difference at the meeting point of grade, as carried in from the two ends, was 0.02 ft.; the two lines differed in alignment by 0.59 ft.

Extend Temiskaming & Northern Ontario Ry. to Hudson Bay

It has been decided by the Temiskaming & Northern Ontario Railway Commission to continue the extension of its main line northward to a terminal at the mouth of the Moose River on James Bay, the southern end of Hudson Bay. Work on the first 70 miles north from Cochrane, Ont., is being carried on by Grant Smith & Co. & McDonnell, Vancouver, B. C., and it is expected to have this completed in 1923. Bids for the further extension will be called for probably in July or August. A 20-mile branch is to be built from Swastika to Ladder Lake and it is expected to call for bids in June for this work. All work is under the direction of S. B. Clement, chief engineer.

Erie R.R. Improvements for 1923

Improvement work on the Erie R.R. during the current year is to include six miles of relocation near Wanaque-Midvale, N. J., on account of the new reservoir formed by the construction of the dam for the North Jersey Water Supply District. Grade crossing elimination will be carried out at Buffalo and Jamestown, N. Y., and Akron, Ohio; while pedestrian subways will be built at Phelps St., Youngstown, Ohio, and at Oak Hill, Endicott, N. Y. Ten miles of second track will be laid on the River Division east from Cuba Junction, N. Y., and an open pier 100 x 680 ft. will be built at Weehawken, N. J. Other items include passenger and freight stations and team tracks at Englewood, N. J.; station at Passaic Park, N. J., and Hamburg, N. Y.; an erecting shop 408 x 108 ft. at Hornell, N. Y.; power house at Jersey City; coaling station at Avon, N. Y.; and a water station with 50,000-gal. tank at Alger, Ohio.

New York Highway Work Is Curtailed

After a conference with his nine division engineers Commissioner of Highways Frederick Stuart Greene, of New York State, has decided that, in the interests of the state, it is necessary to curtail further new construction until the vitally necessary reconstruction work has been provided for. The state has now in force 217 highway contracts amounting to more than $28,500,000, on which less than $9,000,000 of work has been performed. In addition to this uncompleted work, the department will make every effort to award contracts amounting to $5,000,000 for the reconstruction of old roads which have gone to pieces. This proposed reconstruction work added to contracts now unfinished will total $24,500,000, which is more road work than the department has ever accomplished in any one year.

The conditions which have militated against taking on new construction are freight embargoes, scarcity of materials and shortage of labor. Commissioner Greene realizes, according to his own statement, that the policy of continuing to raise prices, in an effort to encourage contractors to submit bids, would not only make it impossible for firms now working at lower figures to complete their contracts, but would rob already undermanned farms of necessary labor. He has determined, therefore, that except for a few important connecting links and some heavy grading contracts, there will be no more new construction attempted until the abnormal conditions in transportation, material and labor have passed. It is estimated that postponement of new work means the deferring of $16,000,000 worth of highway construction which had been contemplated earlier in the season.

The postponement of new work will not affect, however, expenditure of the $10,000,000 authorized for the construction of rural post roads under the federal-aid plan.

New York State Bridge Survey Act Signed by Governor

The Ames bill, appropriating $15,000 and authorizing the commissioner of highways of the State of New York to make a survey of bridges on state and county highways and to report to the legislature of 1924, was signed by Governor Smith last week. The latest available data on the capacity and condition of bridges throughout the state is contained in the legislative committee report rendered in 1915. At that time it was discovered that more than one-half of the important bridges in the state were of less than 15 tons capacity.

According to the bill, the survey can be made either by the forces of the commission of highways or under the direction of the highway commissioner by a competent engineer and assistant to be selected by him. Not only shall a survey of existing bridges be made, but recommendations are to be submitted for needed changes or alterations.

The report is to be in the hands of the legislature on or before March 1, 1924.

Engineering Societies

Calendar

Annual Meetings

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; Annual Convention, Ithaca, N. Y., June 20-23.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, Annual Convention, Chicago, July 11-13.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

The Texas State Highway Association, at its annual meeting in Dallas recently, re-elected W. F. Crawford, Waco, as president, and elected George C. Holmgreen of San Antonio and Col. L. G. Wortham of Ft. Worth vice-presidents, and L. W. Kemp of Houston and Fred E. Rightor of San Antonio directors. A $35,000 budget to secure passage of a proposed constitutional amendment to place highway control with the state in order to secure Federal aid was adopted.

The Louisiana Section of the American Society of Civil Engineers at its recent annual meeting elected the following officers: E. H. Coleman, president; S. M. Young, first vice-president; E. S. Bres, second vice-president; and re-elected Frank A. Muth, secretary, and C. M. Bott, treasurer.

The St. John Branch of the Engineering Institute of Canada, which has a membership of 75, at its annual meeting elected for the coming year: president, H. F. Bennett; vice-president, G. M. Hatfield; secretary-treasurer, W. J. Johnston. Arrangements were made for a general meeting of engineers of eastern Canada to be held in St. John in September.

Personal Notes

COL. N. H. BALFOUR, formerly assistant to Sir Henry Thornton on the Great Eastern Ry. in England, is now an assistant to Sir Henry in the management of the Canadian National Ry.

ELBERT G. ALLEN, formerly chief engineer of the Philadelphia Rapid Transit Co., is now consulting engineer with Stone & Webster, Inc., Boston, Mass.

EDWARD H. WHITTEMORE, formerly manager of the heating department of the Boston office of the Lord Construction Co., has entered the structural division of Stone & Webster, Inc., Boston, as engineer.

WALTER R. EGGLESTON, of Black River, N. Y., engineer in Division 3 Highway Department, Watertown, N. Y., has been appointed superintendent of highways of Jefferson County with headquarters at Watertown. Jesse E. Kelsey will continue as assistant in Jefferson County.

E. R. CONANT has resigned as surveyor in the New Hampshire Highway Department. He intends establishing consulting engineering offices in Boston.

MORTON C. TUTTLE, general manager of and for twenty-five years with the Aberthaw Construction Co., Boston, has organized and is president of the Morton C. Tuttle Co., Boston, which will engage in general building and water-power construction. With him are associated Nathaniel McL. Sage, Clayton W. Mayers, and Lyle M. Richardson. Mr. Tuttle, during the War, organized the Emergency Construction Committee subsidiary to the War Industries Board, and later served the Fleet Corporation in supervision of production, purchase, transportation and storage operations.

BANKS & CRAIG, an engineering firm of Harrisburg, Pa., has been selected as engineer for the borough of Lewiston.

K. E. MCCONNAUGHAY, assistant maintenance engineer for the Indiana Highway Commission, is to become chief engineer for the Hayes Construction Co., Indianapolis. This company announces an improvement in service in the way of providing engineers, plans, etc., for cities not large enough to have a city engineer but too large to have the use of the county surveyor; it will also conduct a series of tests of many kinds of pavement for service in Indiana.

B. J. PARDEE, civil engineer, has been appointed city manager of Visalia, Calif.

J. P. IRONS has been appointed division engineer of the eastern division of the Kansas State Highway Commission. Mr. Irons was overseas with the 110th Engineers, and has been for several years county engineer of Anderson County.

SAMUEL L. GATSLICK, recently with the Raymond Concrete Pile Co., has taken offices at 130 E. 59th St., New York City, and will engage in engineering and contracting.

SAMUEL S. OMAN and **SAMUEL LILIENTHAL,** Chicago, have formed a partnership for the practice of architecture and engineering, with offices at 64 West Randolph St., Chicago.

RAWSON COLLIER, until recently sales manager of the Central Hudson Gas and Electric Co., has joined the organization of Dwight P. Robinson & Co., Inc. Mr. Collier's previous connections were with Collier & Brown, consulting engineers, Atlanta, and the Georgia Railway and Electric Co.

L. P. SCOTT, G. L. CAMPBELL, and **A. A. ANDERSON,** division engineers of the southeastern, northwestern, and south divisions, respectively, of the Kansas state highway commission, and **O. J. EIDMANN,** assistant engineer in charge of bridges, have resigned, effective May 1.

LIEUT. COL. GEORGE R. SPALDING, Corps of Engineers and instructor at the Army War College, has been ordered to Florence, Ala., for duty on the Muscle Shoals project. He will relieve **COL. WILLIAM H. BARDEN,** who, having completed the regular tour of duty on the Alabama station, has been ordered to Seattle, Wash.

A. B. WEST, who has been connected with the Southern Sierras Power Co. of California, has been elected president and general manager to succeed the late Guilford S. Wood.

OTTO B. KIBELE, who recently resigned as works manager of the Los Angeles, Calif., Shipbuilding and Drydock Corp., has been appointed manager of the Los Angeles plant of the Bethlehem Shipbuilding Corp., succeeding James Stewart. Mr. Kibele is a member of the Los Angeles harbor commission.

GEORGE LEWIS has been appointed city manager of Tulare, Calif.

J. WALDO SMITH has been selected as consulting engineer to Fuller & Maitland, engineers for the new water supply works of Kansas City, Mo., the detailed design of which will be under the immediate charge of J. R. McClintock of Fuller & McClintock. R. M. Merriman is chief engineer for Fuller & Maitland, whose staff includes A. R. Holbrook, A. L. Maitland and Wynkoop Kiersted, Jr. On May 16 Kansas City sold $2,500,000 worth of bonds and received an informal bid on the entire $11,000,000 issue voted last year.

JOHN ERICSON, consulting engineer for the City of Chicago during the last political regime, has been reappointed city engineer, succeeding Alexander Murdoch. The latter has been suspended pending the filing of charges before the civil service commission by the commissioner of public works, Col. A. A. Sprague. Mr. Ericson entered the employ of the city nearly forty years ago as draftsman in the water department.

MAJOR W. H. RADCLIFFE has been elected president of the Compass Oil Co. which has a large oil well and other holdings near Corpus Christi, Texas. Major Radcliffe was engineer of the municipal bridge at St. Louis for the American Bridge Co., and recently has been in charge of construction work at the Fitzsimmons Hospital, Aurora, Colo.

Obituary

ELISHA H. TALBOT, retired publisher and founder of *Railway Age,* died May 22 in New York City, aged 83 years. He was born in Ohio, and at the age of 19 established a weekly newspaper in Winterset, Iowa, and during the Civil War served as secretary in Washington to the congressman from his Ohio district. Besides *Railway Age,* he founded a magazine called *The Great West,* and another, *The Club Woman's Magazine.*

LYNN S. ATKINSON, structural engineer and general contractor, died recently in Santa Monica, Calif., aged 58. Among his foremost works are the Polytechnic High School at Long Beach, Calif., the Broadway tunnel, and extensive street and road work in the Imperial Valley and on other California highways.

JOSEPH T. RAYCRAFT, building inspector and former president of the Long Beach Construction Co., died at Long Beach, Calif., May 2. He was born in Ireland and came to the United States when 17 years old.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Varied Products Shown at Water-Works Exhibit

Sixty-Five Manufacturers Represented at Detroit Convention of American Water Works Association

SIXTY-FIVE manufacturers of water-works equipment and materials ranging in scope from the sensitive mechanism of a long distance water-stage recorded to the large-diameter steel pipe, high-pressure pumping plant, or large capacity tank or standpipe exhibited their products at the forty-third annual convention in Detroit, May 21-25, of the American Water Works Association. The displays covered all of the major fields of water-works practice and for purposes of classification may be divided into eight groups, including pipe and fittings, meters, valves and hydrants, pumps and accessories, chemicals and apparatus for water treatment, filters, tanks and standpipes, and miscellaneous tools and equipment, including measurement and control apparatus. In addition, six engineering publications in the water-works field were represented. On the basis of the number of displays, pipe and fittings took first place with 16 manufacturers represented, while meters were second with 14, and valves and hydrants third with 8.

PIPE AND FITTINGS

A wide range of products was shown in the exhibits of pipe and fittings. In addition to cast-iron there were steel and concrete pipe and lead-lined and tin-lined pipe. Several displays featured special joints, such as the Dresser, the Universal, and the McWane—the latter a pre-calked joint—while the field of jointing materials was represented by Leadite. Among the manufacturers of large-diameter steel pipe were the East Jersey Pipe Co. with its lock-bar design, and the National Tube Co., the latter featuring its recently developed hammer-weld pipe for diameters ranging from 20 to 96 in. In addition to the pipe displays were numerous exhibits of special castings and iron and brass fittings.

In the field of pipe and fittings, the manufacturers represented included American Cast Iron Pipe, Central Foundry, Lead Lined Iron Pipe, Leadite, McWane, Glauber Brass, H. Mueller, Hays, National Tube, United Brass, U. S. Cast Iron Pipe & Foundry, Warren Foundry, R. D. Wood & Co., S. R. Dresser, East Jersey Pipe, and Lock-Joint Pipe.

METERS

For measuring both large and small flows of water through pipe lines and in open channels a wide range of meters was exhibited, including the disk, turbine and compound types for domestic and industrial use, and large Venturi meters of the type employed at Detroit's new filtration plant now under construction. Several manufacturers featured the frost-proof, split-case meter. Some of the meters shown were designed for recording the flows of hot water and oil. Meter boxes were featured by several exhibitors in addition to current meters for registering flows in open channels.

The meter and accessory exhibits included those of the following companies: Badger, Builders Iron Foundry, Federal, Ford Meter Box, Gamon, H. W. Clark, Union, Buffalo, National, Neptune, Pittsburgh, Simplex, Thomson and Hersey.

VALVES AND HYDRANTS

Both high pressure and low pressure valves of sizes ranging from hand-operated types to the large motor-operated valves were an important feature of the exhibit. One manufacturer showed indicator valves for automatic sprinkler equipment, and a number of special valves were on display for use on pipe lines carrying chemical solutions. For large pipe lines the application of air valves to prevent the collapse of pipe during heavy drafts of water was illustrated. Fire hydrants with special drainage equipment and other features to prevent freezing during winter weather completed this feature of the show. The Eddy company displayed an aluminum model of its fire hydrant.

In the field of valves, hydrants and other accessories the manufacturers included Kennedy, Ross, Simplex, Rensselaer, R. D. Wood, Water Works Equipment, Eddy, W. P. Taylor, Columbian Iron Works, and Volkhardt.

PUMPING EQUIPMENT

The field of water-works pumping equipment was represented by comparatively few manufacturers. Centrifugal pumps were featured by Worthington, while the air lift had the Sullivan Machinery Co. as its sponsor. Equipment for deep well work was on display by Layne & Bowler, while a large well screen was shown by Edward E. Johnson, Inc. In the exhibit of the Birch Manufacturing Co. were pump valves of various types.

WATER-WORKS CHEMICALS AND EQUIPMENT

Its latest vacuum type of chlorinator for water supplies was featured by Wallace & Tiernan. In this newly developed equipment the chlorine gas, from the time it enters the apparatus until it is made into chlorine solution, is always under a vacuum so that the possibility of escape is reduced to a minimum. Furthermore, the flow of chlorine automatically ceases whenever the water supply to the apparatus is shut off. Manufacturers of chemicals employed in sterilizing or otherwise treating public water supplies were Mathieson Alkali Works, Electro-Bleaching Gas, Pennsylvania Salt, and Electrolytic Chlorine.

FILTERS

Two filter manufacturers, Roberts and New York Continental Jewell, had their products on display. The New York company is featuring the Wheeler false bottom for mechanical filters. In addition, the company showed one of the operating tables of the new Detroit filtration plant equipped with the latest type of indicator-register-recorder gage made by the Builders Iron Foundry. The Roberts company manufactures both water filtration and softening plants.

TANKS AND STANDPIPES

In the field of water-works tanks, towers, and standpipes the representatives at the Detroit meeting were the Chicago Bridge & Iron Works and the Pittsburgh-Des Moines Steel Co. Emphasis was given to the varied uses of elevated tanks in water-works practice, including not only use for fire protection but as a means of insuring more economical operation of pumping plants by providing storage capacity.

MISCELLANEOUS

Exhibits not previously classified included water-stage recorders, measuring equipment and surveying instruments by W. & L. E. Gurley; remote control apparatus for valve operation by Payne Dean; tapping machines and other tools by A. P. Smith; water waste surveys equipment by the Pitometer Co.; water-main cleaning equipment by the National Water Main Cleaning Co.; adding machines for water-works accounting by Elliott-Fisher; and testing and analysis by the Pittsburgh Testing Laboratory.

The engineering publications in the water-works field represented at the convention were *Engineering News-Record, Public Works, American City, Engineering & Contracting, Fire & Water Engineering* and the *Canadian Engineer.*

NEW OFFICERS

At its annual meeting, May 23, the Water Works Manufacturers Association elected as its president John Regan, of the Neptune Meter Co., New York. C. R. Wood, of R. D. Wood & Co., Philadelphia, was named vice-president, Denis F. O'Brien, of the A. P. Smith Manufacturing Co., East Orange, N. J., treasurer, and John A. Kienle, of the Mathieson Alkali Co., New York, secretary.

The committee in charge of the exhibit of equipment and materials at the Detroit convention was headed by George McKay, Jr., of the Leadite Co., Philadelphia, and included J. D. Capron, U. S. Cast Iron Pipe & Foundry Co., Burlington, N. J., and C. C. Behney, Simplex Valve & Meter Co., New York. Next year's exhibit and convention will be held in Memphis, Tenn.

Goldschmidt, Inventor of Thermit Welding Process, Dies

Prof. Dr. Hans Goldschmidt, inventor of the Thermit process for welding iron and steel and for producing high grade metals and alloys, died suddenly in Baden-Baden, Germany, May 20, 1923. He was born in Berlin, Germany, Jan. 18, 1861 and studied at the universities of Berlin, Leipzig, Heidelberg, Strassburg and at the Institute of Technology at Charlottenburg. In 1887 he entered the firm of Th. Goldschmidt, Essen Ruhr, Germany, in joint partnership with his brother Dr. Karl Goldschmidt. Prof. Goldschmidt visited this country frequently and was president from 1904 to 1916 of the Goldschmidt Thermit Co., now the Metal & Thermit Corporation, New York.

Equipment Users Close Discussion on Record Runs

Their Views Agree with Those of Manufacturers—Average Performance Better Than Sprints

For a number of weeks manufacturers have been giving their views in these columns on the subject of featuring record runs or performances of construction equipment and machinery. The consensus of opinion condemns this practice. In this week's issue the discussion is brought to a close by the following contributions from representative users of equipment from whom "Engineering News-Record" requested an expression of opinion:

By W. A. Rogers
President,
Bates & Rogers Construction Co., Chicago

IN MY opinion record runs or performances of construction equipment should not be featured by manufacturers in their advertising or other trade literature. They are sure to be misleading, as the conditions under which they were made have a very important bearing and these conditions will not be set forth. Average runs, however, are of considerable value.

By R. Peterson
Henry W. Horst Co., General Contractors,
Rock Island, Ill.

THE policy adopted by some manufacturers of construction equipment with regard to judicious advertising is highly commendable and indicates a broad-minded viewpoint as to the responsibility and service of the manufacturers in the construction industry. It is apparent from the expressions that have already been gathered from these various manufacturers that very definite policies have been adopted regarding the advisability of advertising record runs or performances of construction equipment. The consensus of opinion seems to be that the publishing of record runs is not a desirable form of advertising.

In construction work no two jobs are identical in solution as to methods of performance and combination of equipment to be used. Every new job is a particular problem in itself which has to be solved in its own way. For this reason the kind of equipment used in the different jobs will vary in combination as to methods of operation, organization used in performance and degree of hard usage required. The natural elements of the job are never the same. The local conditions are always at variance and the human element entering into the performance is never constant.

Under such conditions it is no more than natural for the experienced constructor to hesitate in placing much value upon advertised record performances. Experience has taught us that performance accomplished in one organization with a certain piece of equipment and under certain conditions would fall down when applied in another organization under the same conditions, due to the one big factor of the human element which enters into the operation and maintenance of the equipment. If, at the same time, the factor of local conditions varies in the two cases, the difference in the performance of equipment becomes even greater.

Where the advertising of record runs by equipment manufacturers has been brought to our attention, we have usually read such advertisements with interest but we have never placed great value upon them in concluding the purchase of equipment. We fully believe that the statement of K. H. Talbot, of the Koehring Co., relative to the manufacturer's responsibility creates a sound basis of advertising, which he expresses in the closing paragraph as follows: "* * * a manufacturing company may offer to a constructor a suggestion based on past experience but it cannot take the responsibility of furnishing figures on which an estimate of cost can be based." And this responsibility is fully realized when it is stated that the "manufacturer of construction equipment cannot possibly know the conditions surrounding the individual construction jobs and for this reason he should never furnish information that will be used as means of arriving at an average figure for work based on maximum runs over short periods." A policy of advertising based on the above conditions is absolutely sound from the constructor's standpoint.

By Arthur S. Bent
Past-President,
Associated General Contractors of America
and President Bent Bros., Contractors,
Los Angeles

MY ONLY comment on the whole subject is that I feel quite unfriendly to advertisements which publish record performances. They are misleading and, in most cases, distinctly against the contractor's interest, as I see it. I am referring the matter to the manager of our local chapter in order that he may get the reaction of other members and forward the whole to you. [The communication referred to follows.—EDITOR.]

By E. Earl Glass
Executive Secretary
Southern California Chapter,
Associated General Contractors of America,
Los Angeles

A GREAT majority of contractors will take the reasonable view that a record or "sprint" performance should be strictly barred from advertising pages in the leading technical and trade journals. Mr. Talbot touched upon a point which we believe is the principal objection to the practice of showing unusual performance in manufacturers' advertisements. It is well known that such statements (which are sometimes so presented that they are actually misstatements) make the greatest impression upon the uninitiated who accept the figures at their face value. This accounts for many ridiculously low estimates by young engineers and disastrously low bids by budding contractors. The experienced engineer or contractor is not misled nor greatly impressed by such accounts of record performance, so it is our belief that nothing but harm can result from such misleading data.

There seems to be an increasing desire on the part of some engineers in charge of public work to eliminate the contractor from such construction work under the pretext of "saving the contractor's profit." It is a question whether this is due to the socialistic tendency of the times or to an ambitious desire on the part of over-confident youth to learn the contracting business at public expense. Such glowing accounts of construction performance may mislead the officials into believing they can do the work for a small part of the contractor's price. If they do not actually reject reasonable bids from responsible contractors and undertake the work by force account they would at least feel that the contractor was obtaining an exhorbitant profit, whereas he might actually, and usually does, have to play in luck together with very good management to obtain 10 per cent above his actual costs as his own compensation.

It may be profitable to the manufacturers to encourage engineers and public officials to purchase equipment and operate their own construction department, but all business men are convinced that this practice is not in the public interest and if it were possible to obtain total actual costs rather than net material and labor figures which are often given out as such, the public would learn a great deal about economical expenditure of public construction funds and would insist upon such work being done by skilled contractors, bonded to deliver a satisfactory job strictly in accordance with plans and specifications and at a definite figure kept at a practical minimum of cost by competitive bidding.

For the benefit of the engineer who is tempted to eliminate the contractor, we would like to recommend a half-hour spent on an article by Arthur Bent, "Partners in a Great Adventure" which appeared in the *Constructor* for October, 1922. Mr. Bent's appeal to the engineers and architects for a square deal and fair play in construction, strikes at the seat of one of the most vital problems in the industry today.

By H. H. Wilson
Managing Partner,
Winston & Co., Contractors, Muncy, Pa.

IT IS pleasing to note the practically uniform viewpoint indicated in your columns by representatives of various construction machinery manufacturers concerning the inadvisability of advertising record runs of equipment. The position of constructors as to this matter is, I believe, similar to their attitude regarding publication of cost data by manufacturers, viz.: that such figures are too often unaccompanied by a sufficiently detailed statement of all factors involved to make it possible to dissect and apply them or parts of them to varying conditions. There will undoubtedly be ready response from constructors to the statement already made in your column that "Long time average runs will offer more benefit to the manufacturer and, at least, be of more value to the reader than the occasional flashes."

The thoughtful and experienced constructor, with his mind centered upon cost and efficiency, always seeks for high *averages* rather than records. I believe that manufacturers should offer constructors all possible information to assist in convincing them that they have a durable and efficient machine and to facilitate the obtaining of maximum results from the use of their equipment by purchasers. Anything beyond that would appear, as indicated by Mr. Talbot, to fall within the province of the consulting engineer or cost expert. It is questionable whether, in invading such fields, manufacturers are following their own ultimate interests, which are to assist in building up more conservative and responsible construction concerns with whom to conduct their future business.

Receiver for Filter Company

On May 19 the U. S. District Court for New Jersey appointed William B. Anderson, president of the company and Andrew J. Steelman, an attorney of Newark, receivers for the New York Continental Jewell Filtration Co. of Nutley, N. J. Several years ago, according to Mr. Anderson, the company incurred large losses on several unprofitable contracts, but the organization has a good business and assets, which, if properly conserved and administered, will probably be sufficient to meet its other indebtedness in full.

Business Notes

ATRAX CORP. OF AMERICA, New York, is the name of a new organization formed by a syndicate headed by Felix F. Wiener and Arthur Sachsse, for the production of reconstructed stone, using the Fisher hydraulic ramming machine, and for the promotion of the manufacture of cement roof tiles and partition wall blocks. The corporation intends to give a nation-wide service to users of the machine and to promote a demand for its products.

WARNER ELEVATOR MANUFACTURING Co., Cincinnati, has completed an addition of 35,000 sq.ft. to its Cincinnati plant, which results in a main shop of two stories and basement, 500 ft. long and 200 ft. wide. This is claimed to be the second largest factory in the world for the exclusive manufacture of electric passenger and freight elevators.

FEDERAL TANK & PIPE CO., Seattle, Wash., has been organized for the manufacture of wood stave pipe and wood tanks. The president of the new organization is C. A. Paul, formerly connected with the Continental Pipe Manufacturing Co. and its predecessor, the Pacific Coast Pipe Co.

CROCKER-WHEELER CO., Ampere, N. J., announces that at its annual meeting of stockholders and directors May 9 Edmund Lang, previously vice-president and secretary, was elected president to fill the vacancy caused by the death of Dr. Schuyler S. Wheeler. Herbert C. Petty, formerly assistant sales manager, was appointed sales manager and secretary, succeeding Mr. Lang.

GENERAL SUPPLY & EQUIPMENT CO., Baltimore, has been incorporated by Henry C. Rippel, R. P. Carruthers, and B. H. McKindless, as dealers in building equipment and supplies.

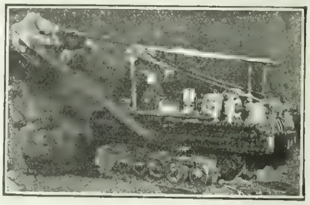
WEBSTER MANUFACTURING CO., Chicago, announces the appointment of Robert T. Pierce as manager of its New York sales office to succeed Glen N. Porter, who died March 31.

Equipment and Materials

Mechanical Mucking Machine for Mine and Tunnel Work

FOR loading lead ore into cars in mine workings the engineers of the St. Joseph Lead Co., whose mines are in southeast Missouri, have developed an electrically operated power shovel or loader, with crawler traction and revolving superstructure, weighing 13 tons. The machine is adapted to the handling of tunnel muck and to other uses than mine work.

A truck carried by the crawlers has a turntable on which is mounted a frame 11 ft. long with a boom consisting of two tubular legs 10½ ft. long and a cross-member having arms between which a bucket is journaled. Each boom leg has its heel pivoted to a crosshead moving in horizontal guides on the side of the frame. An A-frame with backstay rods carries the sheaves of the boom topping lift. The bucket, about 4 ft. long and 2¾ ft. wide, has a notched lip of manganese steel. It is held in the loading position by a latch on the cross-member of the boom; when unlatched by a trip operated by a light cable the bucket tilts forward to dump its load. When empty, the bucket returns automatically to its latched position, as its center of gravity is behind the trunnions.



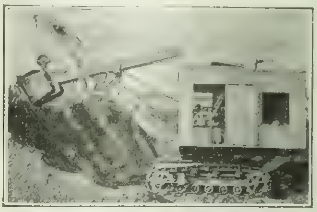
In loading, the boom is thrust forward, with a maximum crowding stroke of 7 ft., by means of sprocket chains attached to the crossheads which carry the boom legs, the boom cable being simultaneously unreeled by a fusee drum at such a rate that the dipper travels in a horizontal path. The crowding, hoisting and swinging motions are each actuated through worm gears by separate reversible motors controlled by the operator through master switches and magnet contactors. Two 12-hp. motors operate the hoisting and swinging gears. A 20-hp. motor operates the crowding and the propelling mechanism.

With boom and dipper drawn back the total length is 15 ft. 5 in., of which 9 ft. is forward of the turntable center, so that with a 7-ft. stroke there is a working radius of 16 ft. In the working position the height is 7 ft. to head of A-frame, but this frame can be lowered to give a clearance height of only 4 ft. 10 in. The width over the boom is 6 ft. 3 in. In ordinarily good digging, with a swinging arc of about 120 deg. and with adequate car service, the machine, it is claimed, can load ore at the rate of one ton per minute, each complete cycle occupying 30 sec. or less and the dipper load averaging ½ ton. As in all work of this kind the actual output is usually limited by the car service.

This loader was invented by Arthur K. Mitchell, assistant to the president of the St. Joseph Lead Co., New York, N. Y. As a result of experience with the first machine twelve more are now being built.

New Size Gasoline Shovel Added to Company's Line

To the line of power shovels manufactured by the Pawling & Harnischfeger Co., Milwaukee, Wis., a new 1-yd. size, operated either by gas or electricity, has been added. It is similar in design to the company's ½-yd. and ¾-yd. machines and requires only one operator. The shovel is mounted on crawler traction and is designed to come within standard railway clearances with a minimum amount of dismantling.



One of the features of the equipment is the manganese rack on the dipper stick driven by a heavy thimble roller chain from a set of planetary gears mounted on the forward drum. This arrangement, the manufacturer claims, gives a positive crowding motion regardless of the position of the dipper and enables the operator to bite into the heaviest digging. The outfit is convertible, by a change of booms, into a dragline, clamshell, piledriver, or crane hook.

Publications from the Construction Industry

Wood Pipe—CONTINENTAL PIPE MANUFACTURING CO., Seattle, has issued a 246-p. catalog, illustrated, dealing with its wire-wound wood pipe, continuous stave pipe, and creo-wood flumes. The wire-wound pipes range in diameter from 2 to 32 in., and the continuous stave pipe from 16 in. to 14 ft. The catalog contains information collected by the company during its thirty years of experience in the wood pipe industry, including hydraulic data and flow tables useful in the design of water conduits for municipal supply systems, hydro-electric developments, irrigation, sewerage, drainage, paper mills and other industries. Descriptions and illustrations are given showing the wide range of uses of wood pipe. In the preparation of the volume much care has been exercised and its contents are of decided technical value.

Hoisting Machinery—O. K. CLUTCH & MACHINERY CO., Columbia, Pa., in a 16-p. illustrated catalog, features hoisting machines made in single, double and triple drum reversible and non-reversible types, operated by gasoline engine or electric power. One page is devoted to the company's friction clutches.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Structural Steel Sales Decline

April sales of fabricated structural steel were less than the March record, according to figures received by the Department of Commerce through the Bureau of the Census, in co-operation with the Structural Steel Society. Sales in April amounted to 80 per cent of shop capacity as against 95 per cent in March and 88 per cent in April, 1922. Total sales of 176,954 tons were reported for April by firms with a capacity of 220,965 tons per month.

Tonnage booked each month by 171 identical firms, with a capacity of 226,625 tons per month, is shown below, togther with the per cent of shop capacity represented by these bookings. For comparative purposes, the figures are also prorated to obtain an estimated total for the United States on a capacity of 250,000 tons per month.

1922	Actual Tonnage Booked	Per Cent of Capacity	Estimated Total Bookings
April.......	199,494	88	220,000
May.......	183,089	81	202,500
June.......	167,641	74	185,000
July.......	155,298	69	172,500
August.....	154,676	68	170,000
September..	145,097	64	160,000
October....	131,303	58	145,000
November....	110,188	49	122,500
December..	136,168	60	150,000
1923			
January....	170,190	75	197,500
February...	182,056*	80	200,000
March.....	216,647**	96	237,500
April.......	176,954***	80	200,000

* Reported by 170 firms with a capacity of 226,425 tons.

**Reported by 167 firms with a capacity of 225,425 tons

***Reported by 150 firms with a capacity of 220,965 tons.

No Sign of Building Slump, Say Brick Manufacturers

In its monthly digest of conditions in the industry, as of April 1, the Common Brick Manufacturers' Association discounts predictions of a building slump due to a buyers' strike. Reports from 128 companies throughout the country show a gain of orders in every district, without exception. This is characterized as "one of the most remarkable reports received during the history of this organization." A great deal of material that is being delivered now, the report states, is for jobs started in 1922. At the same time many new operations are said to be getting under way.

Th report cites a serious shortage in bricklayers and plasterers. The industry, in co-operation with others, is preparing a course of instructions for the training of bricklayers, which, the association states, will be available to any city that will undertake the enterprise. Orders on books on April 1 showed a gain of 161,000,000 brick as compared with March 1. Shipments of brick from plants in March exceeded production. On April 1 figures from 128 plants, of which 29 were closed down, reported 181,298,000 burned brick on hand, 44,940,000 unburned brick on hand, and orders on books for 463,752,000 brick.

April Employment in Industries

The U. S. Department of Labor, through the Bureau of Labor Statistics, here presents reports concerning the Volume of Employment in April, from 5,651 representative establishments in 43 manufacturing industries, covering 2,139,053 employees, whose total earnings during one week amounted to $55,353,080. Identical establishments in March reported 2,128,816 employees and total pay rolls of $54,573,958. Therefore, in April, as shown by these unweighted figures for 43 industries combined, there was an increas over March of 0.5 per cent in the number of employees, an increase of 1.4 per cent in the total amount paid in wages, and an increase of 0.9 per cent in the average weekly earnings.

Increases in the number of employees in April as compared with employees in identical establishments in March are shown in 19 of the 43 industries. The greatest increase was 12.2 per cent in brick and tile.

Heavy Freight Traffic Reported

Freight traffic on American railroads the first three months this year was the heaviest in history for that period of the year, according to reports just received by the Bureau of Railway Economics from the carriers. During the three months period, freight traffic totaled 109,546,090,000 net ton-miles. This was not only an increase of nearly 24 per cent over the first three months last year, but also was an increase of 3.6 per cent over the total for the corresponding period in 1920 which was the previous record. The total for the first quarter this year exceeded by even a greater percentage that for the corresponding periods in not only 1921, but also 1917, 1918 and 1919.

Record Freight Loadings

Loading of 974,531 cars of revenue freight for the week ended May 12 was the highest for this time of year in history, according to reports filed by the carriers with the Car Service Division of the American Railway Association.

This was not only the greatest loading for any one week since Nov. 4, 1922, but was approximately within 4 per cent of the greatest loading for any one week in history which was that of Oct. 14, 1920, when the total was 1,018,539 cars. Compared with the corresponding week last year, the total for the week of May 12 was an increase of 207,437 cars, and an increase of 223,345 cars over the corresponding week in 1921.

Loading of freight cars this year to date, compared with those of the two previous years, follows:

	1923	1922	1921
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	3,452,941
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	974,531	[illegible]	[illegible]
[illegible]	[illegible]	14,278,847	[illegible]

Report Against Cut in 12-Hour Day in Steel Industry

Acting on recommendations of a special committee appointed last year at the request of President Harding, the American Iron and Steel Institute, at its annual meeting in New York May 24, unanimously opposed the abandonment of the 12-hour day in the iron and steel industry. The report of the committee, which was headed by Elbert H. Gary, chairman of the board, U. S. Steel Corp., maintained that the 12-hour day in the steel industry was not injurious to employees physically, mentally or morally, and that hours of labor could not be shortened without curtailing needed production. The committee stated that a shortening of the 12-hour day would require 60,000 additional employees and would result in a 15 per cent increase in prices.

Gary Sees Continued Demand for Steel

In his presidential address before the annual meeting of the American Iron and Steel Institute in New York May 25 Elbert H. Gary, chairman of the board, U. S. Steel Corp., stated that "there is nothing in sight to indicate that there will be a substantial diminution of the demand for finished steel in this country during the next six months, to say the least." At present, he said, the furnaces and mills of iron and steel manufacturers are operating nearly to full capacity, limited and modified only by a lack of sufficient working forces. The producers, for months past, have found it difficult to satisfy the "peremptory demands" of consumers.

"There has of late," Judge Gary continued, "been a deliberate and persistent attempt to create an impression that there will be in the near future a substantial recession in business activities. Business men generally understand this. The propaganda is inspired by a few short-sighted persons who do not seem to understand that if they could succeed in wrecking the business structure they would themselves be buried in the ruins. However, the postponements in some lines of business operations have not wholly resulted from deliberate and unworthy propaganda. In the building lines particularly, where work has not already been commenced, projected operations more or less have been postponed by reason of the extraordinary and inordinate prices charged by certain trades for wage rates, and also by the numerous strikes or threatened strikes for still higher wage rates.

"We often stated publicly 85 per cent or more of the cost of producing steel, from the raw products to the finished material, is paid to the workmen. When, in order to secure sufficient workmen on buildings, contractors are compelled to pay the carpenters, painters, bricklayers, plasterers, plumbers and others in kindred lines, $10 and upward per day of eight hours, and this to workmen who are demanding a five-day week, with arbitrary limits of the work done, it is not surprising if the building of costly structures is being postponed until more favorable conditions shall obtain.

"Building operations, though important, are a small percentage of our business. Even though there should be no more new contracts for structural steel during the next six months, apparently the steel business taken as a whole would be satisfactory."

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 319 to 332, are the following:

Hotel, Hot Springs, Ark., for Arlington Hotel Co., $2,500,000.

Temple, New Castle, Pa., for Scottish Rites Bodies, F. and A. M., $1,000,000.

Hotel, Madison, Wis., for Hotel Wisconsin Realty Co., Milwaukee, $1,000,000.

Jurisdictional Board Stands Firm

The Joint Board for Jurisdictional Awards in the Building Industry has declined to change its ruling made two years ago awarding metal trim work to the Metal Workers union. Because of this ruling, the Carpenters union has declined to recognize the authority of the Board, claiming that the ruling was made without a presentation of the case on behalf of the carpenters. The carpenters had obtained several postponements of the hearing and their representative withdrew from the Board when the majority decided that no further delay should be granted.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 3; the next, on June 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.64	$4.30	$4.50	$3.40	$3.55	$4 20	$3.85	$4.10	$3.75
Structural rivets, 100 lb	4.40	5.00	—4 90	3.75	4.25	5.15	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb	3.54	4.25	3 70	3.32½	3.45	3.85	3.65	4.10	3.50
Steel pipe, black, 2½ to 6 in. lap, discount	49%	50%	45%	59½%	53-5%	36%	35.2@47.6%	40%	32.76
Cast-iron pipe, 6 in. and over, ton	62.50@63.50	—53.00	63.00	60.20	60.50	69.00	60.00	70.00	60.00
Concreting Material:									
Cement without bags, bbl	2.70@2.80	+2.85	2.25	2.20	2.39	2.85	2.71	2.90	2.68
Gravel, ¾ in., cu.yd	2.25	1.90	2.25	2.00	1.75	1.90	2.15	1.25	1.50
Sand, cu.yd	1.25	1.24	1.95	2.00	1.00	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd	1.75	2.00	2.50	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	65.00	42.00	53.00	60.00	45.75	44.00	41.00	31.00	90.00
Lime, finishing, hydrated, ton	18.60	23.50	22.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	3.00@3.25	1 50	2.50	1.50	1.50	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	14.00	—12.90	11 00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.0893	.115	.1032	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1573	.0893	.115	....	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal	1.16	+1.26	1.35	1.37	1.29	1.39	1.24	.86	1.38
Common Labor:									
Common labor, union, hour	.75	.35	....	......	....	.50@.55	.56¼	....	....
Common labor, non-union, hour	....	.30	.30@.50	.72½	.35@.50	.35@.50	.50	.50@.62½	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 81½c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.74). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Structural steel market stable during week, but with an easier tone. The minimum on steel bars is now placed at $2.40 per 100 lb., with shapes $2.50, on all current mill business. The maximum, however, does not exceed $2.60. Plate inquiries continue fair, especially for ship and tank construction, with buying a trifle slower. The minimum on steel plates is now $2.50 per 100 lb., Pittsburgh, for prompt deliveries. Steel mill shipments continue heavy.

The only prices changes in seven cities reporting weekly to *Engineering News-Record*, were as follows: A drop of $2 per ton in cast-iron pipe, and advances of 5c. per bbl. in cement and 2c. per gal. in linseed oil, in Atlanta; declines of 35c. per 100 lb. in structural rivets and 20c. per M. in common brick, in Dallas.

The labor situation in New York City was marked last week, by the granting of wage demands to the painters. This week's developments reveal similar concessions to the stone cutters and planer men, who received an increase of $1 per day. Bricklayers, however, still hold out for the two year contract of $12 per day, against a three-year agreement at $10, with a bonus of $2 per day, as offered by the employers. Brickyard workers are still on strike in the Raritan district with the Hudson River district not visibly affected.

A Consolidation of Engineering News and Engineering Record   McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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Disregarding the Public

IN ITS tone rather than in its content the report of the representatives of the steel industry on the 12-hr. shift is disappointing. Judge Gary and his associates on the committee of the Iron and Steel Institute have yet to learn the art of giving in gracefully. It is hard to believe that they do not know that the public generally regards the 12-hr. day as a social anachronism and that any industry that persists in continuing it under the plea of economic demand must sacrifice much of the good will of which big business today stands in so much need. Sooner or later the steel business will give up the long shift; just now the condition of the labor market and the general drive for production may make the change difficult but the economic as well as the social trend point surely to the shorter day. How much better would the steel manufacturers have stood in the eyes of the critical public had they acknowledged this future certainty and argued then the current difficulties instead of throwing an atmosphere of refusal around a report which does at least grudgingly admit the possibilities of future retreat. They might, too, have let the experts on public relations who in late years have done so much to increase the public's respect for the steel industry advise them before they wrote into their report that masterpiece of tactless phrasing—"Whether or not, in the large majority of cases, 12-hr. men devote less time to their families than the employees working less hours is perhaps questionable."

Mountain Highways

ONE of the most virile passages in the story of American engineering—flinging the great transcontinental railways across the Rocky Mountains—is in a large measure being repeated today in the mountain road-building of Colorado and Wyoming and their sister states of the Far West. The Wind River Canyon highway described in this issue is but one of a score of similar projects and is chiefly significant because it typifies a group of undertakings which are as bold in their expenditures and as difficult in execution as engineering anywhere has attempted. It is of structural practice, however, that it is desired to speak. These mountain highways are not inferior road structures. They are being built almost invariably to grades not exceeding 7 per cent, while eastern states are protesting that in rough country the costs of such grades are prohibitive. They are graded 26 and 30 ft. wide and are ditched and drained in permanent fashion. Costs of $50,000 to $100,000 a mile are freely assumed to produce permanent grade without surfacing. Accomplishments of such nature, in states whose property values and population are less than those of many counties in the East, indicate as sound a conception of the modern highway as any of the paved roads of Pennsylvania or Massachusetts. And these expenditures are being undertaken, not as they are in the East, to accommodate an existing traffic, but to develop a territory and create a traffic. Roads like that through the canyon of the Wind River in Wyoming are constructive enterprises in the largest meaning of the term, for they are creative as well as serviceable.

The Building Congresses

THE Building Congress movement entered a new phase of its development last week when the New Jersey Building Congress was organized. The building congresses now in existence, at New York, Boston, Philadelphia, Portland, and Seattle and the new one organizing at Minneapolis cover their specific localities only. State-wide organization has not been attempted. The reason for the broader movement in New Jersey readily suggests itself. The state is small. The communities of importance are relatively close together and conditions in one city quite quickly effect all the others. Close relationship, therefore, between all of the communities of the state was highly desirable. The enthusiasm with which the original suggestion for a local congress at Newark was expanded into a state-wide conception is evidence of the general appreciation of the inter-dependence within the state. But at its very first meeting, for organization, it was quite apparent that the leaders of the movement understand clearly that its strength must be derived from vigorous local functioning. The first care of the executive committee will undoubtedly be the establishment of subsidiary branches in each important center. The short distances between them will contribute to a vigorous stimulation one by the other. While New Jersey's case, therefore, is a special one, it should quickly give indication of the value of organizing the building congress movement along state as well as along local lines.

From Small Beginnings

THE preceding comment on the New Jersey Building Congress prompts a word of admiration for the steady progress of this movement and for the foresight of its organizers in placing their faith in small and simple beginnings. They believed that if their idea was sound the congresses would grow of their own strength without any elaborate machinery of promotion or complication of constitution or by-laws. The parent body is an extremely loose organization with little or no machinery. It keeps in the background. It does hardly more than interchange information regarding the new activities of the local congresses. The New York Building Congress, the Boston Building Congress, the Seattle Building Congress—these are the bodies in the public eye, these, and not an overspreading national organization, constitute the strength of the movement. Without much blare of trumpets the several local congresses have brought together in an effective way every element of the building industry; we should underline the word *every* for that is an actual accomplishment. Aside from results in the establishment of apprenticeship systems, development of codes, studies of seasonal employment, etc., there has been engendered in these several cities a confidence of each group in the other. Controversial subjects have been avoided that there those things might be accomplished on which all were agreed. The building industry as a whole is under a debt to Robert D. Kohn and his associates for launching the movement and for vesting it with an appealing simplicity.

Give the Railroads a Chance

EVIDENCE is accumulating that the next Congress is to be the scene of another attack on the railroad problem with the avowed purpose on the part of the so-called "Progressive" bloc of ultimately forcing government ownership. The conference called at Chicago last week by Senator La Follette was only the opening gun. Such of the proceedings of that conference as the public was permitted to hear indicated a drive against the Transportation Act with special animus against the fixing of rates by the I. C. C. valuation, which according to all the speakers is pointing toward an unreasonable excess over what they are pleased to call investment cost. If the valuation which these men think reasonable were established the railroads of the country could not survive and the government would have to assume ownership. Fortunately those who believe that this would be a calamity realize the situation and are preparing to meet it. The study under way by the Chamber of Commerce of the United States will be available before Congress meets. The facts there gathered, backed by the sound business men of the country, should have a salutary influence in persuading Congress to let the railroad situation alone for sufficient time to demonstrate whether or not the Transportation Act will work. The past five years have been so unsettled in the railroad business that no useful deduction can be made from what has happened. The railroad managers should be permitted to carry on under some sort of stable conditions for long enough to show what they can do when given a fair chance.

Road Location by Legislature

ONLY commendation is deserved by Governor Smith of New York for his defense last week of technical direction of state highway development. In vetoing a bill which had taken a consistent state system map prepared by the engineers of the highway commission and transformed it into an engineering absurdity of dead ends, missing links and parallel roads he announced: "The laying out and construction of roads is an administrative duty. We have a corps of competent engineers who have been in the employ of the state for a great many years, and if the legislature would leave them alone these engineers would give us a connected and a comprehensive state highway system that would be designed to meet the needs of the greatest number of our people; but as long as politics and legislative tinkering continue to dictate by a law to the highway department, we must expect the same chaos and disorder that grew out of the performance of this year's legislature." Highway location by legislature has no justification in engineering thought and seldom commands the respect of even its own political supporters. New York State does not stand alone as an example of its extravagance and inconsistency, and in speaking out frankly for engineering direction in his state, Governor Smith has strengthened the hands of state highway department engineers all over the country.

Reproduction Cost New Affirmed

IN THE Missouri telephone rate case just decided by the United States Supreme Court the significance, curiously enough, lies in the minority opinion by Justices Brandeis and Holmes, rather than in the majority ruling. The decision itself, though it reversed both the Public Service Commission and the courts of Missouri, is in accordance with the long established rule of the Supreme Court that for rate making purposes the present value of a public utility must be used and that value is best established by determining the reproduction cost new less depreciation. The public service commission undertook to fix 1919 value on the basis of 1913-14 costs and the Supreme Court ruled that in view of the rising scale of prices in that period rates so fixed are confiscatory and therefore unconstitutional. The dissenting justices agree that the fixed rates were too low and therefore concur in the reversal but argue against the reproduction cost new theory of establishing value and suggest the prudent investment basis.

The law, as interpreted by the highest court, has not, therefore, been changed. Regardless of the fact that more and more frequently public service commissions have been seeking to establish some other basis of value than reproduction cost at present prices, that method is accepted with practically no argument or explanation by the Supreme Court. The court does not, to be sure, accept such a value except for rate-making purposes, as is indicated by the fact that it sets the proper value of the telephone properties involved at around $25,000,000 as against the $20,400,000 of the commission's production cost and the $31,000,000 of the company's reproduction cost less depreciation, deducting therefrom the $5,500,000 cost of establishing the business. What it does do is to state that present prices must have large if not governing consideration in establishing present value, which it continues to maintain is the proper basis for rates.

Justice Brandeis, on the other hand, points out the numerous difficulties in such a plan. The most important of these is the obvious necessity, in these days of rapidly and materially changing unit prices, of revaluing at frequent intervals, for if the company is entitled to profits on the unearned increment in its property, the public is likewise entitled to the decrement which follows a dropping price scale. The economic trend of the past five years has forced recognition of this principle. When prices were fairly stable, or at least rising on a gradual slope, established values were good for long periods. Since the war, however, the difference between profiteering reward and bankruptcy may well lie in the exact date of fixing value, if reproduction cost is used as the basis for such value. And it may well happen in some particular case that the company is just as opposed to such a method as the Missouri telephone company favored it.

The other major point that the minority opinion makes is that it is becoming increasingly easier to determine actual prudent investment. With the growing requirements for public utility publication of accounts and the necessity such utilities are under of keeping their books in accordance with rules true value is more nearly a matter of record than in the past when the details of such a business were not discoverable. The difficulty of determining just how much money had really been invested was possibly the principal reason why the reproduction method was adopted. In many valuations that reason is still controlling. In fact, the easy avoidance of that difficulty by the so-called LaFollette conference at Chicago last week (p. 1016) does more than anything else to discredit the intentions of that body. As time goes on, however, the public utility business will become better defined as to investment and the determination of the "fair value" laid down in the legal rule become more nearly a matter of study of records than of opinion, as it is today.

Companies engaged in public utilities are entitled to a fair return on their investment, having due regard both to the privilege the public extends to them in letting them do a public business and to the necessity for encouraging capital to embark in such enterprises. Many methods for fixing that fair return have been advocated—and practically all have been applied in some cases—but the trend of the law, which in spite of theory must be governing, has been toward a full recognition of the reproduction cost new as the most equitable basis of establishing value. It is, however, only a basis and not the universal and simple solvent. With the increase in public utilities and with the increasing desire of the public to supervise their operations the problem will become simplified because more of the facts needed to establish value will be available.

Road Work and Construction Congestion

ROAD building is the greatest construction task of the United States. A billion dollars, it is estimated, represents the work which may be undertaken this year. With the claimed deficiency in construction capacity to meet construction needs, which is developing, the suggestion is being made in some quarters that immediate highway improvements should be postponed. Admitting the emergency this thought is wholly natural and logical.

If restraint in construction is desirable, as appears to have been generally concluded, then highway builders should exercise it in conjunction with other builders. It is just as apparent, however, that drastic curtailment of highway improvement programs should not be undertaken until it is clear how far it will release contractors, materials and workmen of which there is a deficiency in the general construction market. Indeed it may be written down as a certainty that federal and state highway officials will not approve reduced construction program until they have more evidence than their observation provides that general curtailment of road building operations will greatly affect the shortage which it is asserted exists in the means for other construction activities.

Except in paved road work few of the agencies demanded in industrial and municipal construction are being extensively employed in road building. Barely 25 per cent of the money being expended in road improvement is for paved roads. Three-quarters of the work being done is permanent grading and drainage and surfacing with gravel or other special soils obtained locally. The contractors employed confine their operations largely to earthmoving and do not go far abroad for work. The same is true of their help. Commercially-produced materials are but little used and transportation is a local haulage operation employing trucks and trains. It is not possible to draft any significant volume of these construction forces into the field of building or general engineering construction.

There is now no general lack of contractors and labor for road work except possibly in paved road construction. In pavement construction only is the materials supply a matter of concern. Plenty of bidders are being had for grading and gravel surfacing. Observations made in a survey of road development in ten states indicate that for grading and surfacing competition is active and prices are reasonable. A less favorable situation exists in respect to paving. Here there is developing a lack of bidders and prices are rising. Curtailment is already being and will continue to be undertaken as costs mount to a level where it is economy to delay paving contracts and turn money and effort in other directions.

There should not be nor will there be by public roads officials any holding back in an effort which, like the present campaign to prevent an excessive demand on construction agencies, tends to stabilize construction. To go about the reduction of road construction in any wholesale way is, however, not effective co-operation in the emergency which it is considered exists.

Rudolph Hering

WITH the passing of Rudolph Hering America loses her long-time dean of the sanitary engineers.

Eminent as Dr. Hering was in his profession, and as much as he contributed to its technical advancement, he will always stand still higher as a friend. That capacity for friendship and a helpfulness to all, especially to young men, were notable traits of his character. This was well expressed in an address on Dr. Hering's professional career, made at his funeral by George W. Fuller, his one-time partner, when he said: "My first impression of Dr. Hering was that of his unusual interest in helping young men, particularly young engineers. Men from various parts of this country and abroad have repeatedly spoken to me of this very lovable trait of his. I am sure that he was a powerful inspiration of many a young engineer."

Dr. Hering's contributions to sound engineering theory and practice are so well known that to enumerate them here is unnecessary. Attention may be called to the summary of his career printed elsewhere in this issue; to a review of his work up to that time in *Engineering Record*, Aug. 15, 1903, p. 195 (unsigned, but by John M. Goodell) and to a longer appreciation, by Charles Whiting Baker in *Engineering News-Record*, Aug. 6, 1918, p. 274.

Professionally, Dr. Hering's most notable characteristics were engineering scholarship, practical judgment and its application, a tireless interest in advances in theory and practice, and a never-waning enthusiasm to pass on the torch of sanitary engineering progress. He kept ever in touch with his profession, both by attending technical society meetings and by visiting sanitary engineering works showing marks of progress. This was particularly true as regards achievements abroad, as was so well put by Mr. Fuller: "He had an unusual gift of learning what was new in European practice and in bringing the principles back to this country and stating them in a way that their usefulness might be available to his co-workers in America. In my opinion he was foremost of the American engineers to teach his associates on this side of the ocean how to be wisely guided by developments abroad."

A scholar, a leader of thought and practice, a friend, has passed on, but there remain his work as a monument and his rare personality as an inspiration.

Construction Methods on a Canyon-Side Road in Wyoming

Side Hill Cuts in Solid and Loose Rock Slopes Involved Coyote-Hole Blasting, Tunneling Granite and Diorite and Blasting Talus for Steam Shovels

By R. L. Silver
District Engineer, Wyoming State Highway Department, Basin, Wyo.

HIGHWAY construction involving expenditures for grading as large as $97,000 a mile is worthy of note anywhere. In a state covering 100,000 square miles, with a total population of 200,000 and taxable property less than in many counties in eastern states, the undertaking becomes remarkable. Wyoming now has such an operation under way near Thermopolis, through the lower canyon of the Wind River. The project moreover is strikingly characteristic of modern highway development in the mountain country of the West: (1) A comparatively short road opens up a vast and naturally rich territory previously isolated in a great measure; (2) physical standards, as grades, curves, width and alignment, are not excelled in any section of the country; (3) construction methods typify modern practices in rock-cliff and talus-slope cuts and fills and large-section tunneling.

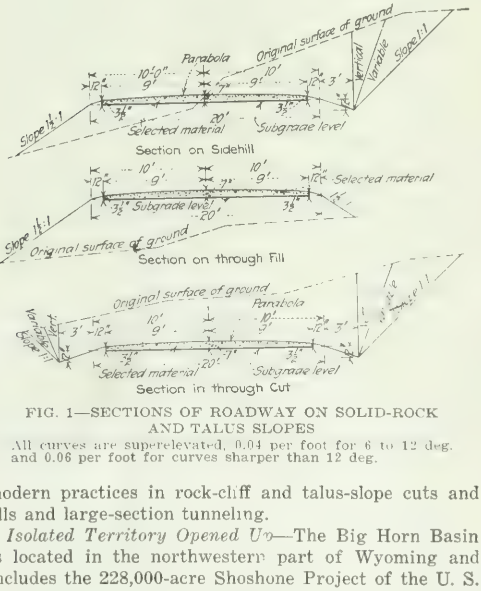


FIG. 1—SECTIONS OF ROADWAY ON SOLID-ROCK AND TALUS SLOPES

All curves are superelevated, 0.04 per foot for 6 to 12 deg. and 0.06 per foot for curves sharper than 12 deg.

Isolated Territory Opened Up—The Big Horn Basin is located in the northwestern part of Wyoming and includes the 228,000-acre Shoshone Project of the U. S. Reclamation Service, in addition to many Carey Act and private projects under cultivation. Oil fields, with a refinery, extensive coal mines, and an apparently inexhaustible supply of natural gas exist. Topographically this basin, so richly endowed in natural resources and possessing such extensive agricultural possibilities, is separated from the rest of the state, being bounded on the east, west and south by high and rugged mountain ranges and on the north by the state of Montana. The mountains make an unsurmountable barrier to highway transportation except during a short summer season when light automobile traffic is possible. From the southern boundary of the basin the Big Horn River enters through a narrow box canyon known as the Wind River Canyon. This is the only possible low-grade route for a highway which will eliminate the objectionable and dangerous link over the mountains.

Locating the Line—A preliminary survey was made early in 1921 and the data obtained from this survey were used in working out the details of the financing of the project. A location survey was made early in 1922, upon which the Federal Aid plans were prepared and a contract let June 1, 1922. The project was approved by the officials of the Bureau of Public Roads upon the regular basis of Federal Aid in Wyoming, which is 64.65 per cent to be paid from Federal funds.

For the preliminary survey the organization comprised a party chief, a transit man, two chainmen, a stakeman, a levelman, a topographer, two rodmen, a cook and an axeman. The organization of the location party was the same except that the topographer was omitted.

Both the preliminary and location surveys were made during severe winter weather when the mercury would average 10 to 12 degrees below for long periods, and access to the work was made possible by the river being frozen over at most points. This survey consisted of 28 miles of line from Bonneville to the northern end of the project and the two surveys cost $7,405.49. On the preliminary survey a base line was run, from which accurate topography was taken, and an estimate was prepared from a paper location. The second survey could be considered as a second preliminary, although all curves were staked and sufficient cross-sections for the preparation of an estimate were taken. However, in order to improve the line and fit it more closely to the topography, the major portion was relocated by the construction parties and a revised estimate was prepared. Location parties camped at Boysen, Dornick and Thermopolis, and all supplies were shipped in by rail.

On this project the grades are a minor consideration as the general route follows the river, and what grades were used were for the purpose of avoiding difficult points of construction. On the talus Section C where danger from slides was evident the line was placed as near the edge of the cliff or top of the talus as practicable in order to avoid as much slide material as possible. In many cases where slides might be encountered at a lower elevation the upper slope reaches the rock cliff making any major slides at these points impossible.

In the mountains where grade development is necessary it has always been possible to adhere to a 7 per cent maximum by the expenditure of sufficient money. The Bureau of Public Roads has generally demanded a 7 per cent maximum or less, and the state department has followed the principle that where a project is worth constructing it is worth the expenditure of sufficient funds to obtain at least a 7 per cent maximum grade. In the present instance the final location is on a 5.6 per cent maximum grade, maximum curvature of 200-ft. radius, and 20-ft. roadbed with 3-ft. ditch in cuts as indicated by Fig 1.

Physical Features—Due to the marked division of the nature of the material encountered the project was

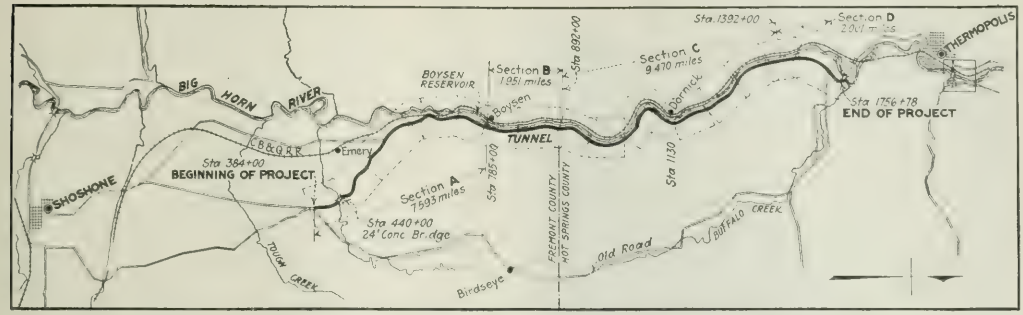


FIG. 2—LOCATION MAP, WIND RIVER CANYON ROAD

divided into four construction sections, Fig. 2. Section A extends from the south end of the project to the end of the canyon, a distance of 7.59 miles. The estimated cost is $106,000. The material is varied and the contract was let upon specifications having the three general classifications.

Section B, from Station 789 to 892, extends through the box canyon where the material is 100 per cent solid rock, consisting of a very hard black diorite and a hard red granite. The length of this section is 1.95 miles and the estimated cost is $189,238 exclusive of surfacing and guard rail. The estimate on this section includes 84,000 cu.yd. of unclassified material, and three tunnels having a total length of 842 ft. The tunnels are through black diorite and are constructed 18 ft. wide and 14 ft. high.

Section C is 9.4 miles long. The material is principally a sandstone and limestone talus covering many massive boulders, with several short stretches of vertical cliffs. There are 302,600 cu.yd. of unclassified material on this section and the estimated cost is $233,600, exclusive of guard rail and surfacing.

Section D covers 2 miles at the lower end of the canyon, where the material is earth and the construction is comparatively light.

Construction Plan—Contracts for Sections B, C and D were let on June 1, 1922, to the Utah Construction Co. of Ogden, Utah. The construction program adopted by the contractor calls for the handling of Section B largely by hand labor, Section C by steam shovels and Section D by team and fresno outfits.

The Denver-Billings line of the Chicago, Burlington & Quincy Ry. runs through the canyon on the opposite side of the river, which materially simplified the problem of getting material and equipment to various points on the work. Opposite Station 792 the Wyoming Power Co. has a plant from which power for camp purposes and the operation of a compressor plant was obtained. The contractor established his headquarters camp at Boysen, near the power plant, and installed a compressor plant at this point. Air was piped from this plant over the full length of Section B, the box canyon section. A number of foot bridges were also constructed across the river.

Open Cut in Rock—Coyote-hole blasting was the characteristic feature of open cut in rock. On the up-hill side the rock stands practically where shot and very little trimming is necessary. Many of the slopes, where seams occurred near the slope line, are standing practically vertical and in very few cases in the hard rock material does the slope exceed ¼ to 1. The spacing and loading of coyote holes, Fig. 3, varied for every shot and depended on the size of the cut, the nature of the material, and the judgment of the foreman in charge. In some cases these holes were loaded heavier than necessary in order to get rid of the material or to obtain extra material for borrow. It has been the intent of the contractor throughout the job to do as little hauling as possible and he has moved considerable extra material in order to avoid haul which in some cases has not appeared to the writer to be the most economical practice. Coyote holes averaged 3½ ft. in diameter and

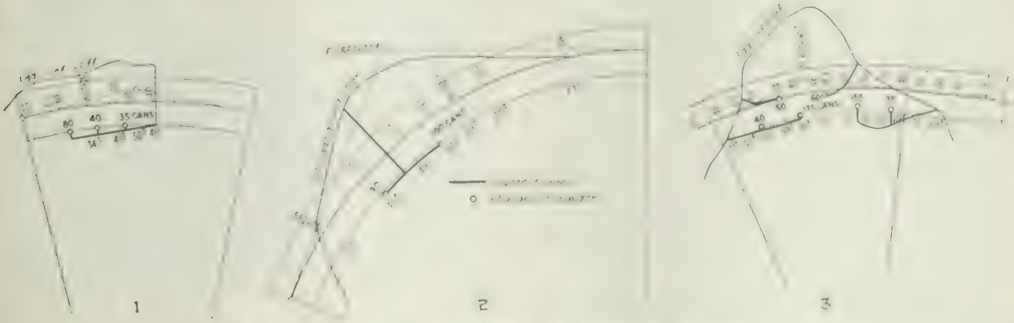


FIG. 3—TYPICAL COYOTE-HOLE BLASTS ON ROCK CUTS

1. This blast moved 2,500 cu.yd. [illegible] the fill to full width. 3. There were 3,000 cu.yd. in the cut seam on the upper slope line [illegible] per cent of [illegible] side of the section. It broke off [illegible] placed all material in such a way [illegible]

were usually flat on the bottom and had a circular arch top. The loads were placed about 1 ft. below grade, and the cut generally broke a little below grade. The heaviest charges were placed on the upper cut ditch line, as shown in the diagrams.

No appreciable amount of material has been thrown upon the track, although some of the shots have caused some damage to a few rail lengths. The railroad company was notified before shooting the heavier charges, and had a gang of men nearby to repair any damages. Indeed the railroad company has co-operated with this department wherever possible and has been of great assistance to the contractor in giving him sufficient unloading points for supplies and equipment. The shots at Stations 857 and 884 were at a safe distance from the track. It will be noted that the load at Station 854 was so placed as to tend to throw material parallel to the line instead of across the river. The variation in amount of loading of these charges was due to the intent of the contractor either to waste or save the material. In loading coyote holes all powder was emptied from the cans and covered with 1 ft. of loose material. The primer consisted of two sticks of dynamite and a cap; two primers in each charge, the extra primer being placed for emergency. All were shot by battery. The ends of coyote holes were plugged with the material at hand. The breakage of all was near to grade but where it was necessary to move the material considerable block holing was necessary. Hexagon ¾-in. jackhammer steel was used for all open cut and coyote work. The overbreak was small except where the contractor was loading with excessive charges in order to get rid of the material.

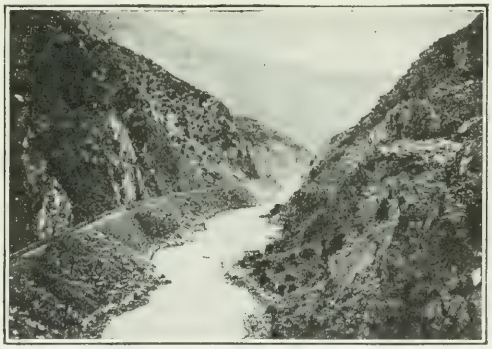


FIG. 5—BOX CANYON TERRAIN BEFORE CONSTRUCTION
Temporary bridges at intervals from the railroad track side were the only means of access to the road location. At point of view classification was 100 per cent solid rock.

Tunneling Methods—A section of one of the tunnels showing the arrangement of holes and the blasting schedule is shown in Fig. 4. This represents the average condition, but where the material was extra hard six additional holes were used in the lower heading. Cut holes were loaded generally with twelve sticks of 80 per cent, the rest with six sticks of 80 per cent, completing the charge with 60 per cent. All firing was done with fuse. The cut holes were shot first and any remaining hole was reloaded and shot with the rest of the charge. Holes five and six were shot after one, two, three, and four, permitting the material to rise and avoiding the throwing of much material in front of holes C and B. The material in tunnels broke small enough to handle by hand mucking and required little block holing.

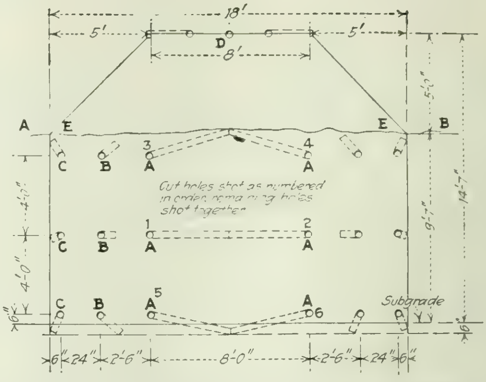


FIG. 4—DRILLING DIAGRAM FOR HARD ROCK TUNNEL
Loading: Lower heading 75 lb. to 150 lb. dynamite—80 per cent of which consisted of 80 per cent strength and 20 per cent of 60 per cent strength. Average break 6 ft. Upper or Arch Section 35 lb. to 40 lb. dynamite, 30 per cent of which consisted of 80 per cent strength and 70 per cent of 60 per cent strength; average break 10 ft.
Drill Holes: A, cut holes 9 ft. deep meet at center as shown; B, 7½ in. deep, tilt toward center 1 ft. and bottom and top holes tilt down and up 1 ft. as shown; C, 7½ in deep tilt out 6 in. and at bottom and top holes tilt down and up 1 ft.; D, three holes for arch starting 2 ft. c. to c. and ending 4 ft. c. to c., 10 ft. to 11 ft. long and following grade of roof; E, short plug holes after arch shot.
Schedule: Heading blasted first and then arch section.

The steel used in tunnel drilling was Ludnum hollow round 1¼ in. in diameter. The drills were Waughturbros and Ingersoll-Rand water liners and the sentiment of the drillers favoring each of these machines was about even. As many as four machines on two columns were worked in the heading face but generally two machines on separate columns were used. Drilling was principally done at night and mucking in daytime. The drills were sharpened by machine and experiments were carried on for about six weeks before the proper temper was obtained.

Open Cut in Talus—Section C is nearly all talus slope. From Station 892 to 1,232 the material is a limestone talus for about 80 per cent of the total yardage, with 20 per cent limestone boulders averaging from 20 to 40 cu.yd. in size. These boulders contained a large percentage of calcite crystals, making them difficult to drill. Practically all of Section C was loosened ahead of the shovels by vertical holes, on 20 ft. centers, to 1 ft. below grade loaded with from 125 to 250 lb. of black powder. The delays to the shovels were caused by uncovering buried boulders, which were block-holed and shot with 40 to 60 per cent dynamite. From Station 1232 to 1392 similar conditions and similar methods were used except that the material was sandstone. The cut slopes on Section C range from ½ to 1 depending on the material. With several exceptions, where slides were encountered, the slopes are standing about as staked, although considerable maintenance on cut ditches and slopes is anticipated for several years in the futur

Three types of shovels are being used; type B has a ¾-cu.yd. dipper, the 40 R a 1¼-cu.yd. dipper and the 70 C a 1½-cu.yd. dipper. The dippers all have teeth and frequent renewals are necessary The shovels overcast practically all material. In some of the heavier cuts the material has been wasted above grade. It is intended to use the Type B shovel for cleaning up these places, and this material will be loaded in wagons and used where hauling is necessary. The 70 C and 40 R have been making full width at one cut. The Type B has been making full width in two cuts except in the lighter work where full width is made in one cut. This shovel is also loading wagons where hauling is necessary.

The average heavy cutting was 30 to 50 ft. except where slides were encountered. At the vertical cliffs at Stations 1225 and 1295 the maximum cuts are as high as 100 ft. These cliffs have not as yet been shot.

The average monthly yardage, as of April 15, for the 70 C has been approximately 10,000 cu.yd.; for the 40 R, 6,000 cu.yd.; and for the Type B 3,500 cu.yd. These, however, are pay quantities and the actual quantities moved are somewhat in excess of this due to contractor overcasting in practically all cases rather than haul. Our specifications are on a pay-one-way basis, but the contractor on this job has been permitted to waste and borrow at his own expense at points where such practice is not detrimental to the line.

Due to the uncertainty of coal supply during the coal strike all shovels were equipped for fuel oil at the start of the job. During the winter the temperature made fuel oil difficult to handle, and as a coal supply was again certain, the shovels were converted back to coal burners. Fuel has been shipped by rail to points opposite Stations 892 and 1,130 where pile bridges were constructed across the river and hauled by teams from these points. Both of these bridges were lost in ice jams on March 29 and since that time all supplies have been ferried across the river at these points. The water supply has been obtained by portable pumps direct from the river to the shovels. All powder was taken across the river on cableways.

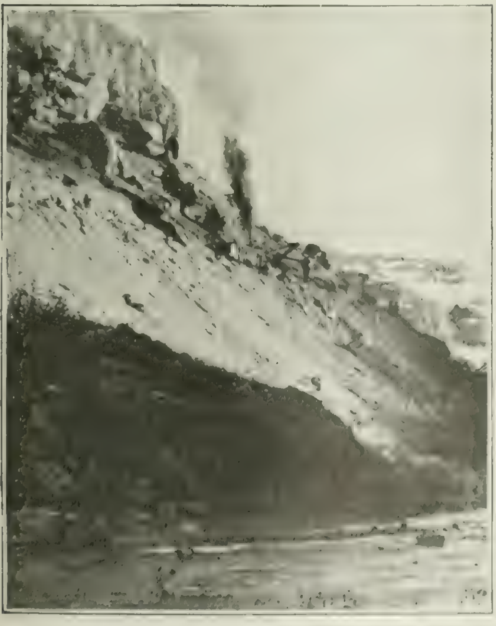


FIG. 6—EXCAVATION OF TALUS INTO RIVER BY STEAM SHOVEL

In section C the material was [illegible] and limestone talus with massive boulders [illegible] cliffs.

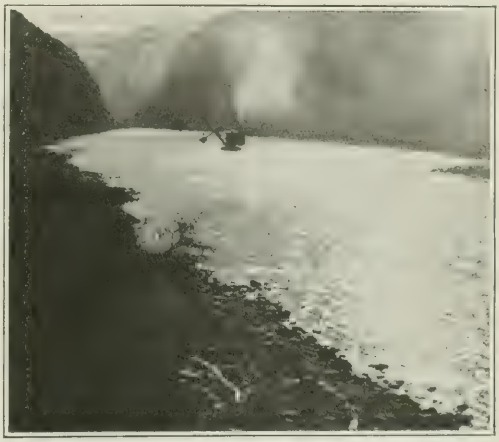


FIG. 7—STEAM SHOVEL FORDS RIVER BY OWN POWER

Management—The work has been handled under the general supervision of Z. E. Sevison, state highway engineer, and the writer as district engineer. The final surveys and field supervision of the work have been under the direction of N. T. Olson, resident engineer. Frank Burek has been in charge for the Utah Construction Co.

Burden of Taxes on British Local Railways

The people of Great Britain in their efforts to reduce railroad rates have discovered that the principal cause of the high rate is due to the local burden of taxes which the railways are called upon to bear. At the present time, notwithstanding reduced assessments, the railway companies are still paying over £8,000,000 a year in the form of local rates, an amount almost double the rate before the war. The ratable value of the railways is represented by net receipts less interest and trade profits. The calculation of local rates on the basis of receipts is made separately for the section of line in each parish, and as a large railway may pass through from 2,000 to 3,000 parishes, the effect is that the sum of parochial assessments is larger than if the undertaking were assessed as a whole. Examination of these local taxes shows that in almost every case the railroads are paying over 80 per cent of the total amount levied. The bulk of these taxes goes to the maintenance of local roads which are handling even more traffic in competition with the railways in England than they are in this country. One parish even maintains a tramway parallel to the railway and as this tramway is run at a loss the railway taxes help to keep it in existence. The estimated cost of maintaining British highways today is, in round figures, £50,000,000 a year, to which owners of motor vehicles contribute between £11,000,000 and £12,000,000, while the railway companies are taxed to the extent of £8,000,000, and are denied the extended use of the highways for purposes of motor transport.

Why One Engineers' Registration Law Was Not Enacted

Some Comments on License Laws in General and on the Proposed Law in Ohio in Particular

By Arthur Richards
City Engineer, Chillicothe, Ohio, and Secretary of the Associated Engineering Societies in Ohio Favoring Registration

IN OHIO, during the session of the General Assembly just ended, an effort was made to pass a registration bill for engineers and land surveyors. The main provision of the bill was: "That in order to safeguard life, health and property, any person practicing or offering to practice the profession of engineering in connection with the design or construction of any public works of the state or any of the political subdivisions thereof, or of land surveying within the meaning of this act shall hereafter be required to submit evidence that he is qualified so to practice. . ." The bill passed in the Senate by a vote of 24 to 1, but was defeated in the House by a vote of 52 to 41.

An examination of the bill will show that it applies only to engineers engaged on work for which public funds are expended and the proponents of the bill were of the idea that this would be the most direct method whereby the engineering profession could act for the good of the public. It is evident to those familiar with public improvements that at least 85 per cent of the engineers required to be registered under this bill would belong to the civil engineering branch, while the remainder would consist chiefly of mechanical and electrical engineers.

While those in favor of registration are actuated primarily in the interest of the public welfare the fact remains that some good is also expected to accrue to the profession and its members. To expect or desire otherwise would be foolish. I have been directing affairs in Ohio in favor of registration for the past six months and in all that time neither by spoken word nor by letter have I known any engineer or person to state he favored registration for purely selfish motives.

The defeat of the bill in Ohio this year can be attributed directly to the opposition of engineers themselves, as the result of the vote taken by the House plainly shows that in the cities where there was active opposition by the local engineers' club the majority of the representatives voted against the bill.

Reason for Opposition—I have pondered considerably as to why any engineer in Ohio should or would want to oppose the bill as introduced. It is significant that those actively opposed did not advance any arguments, o the best of my knowledge, claiming that the passage of the bill would be detrimental to the interests of the public, the state or the profession or to the interests of the engineers and land surveyors in the state who could qualify to become registered.

It will be conceded no doubt by every one that the great majority of persons in the following groups would oppose registration: (1), Incompetent persons practicing engineering; (2), engineers who place money first, ethics second; (3), engineers not directly affected by the bill and who take little interest in civic affairs; (4), corporations securing work of a public nature by submitting their own plans and designs; (5), various self-styled engineers; (6), inexperienced self-made land surveyors.

Of these six groups the third is the only one which could exert a strong influence on the legislators as the group is composed of engineers who are fully qualified to become registered if they so desire.

A ballot taken by the Engineers' Club of Cincinnati among the members of the following societies in Ohio shows very plainly that engineers not affected by the bill and not engaged on public works are very much opposed to registration:

	Per Cent
In favor—A. S. C. E.	54
Opposed —A. S. M. E.	84
Opposed —A. I. E. E.	83
Opposed —A. I. Ch. E.	80

The members voting in the above ballot, however, did not receive a copy of the bill for consideration which may account for the large percentage of opposition.

When a ballot was taken by an engineering society in Ohio where every member received a copy of the bill and no intimation was given as to which way you desired the members to vote an entirely different result was secured, as shown below:

	Per cent in favor
Akron Engineers' Club and affiliations	58
Columbus Engineers' Club and affiliations	84
Ohio Engineering Society	93
N. W. County Surveyors' Association of Ohio	95
American Association of Engineers in Ohio	94

In no case where a society received copies of the bill did a ballot show a majority opposed to the bill.

I know a great many good engineers in Ohio fully qualified to become registered who were opposed to the bill. They presented various arguments but none stated that the bill would be detrimental to the interests of the public, the profession or the engineer. One stock argument was: "That the bill is not demanded by the public." Those familiar with government legislation know that very, very few bills for the public good are initiated, demanded and fought for by the public. Legislation for the public good is invariably presented and advocated by specialists in some line of endeavor and the engineers' registration bill is no exception to the rule.

Some engineers were opposed to the bill because the requirements were too strong, while others thought they were not strong enough. Some of the legislators voted against the bill because they felt they had no engineers in their county who could qualify to become registered and therefore they would have no one competent to run for the office of county surveyor or to perform their other public engineering work. This thought was stated to me personally by three different representatives, and it is a fact that in three counties of Ohio the county surveyors or engineers are respectively a blacksmith, a clerk, and a farmer.

It was brought out that a great many of the older engineers are very indifferent as to registration while the younger engineers are invariably in favor of it. The members of the American Association of Engineers in Ohio, having an average age of thirty, and about 1,200 in number, voted 94 per cent in favor of registration, practically all of the members being fully qualified to become registered. Students at engineering colleges who had an opportunity to study the provisions of the bill were generally in favor of such legislation and a ballot taken at one college showed a 100 per cent favorable vote.

In *Engineering News-Record,* April 19, 1923, is an editorial treating on various non-technically trained persons who call themselves "engineers." In the same issue is an article on "Some Engineers I Have Known" which plainly shows just where the title "engineer" is going—most anywhere. The editorial states: "The fact remains that the title is the necessary designation of a large class of men engaged in responsible, difficult, professional work, and they can not long countenance its flagrant misuse, whether within or without the profession," and still *Engineering News-Record* will not advocate the one sure plan of protecting the title, which is by registration.

The section in the defeated Ohio bill which defines professional engineering contains the following: ". . . and who represents himself to be such an engineer, either through the use of the term engineer with or without qualifying adjectives, or through the use of some other title implying that he is such an engineer." It is considered that this section would preclude any one's using the title "engineer" in any manner, unless exempted because of present statutes, and it would seem this would be the shortest and surest way to accomplish the purpose desired.

Misuse of "Engineer"—The editorial further states: "Abuse on the part of non-professional men must be fought by engineers themselves, through group opposition." Experience has shown in other professions that the only way to stop such abuse is by legal methods and the only legal method available in this case is registration. The general promiscuous use of the title "engineer" has developed very rapidly in the last few years and in my opinion has been due to two causes. One is the prominence the engineer received during and just after the World War, and the other is the fact that the engineer finally is being recognized by the public as a person of high accomplishments. The pseudo-engineer appreciates the full value of the title "engineer" and knows it is a sure means by which he can gain the confidence of his victims, and the people in general having a high regard for the title take the pretender at his word. You can not combat the pretender with soft words or by explaining the ethics of the profession, because he is out for business and the title "engineer" is the "good will" which he covets.

The strictly professional engineer a great many times uses his technical brain to the exclusion of his common sense one. He is apt to think he is in a class by himself, that he is above doing business things like other common mortals and that he should be always the instigator rather than the follower. A lesson in how to do things for the good of the public and incidentally for the good of himself may be learned from the "stationary engineer" who is not technically trained, is not highly educated and has learned his trade mainly by practical experience.

For over twenty years in Ohio there has been a law which provides that no person shall operate a stationary steam boiler and engine of more than thirty horsepower, except boilers and engines under the jurisdiction of the United States and locomotive boilers and engines, without obtaining an engineer's license. I inquired in particular as to why such a law was passed and was informed it was enacted for the public good, and those familiar with the subject know the statement to be true. Most engineers also know that the basis of boiler construction and inspection in many states is the A. S. M. E. boiler code, which fact demonstrates that there can be close co-operation between the professional engineering societies and the public.

The Ohio registration bill as introduced was intended to perform a duty in regard to public works just as the "stationary engineer's" bill performs a duty in safeguarding the lives of people, and there is no reason why in time there should not be an Am. Soc. C. E. code to cover the general design and construction of public improvements so the people would be assured of safe and economical improvements.

The Ohio bill, as mentioned, sought to have registered only those engineers engaged on public works and it is obvious that this method would assure the most direct benefits to the people at large. As to whether we should have a general compulsory registration law for all engineers is an entirely different problem as an analysis will show that such registration would be primarily for the interest of the profession and its members, the public consideration being of secondary importance inasmuch as the great majority of engineers are not engaged on public works. Optional registration can not accomplish very much unless most of the engineers register, and because there are so many engineers who care nothing about the status of the profession, who do not belong to any local or national engineering societies, who do not subscribe for current engineering literature and who take no part in civic affairs, then it follows that few will register of their own accord.

The movement for registration, as I see it, is simply a movement of those engineers who have a vision of good for the public and the profession, which vision some engineers will not see until they are forced to look.

The personal success of the engineer depends upon the concerted efforts of all engineers and the best way to success is to get behind a just registration bill and have it enacted into a law.

Reading Railroad Is Carrying Out Extensive Improvements

Various improvements aggregating expenditures of about $12,084,500 are planned for this year's work on the Philadelphia & Reading R.R., as summarized below. Much of the work is under contract and in progress, but plans are being prepared for the Port Richmond grain elevator, the ventilation of the Mahanoy tunnel and the extensive program of rebuilding bridges to carry the heavy consolidation freight engines now in service. The Susquehanna bridge is about 80 per cent completed and the cost given in the table is the total cost for that structure.

Grain elevator at Pt. Richmond	$[illegible],500,000
Rebuilding bridges	1,151,000
Ventilating Mahanoy tunnel	73,000
Filling Ringtown Viaduct	680,000
Camden terminal piers and ferry slips	[illegible],800,000
Car dumper and pier at Pt. Richmond	1,650,000
Completing Susquehanna Bridge (total)	1,703,000
Signals and interlocking	88,000
Train control system, Camden to Atlantic City	300,000
Buildings at Reading yard	166,000
Freighthouse at East Trenton	15,000
Yard improvements at Lancaster	17,500
Bridges	83,000
Footway tunnel at Douglasville	35,000
	$12,084,500

Concreting Plant Designed for Cold Weather Work

Special Layout for Group of Buildings in Cleveland Erected During Cold Weather of the Past Winter—Principles of Cold Weather Concreting Outlined

By Richard P. Wallis
The Lundoff-Bicknell Co., Cleveland, Ohio

WINTER concreting is a problem that must be met if the cost of concrete buildings is to be brought down to compete with other types of structure. In the construction of a group of buildings for Western Reserve University and Lakeside Hospital at Cleveland, Ohio, carried out through the past winter, special attention was paid to the design of the plant not only to insure economy, but to insure economy by continuous work throughout the cold weather. The additional cost chargeable to placing the concrete due to winter conditions amounted to 9c. per cu.yd.

The group which will cost approximately $2,500,000, consists of three buildings; a four-story medical school, 308 ft. in length and 62 ft. in width with wings on either end averaging 165 ft. in length, a two-story animal hospital in the form of an L 80 ft. by 70 ft. and 25 ft. in width, both for Western Reserve University, and a power house 112 ft. by 128 ft. and 50 ft. in height including stack 210 ft. high and with an inside diameter of 10 ft. that is to supply heat and power not only to the other two buildings in the group but to the future Lakeside Hospital units that are to be erected on property adjoining this site. These buildings are connected by concrete service tunnels that carry the heating, plumbing and electrical lines from the power house to the various units.

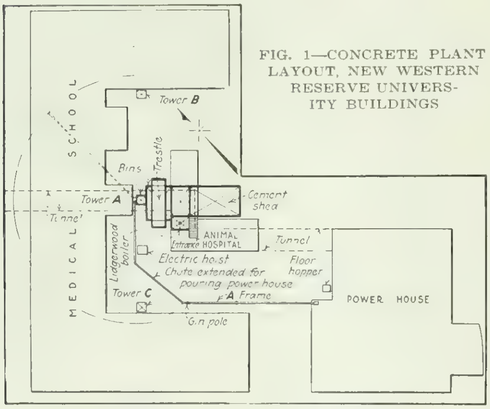


FIG. 1—CONCRETE PLANT LAYOUT, NEW WESTERN RESERVE UNIVERSITY BUILDINGS

The buildings are constructed of brick, structural steel fireproofed with tile and concrete and reinforced concrete. There are approximately 11,000 cu.yd. of concrete in the entire group, excluding concrete walks and drives.

The site is on level ground and so located as to be inaccessible by direct rail connection. For this reason it was necessary to deliver all concrete materials to the job in trucks and accordingly the concreting plant was designed and built with this limitation in mind.

Plant Layout—A central spot was chosen for the location of the mixer and elevating tower, "A." Combined material hoists and secondary towers were erected on the court side of the two wings of the medical school. These towers "B" and "C" serve as supports to the chutes that relay the concrete to floor hoppers whence it is distributed to the more distant parts of the building in buggies.

A 45-ft. gin pole equipped with a double-drum crab and an A-frame serve to support the chutes that convey the concrete from tower "A" to the power house site. As over seventy per cent of the volume of concrete contained in the power house is located below the level of the first floor it was not deemed expedient, in view of the disproportionate cost, to construct tower "A" to a height sufficient to permit of chuting the concrete for the power house superstructure directly into the forms. This concrete for roof slab, coal bins, etc., is re-elevated from the ground level at the power house in buggies on the material hoist and is thus placed at very small additional cost. (Figs. 1 and 2.)

Fortunately it was possible to locate the mixing plant at the point where the service tunnel enters the medical school. At this point the floor of the tunnel steps down to a level 30 ft. below the surface of the ground in order to enter the building at the sub-basement level. By excavating this portion of the tunnel in advance it was possible with a slight amount of additional excavation to locate the mixer and bins practically below grade. This arrangement made it possible to utilize the force of gravity throughout in the handling of the concrete materials back of the mixer. (Fig. 3.)

The bins for the storage of aggregate are constructed of timber with their tops approximately 6 ft. above grade and are so located as to be immediately above the charging hopper. A timber trestle 8 ft. in width with ramps at either end was constructed over the bins forming a continuous way so that the loaded trucks drive up one incline, dump their load through the respective floor gates and continue on down the other incline and out.

There are two separate bins, a sand bin with a capacity of 44 cu.yd. and a stone bin divided into two portions of 44 and 66 cu.yd. capacity, respectively. This latter arrangement makes it possible to stock aggregates of different sizes and kinds and permits of considerable flexibility in the operation of the plant. These bins discharge through short sections of chute to the charging hopper, the flow of materials being controlled by steel shut-off gates operated by hand.

Cement Storage—The cement shed is located back of the mixer and at ground level. This shed is of frame construction covered with roofing paper to make it weatherproof and has the floor raised six inches above the ground and measures 24 by 40 ft. Space is here provided for approximately 8,000 sacks or six carloads and is so arranged that each shipment may be stored by itself. Samples for testing are taken at point of shipment and the cars sealed and released for transit. This cement is not used until after the receipt of the

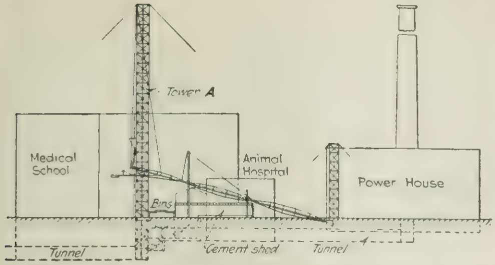


FIG. 2—ELEVATION OF THE MAIN CONCRETE PLANT

report of the seven-day test but as this report is usually received within a day or so following the arrival of the cement very little delay is occasioned thereby. Signs with the car number and the status of the cement are posted in conspicuous locations near each shipment as an aid in seeing that only approved cement is used.

The proper amount of cement destined for each batch is unsacked on the floor of the cement shed and is conveyed to the charging hopper below by a short section of circular chute pitched at the proper angle to permit of a free flow of material. This method of handling the cement avoids the confusion that inevitably occurs when the sacks are emptied on the charging hopper platform. The empty sacks are cleaned in a Handy Sac Cleaner and are counted and baled in bundles of fifty sacks each for ultimate return to the mill.

The water used in mixing this concrete is obtained from city mains and is measured by means of a tilting barrel located at the hopper, the flow being controlled from the hopper floor by a quick-acting valve. Only enough water is used per batch to cause the concrete to flow freely in the chutes. This amount is constantly checked in order to avoid the detrimental effects resulting from excess water in the mix.

The charging hopper is separated into two properly proportioned parts by an adjustable vertical partition. The proper level to which each section must be filled for the batch is determined by filling each section of the hopper with a previously measured quantity of material and marking the level to which the hopper is filled in each case.

Concreting Operations—The ½-yd. mixer is located directly below the hopper floor and is operated by a 15-hp. motor geared direct to the mixer. When properly mixed, the concrete is elevated in a hoist bucket in tower "A." This bucket is operated by a single-drum 55-hp. high-speed electric hoist designed for a speed of 1,000 ft. per min. For better control this speed is geared down to 500 ft. a minute.

Tower "A" measures 175 ft. in height above the bottom of the pit and is built in 7-ft. bents of 6x6-in. posts, 2x8-in. ledgers and cross braces and measures 7 ft. 3 in. by 7 ft. 10 in. out to out. The cross bracing is placed on the outside and the ledgers on the inside of the posts for the additional stiffness to the tower gained thereby.

The hoist bucket discharges into a tower hopper which admits to the chute, which is composed of two 50-ft. sections. The section adjoining the hopper is a trussed chute supported by cables from the top of the tower and the other a counterbalanced trussed section supported from the end of the first section. A counterweight of 2,500 lb. is required to balance this latter section of chute. Additional sections of chute are added to these as required in order to reach the more distant parts of the building. These two sections are connected by a swivel joint and splash hood in order to prevent waste of material. These chutes are pitched with a slope of 3 in. to the foot and are supported on a sliding frame so that together with the tower hopper they may be raised with winches as the work progresses.

The two permanent sections when fully extended reach hoppers in the combined hoists and towers "B" and "C" whence the cement is handled by a 50-ft. section of trussed chute to floor hoppers located in the wings of the building. These combined hoists and towers measure 6x10 ft. out to out and are 98 ft. tall. They are constructed of 4x6-in. posts and 2x6-in. braces and ledgers. The cage operating within has a capacity of three barrows. Provision for supporting the concrete chute is made by means of wood brackets framed into the tower. In this manner it is economically possible to reach all portions of the medical school.

The tower hopper in tower "A" is housed in by a wooden shed fitted with windows in order to protect the laborer, stationed there to regulate the flow of concrete through the chutes, from the wind and cold. This station is connected to both mixing platform and electric hoist by a series of electric bells for signaling purposes.

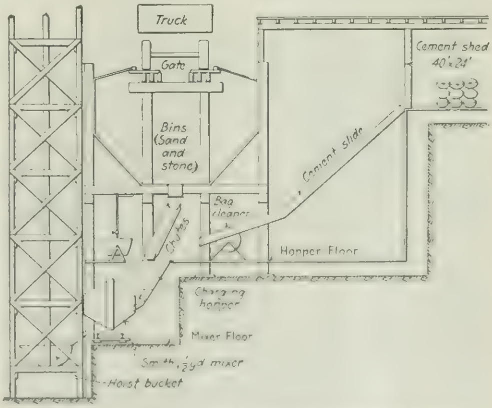


FIG. 3—LAYOUT OF THE CONCRETE MIXING PLANT

The mixing platform is also connected to the hoist in similar manner so that the travel of the hoist bucket is always under control and should anything go wrong it would be possible to stop the bucket before any damage was done to the tower.

The plant is designed to place a maximum of 200 cu.yd. of concrete per 8-hr. day. This amount of concrete requires 110 cu.yd. of sand and 170 cu.yd. of stone which means that the bins must be refilled at least three times for sand and twice for stone during each day of continuous pouring. This amount of concrete requires 300 bbl. of cement per day. Allowing 1,000 sacks or one carload, not released for use, there is still sufficient capacity in the shed for six days of continuous running.

The 11,000 cu.yd. of concrete contained in the structure necessitates the handling of over 6,050 cu.yd. of sand, 9,350 cu.yd. of stone of different sizes and 16,500 bbl. of cement.

Labor Required—There are required to operate this plant six laborers; one tending the stone and sand cutoff gates, one at the water valve, two handling cement (one at the cement shed and one at the mixing hopper), one dumping the mixer and one stationed in the tower to regulate the flow of concrete to the chutes; two engineers, one at the mixer and one at the hoist; and a foreman. The labor cost incidental to the operation of this plant, exclusive of labor stocking materials and wheeling buggies and puddling the concrete in the forms, is in the neighborhood of $65 per day or an average of $0.32 per cubic yard of concrete poured. The power cost of operating this plant amounts to approximately $10 per day or $0.05 per cu.yd. This latter figure is unusually low as the mixer and hoist constitute the only power-driven equipment in the plant.

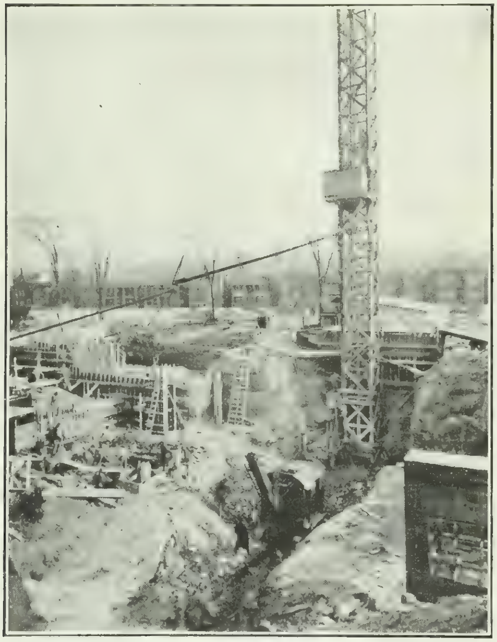


FIG. 4—TOWER A, SHOWING RELATION OF BINS, CEMENT SHED AND TRESTLE

Stocking costs for the aggregates are nil, while that of cement amounts to approximately $0.05 per bbl. Had manual labor been employed in the handling of the concrete material back of the mixer it would have necessitated the use of fifteen men instead of the four actually employed to put the batch in the mixer. This means a saving of eleven laborers or $66 per day for a maximum run of 200 cu.yd. or $0.33 per cu.yd., a total saving for the entire job of approximately $3,630 due to the efficient manner in which it is possible to handle the materials on the dry side of the mixer.

As the total cost of the plant back of the mixer amounted to $800 it is evident that the saving effected by its use amounts to 450 per cent, or, in other words, this arrangement paid for itself between four and five times.

The labor cost of mixing, depositing and puddling concrete in the forms varies with the locality for which the concrete is destined and is constant for any particular type and arrangement of plant layout. The equipment and methods for handling concrete on the wet side of the mixer have become more or less standardized resulting in comparatively uniform costs whereas the cost of putting the batch in the mixer varies with the ingenuity shown in the laying out of bins, hoppers, etc., required on the dry side for the unloading, stocking and transportation of the raw materials.

This plant when fully equipped costs in the neighborhood of $7,600, including rentals on certain portions for the estimated duration of the job, the net cost of the remainder of the equipment and the labor, cost of building, maintaining and wrecking the plant. This cost amounts to $0.69 per cu.yd. of concrete placed.

Comparing the cost of chuting the concrete from the tower hopper to the forms with the cost that would have resulted had the concrete been buggied from the hopper it is estimated that a saving of $0.26 per cu.yd. was effected.

The 11,000 cu.yd. of concrete contained in the structure were placed at an average labor cost of $0.85 per cu.yd. based on the total cost properly assessable against the concreting operations.

Precautions for Cold Weather—As stated, it was necessary, owing to the fact that the greater part of the concrete was to be placed during the winter months of the year, to lay great stress upon cold weather and frost protection in order that the concrete should be of the proper quality.

The stone and sand bins are equipped with perforated steam coils connected to a 35-hp. boiler. These bins were constructed with covers in order that the heat so imparted may be retained for as long a period as possible. In this manner it was possible to maintain, when weather conditions required, a temperature of about 150 deg. F. This temperature proved to be sufficient not only to thaw out any ice or snow found in the aggregate but to impart sufficient initial heat so that the resulting concrete was well above the critical temperature when placed in the forms. The mixing water was likewise heated to a similar temperature. The cement and reinforcing steel were not preheated as they constitute such a small percentage of the volume of the concrete.

Among the advantages obtained from locating the bins and mixer below ground and in an enclosure was the protection gained by the men working at the mixer from direct exposure to the wind. It was found possible to maintain fairly comfortable working conditions by the use of salamanders placed on the various platforms.

Care was taken to place the warm concrete in the forms immediately after mixing in order to lose as little heat as possible. The temperature of the concrete was tested with a thermometer from time to time to insure its being maintained sufficiently warm to withstand the action of the cold. Every effort was made to keep this temperature around 80 deg. F. All snow and ice were carefully removed from the forms by means of a steam jet before the concrete was deposited.

During the 48 hours immediately after pouring, in the case of moderately cold weather and from three to five days in freezing weather, the new-laid concrete was protected from the action of frost and wind by tarpaulins enclosing the area in which the concrete occurs. Salamanders burning coke were kept constantly going in order to maintain a temperature of at least 60 deg. F. This temperature was frequently checked in order to prevent its falling below the critical point. The night watchman was charged with the responsibility of keeping these salamanders burning during the night. Buckets of water were kept near all salamanders not only as a precaution in case of fire originating from hot ashes or overheated salamanders but also to provide the necessary amount of moisture for the proper setting action.

Great care was exercised in removing the forms whenever the temperature registered below 50 deg. F. and particularly when the temperature was below 32 deg.

Simple tests were made on the concrete before removing the forms from important portions of the work to determine if the concrete had hardened sufficiently and if so whether due to its having set properly or to freezing. Eight-penny nails were driven into such concrete. If they penetrated, it indicated that the concrete was still soft and that the forms should remain in place. Should the concrete resist penetration it served to indicate that the concrete had hardened. If any suspicion existed that this hardness was due to frost the flames from a gasoline blow torch were directed against the surface of the concrete. If the concrete went to pieces under such treatment it indicated that frost was present and the section must be allowed to thaw after which it might set properly. Due to the thoroughness of the precautions taken very little of the concrete was found to be in this condition.

This work was carried on under the direction of Hugh Cook, representing the contractor, the Lundoff-Bicknell Co.; M. P. Potter representing the owner; and J. J. Deveney representing the architects, Coolidge & Shattuck of Boston, Mass.

Torsional Strength of Reinforced Concrete

Tests of the torsional strength of rectangular sections of plain and reinforced concrete have been made at the University of Toronto and have been published in Bulletin 3 of the University of Toronto School of Engineering Research. Tests were made by Prof. C. R. Young, W. L. Sagar, and C. A. Hughes. They were made on 5 x 5-in., 5 x 7½-in., and 5 x 10-in. beams all 4 ft. long, some plain, some with longitudinal reinforcement, some with medium longitudinal reinforcement and light spirals, and the last with heavy longitudinal steel and close spirals. Twelve test beams in all were made. As a result, the authors state (1) rectangular specimens of plain concrete with various ratios of long to short sides developed substantially the same computed maximum torsional shearing stress at the center of the long side. For 1:2:4 concrete one month old, this is about 540 lb. per sq.in. (2) Longitudinal reinforcement alone is of little value when reinforcing concrete beams for torsion. (3) Spiral reinforcement increases the torsional strength of beams, the increment in strength being approximately proportional to the amount of such reinforcement. Spiralling to the amount of from 0.4 to 1.0 per cent may be expected to increase the torsional strength of a member with or without straight longitudinal rods from 20 to 50 per cent. (4) The torsional modulus of elasticity of plain concrete of 1:2:4 mix one month old averages about 1,500,000 lb. per sq.in.

Efficiencies of Old Reaction Wheels Improved by Rubber Seal Rings

SINCE the advent of rubber seal rings for reaction type waterwheels the idea of fitting such rings to old units to improve operating conditions has been tried out successfully in a number of Western plants. These rings can be installed to good advantage, it is claimed, when a unit has fallen off in efficiency after long service due to seal ring leakage or where sediment in the water makes necessary frequent renewal of the ordinary metal seal rings. The rubber seal rings developed by E. C. Hutchinson of the Pelton Water Wheel Co. were described in *Engineering News-Record* Nov. 9, 1922, p. 789.

Based on the operating experience in Western plants, it is stated that under hard wearing conditions the rubber seal rings will last longer than metal and will also keep water leakage and resultant efficiency loss to a minimum without any danger of internal rubbing or damage. There is no means of figuring exactly the improvement in operating conditions that may be expected from the use of rubber seal rings in old turbines. However, in all cases where they have been put in old units the improvement of efficiency and turbine capacities is said to have made the first cost of the improvement a highly satisfactory investment.

On one California plant, for example, which has been in service more than ten years, the turbine, when new, developed 1,550 kw. with a depth of 37 in. of water in the canal supplying the forebay. After years of wear without renewal of seal rings the output dropped to 1,440 kw. with the same depth of water in the canal. Rubber seal rings were then installed and the turbine output was thereby increased to 1,670 kw., using the same amount of water. This capacity, however, was too great to be carried continuously on the generator and the amount of water admitted to the turbine was reduced to keep the power within limits safe for the generator. The surplus water was then used to operate an old standby unit for which no water supply had previously been available. This standby unit is now delivering 110 kw. and the main unit 1,550 kw. with the same 37-in. depth of water in the supply canal.

In this case, as in most cases of putting the rings in old units, the change is quite simple and involves only the removal of the existing all-metal wearing rings or sealing rings and the substitution of the rubber rings. Usually this is done without other modification of the unit.

The present construction of the seal rings, particularly for high-head turbines, requires that the rubber shall be vulcanized directly into the metal rings. When the rubber becomes worn, however, it is unnecessary to renew the metal ring section as it can be again used for vulcanizing a new rubber facing into it.

The highest head under which rubber seal rings are now used is 350 ft., but similar rings are in process of construction for the Oak Grove turbines which will operate under a head of 850 ft. The largest rubber seal rings thus far made are 5½ ft. in diameter but plans are now being developed for making seals of this type commercially for the very large diameter low-head turbines used extensively in the eastern part of the United States. This plan contemplates the manufacturing of the rubber seals in strips which are then secured to their ring containers.

False Statement of Quantities Unbalances Bid

Practice in Stating Indeterminate Quantities May Provoke Unbalanced Bids—Four Methods Analyzed—Conclusions Drawn

By Clinton L. Bogert
Teaneck, N. J.

IN RENDERING a balanced bid the contractor relies on the "Approximate Statement of Quantities" prepared by the engineer; he assumes that this list represents comprehensively the nature of the undertaking. A large responsibility, therefore, rests on the engineer to make his statement as nearly as practicable representative of the character of the work to be performed and of the materials to be delivered. In other words, the "Approximate Statement of Quantities" should be as faithfully balanced as it is expected the contractor's bid will be.

Unfortunately, conditions beyond the control of the engineer often militate against completeness in the approximate statement of quantities. City councils are notoriously loath to appropriate money for any purpose previous to the signing of the contract; even a few dollars for test-pits are difficult to obtain. On small municipal jobs, particularly, this inhibition of expenditures for borings and other subsurface studies often makes it impossible to do any testing and thus puts the engineer in a quandary.

METHOD OF UNBALANCING BIDS WHEN NOMINAL VALUES ARE GIVEN TO INDETERMINATE QUANTITIES

Accuracy of Statement of Quantities	Item No.	Class	Cost to City Based on Statement of Quantities					Cost to City Based on Final Estimates				
				A. S. Usual, Bidder		A. Local Wise, Bidder			A. S. Usual, Contractor		A. Local Wise, Contractor	
			Preliminary Estimate	Unit	Total	Unit	Total	Final Estimate	Unit	Total	Unit	Total
Quantities estimated from surveys, etc.	1	Earth excavation, 0–6-ft., cut	10,000 cu.yd.	$0.50	$5,000	$0.65	$6,50	11,000 cu.yd.	$0.50	$5,500	$0.65	$7,150
	2	Earth excavation, 6–9-ft., cut	3,000 cu.yd.	.80	2,400	.70	2,100	4,000 cu.yd.	.80	3,200	.70	2,800
	3	Earth excavation, 9–12-ft., cut	2,000 cu.yd.	1.00	2,000	1.00	2,000	2,000 cu.yd.	1.00	2,000	1.00	2,000
	4	Earth excavation, 12–15-ft., cut	1,000 cu.yd.	2.00	2,000	1.25	1,250	1,000 cu.yd.	2.00	2,000	1.25	1,250
	5	Earth excavation, 15–18-ft., cut	500 cu.yd.	3.00	1,500	2.00	1,000	500 cu.yd.	3.00	1,500	2.00	1,000
	6	Earth excavation, 18–21-ft., cut	200 cu.yd.	4.00	800	3.00	600	200 cu.yd.	4.00	800	3.00	600
	7	42-in. reinforced concrete pipe	8,000 ft.	5.50	44,000	5.20	41,600	8,000 ft.	5.50	44,000	5.20	41,600
	8	39-in. reinforced concrete pipe	1,000 ft.	5.10	5,100	4.60	4,600	1,000 ft.	5.10	5,100	4.60	4,600
	9	C. I. pipe, etc.	20 tons	70.00	1,400	80.00	1,600	22 tons	70.00	1,540	80.00	1,760
		Sub-total of Items 1–8			$64,200		$61,250			$65,640		$62,760
Quantities inserted to "get a price"	10	4-in. vitrified pipe	100 ft.	$0.15	$15	$0.45	$45	800 ft.	$0.15	$120	$0.45	$360
	11	6-in. vitrified pipe	100 ft.	.25	25	.80	80	600 ft.	.25	150	.80	480
	12	8-in. vitrified pipe	100 ft.	.40	40	1.20	120	700 ft.	.40	280	1.20	840
	13	10-in. vitrified pipe	100 ft.	.60	60	1.60	160	...	...	...	...	...
	14	12-in. vitrified pipe	100 ft.	.80	80	2.00	200		...	...	...	...
	15	15-in. vitrified pipe	100 ft.	1.00	100	2.40	240	200 ft.	1.00	200	2.40	480
	16	18-in. vitrified pipe	100 ft.	1.20	120	2.70	270	400 ft.	1.20	480	2.70	1,080
	17	20-in. vitrified pipe	100 ft.	1.40	140	3.00	300	...	...	...	...	...
	18	22-in. vitrified pipe	100 ft.	1.60	160	3.30	330	200 ft.	1.60	320	3.30	660
	19	24-in. vitrified pipe	100 ft.	1.75	175	3.50	350	300 ft.	1.75	525	3.50	1,050
	20	Concrete, Class A	10 cu.yd.	14.00	140	25.00	250	30 cu.yd.	14.00	420	25.00	750
	21	Concrete, Class B	20 cu.yd.	12.00	240	20.00	400	60 cu.yd.	12.00	720	20.00	1,200
	22	Concrete, Class C	30 cu.yd.	10.00	300	15.00	450	50 cu.yd.	10.00	500	15.00	750
	23	Brick masonry	10 cu.yd.	25.00	250	40.00	400	20 cu.yd.	25.00	500	40.00	800
	24	Rock excavation	50 cu.yd.	4.00	200	9.00	450	400 cu.yd.	4.00	1,600	9.00	3,600
		Sub-total of Items 9–24			$2,045		$4,045			$5,810		$12,050
		Totals			$66,245		$65,295			$71,450		$74,810

Bid prices must have as their basis the "approximate statement of quantities" in the preparation of which the engineer has one of four courses open to him as regards the uncertain items:

1. Place the quantity at some conveniently round nominal figure; this is a widespread practice.

2. Use a figure high enough to be certain that it cannot be exceeded.

3. Prepare as careful an estimate as possible based on final estimates from similar structures similarly conditioned, and explain fully to the bidder the nature of the estimate.

4. Ignore the minor items entirely in the approximate statement of quantities and pay for such as extra work.

Unknown Items Estimated Low—This practice consists in inserting some conveniently round number, say 10, 50, 100, opposite the unestimatable item. In reality this procedure unbalances the approximate statement of quantities, leaving the way open for some unscrupulous bidder to profit at the expense of the municipality. A concrete case is given in the table based on a canvass of bids published within the last year in the Construction News section of *Engineering News-Record.*

The canvass of but two bids is here shown. A. S. Usual bid according to his best judgment in the light of the drawings and specifications and a visit to the site. On the other hand, A. Local Wise has done work in this locality previously and suspects that there will be several hundred feet of some of the pipe sizes tabulated as 100 ft. long, and that there will be a considerable quantity of rock. Acting on this hunch, he prepares his bid-prices according to his usual procedure, and then shades off a few hundred dollars from the subtotal of items 1-9, and adds them judiciously to items 10-24. On the known items, 1-9, Wise is $3,000 under Usual, while on the total Wise is but $1,000 under. Being the lowest bidder and a local man he gets the contract.

Later when the progress of work has disclosed the actual quantities of items 10-24 the comparison is quite different. There has been inserted in the table what might be considered a fairly representative final estimate for this type of work—one not beyond the realms of reason on small-town contracts. The resulting figures require no explanation.

Unknown Items Estimated High—This is not common practice, but is not unknown. It is unfair to the contractor, even on minor items, as it leads him to plan his plant and to allocate his overhead charges on the basis of a certain large quantity of work. Again, if the total of the bid price is run up by their insertion to such a figure as to create a wrong impression of the ultimate cost the council may be put in a state of mind to delay for months a much-needed public improvement. In brief, unbalancing the statement of quantities by the adoption of excessive figures for the unascertainable items works an injustice on the contractor which may lead to a costly court action; and it deceives the council as to the final cost.

Unknown Items Estimated Carefully—This method provides the nearest approach to a balanced statement and probably constitutes the best practice although many engineers favor the extra work alternative. The inability to ascertain the full extent of all the work to be done under a contract is no excuse for the slovenly use of round numbers, nor for extravagant figures. Every engineering office has in its files the final estimates and the contracts of similar work done, from which can be derived some relative figures between the known and unknown items which can be put to practical use. After the preparation of as comprehensive a statement of quantities as the nature of the work permits, take the contractor into confidence and explain to him the conditions of the estimate and what conditions encountered may alter the figures.

Unscheduled Work Classed as Extra Work—During the life of a municipal contract so many alterations may be required by the authorities that some engineers despair altogether of getting out a comprehensive and balanced approximate statement of quantities and swing to the other extreme of inserting only the items which can be estimated, leaving all others to be classified as extra work.

Extra work always opens the way for innumerable squabbles as to what constitutes the cost of the work so done, and especially as to the apportionment of overhead charges to such work. Moreover, extra work bills generally have to be passed by the City Council, which affords opportunity for discourses relative to the competence of every one concerned. This alternative also misleads the council as to the final cost of the work, since the canvass of bids, which councilmen often pin their faith to as representing the ultimate expenditure for a project, was totalled excluding these items. Here again we see the evils attendant on an unbalanced statement of quantities.

Conclusions—The estimating of the unascertainable quantities at too low a figure has been shown to be a means of mulcting the public treasury when a bid is once accepted. There is no relief to the city from the contractor's high prices. It can work no hardship on a contractor who wants to resort to law, as he can expect relief from low prices.

The placing of excessively high figures works no good to any one.

The resort to the "extra work" clause to cover items which are purposely ignored when preparing the approximate statement of quantities, should be had only in extreme cases.

The use of a carefully prepared estimate, with adequate cautions to the bidder undoubtedly constitutes the nearest approach to a balanced statement of quantities, and as such should be looked upon as standard practice for small as well as large works.

Indiana to Build 235 Miles of Road in 1923

A total of 235 miles of road will be constructed by the Indiana State Highway Commission this year, according to John D. Williams, director of the state highway department. Projects now under way, to cost $2,254,131, include 20 mi. concrete pavement, 2 mi. sheet asphalt on concrete base, 2 mi. bituminous concrete on concrete base, 2 mi. Kentucky rock asphalt, 1 mi. bituminous macadam on waterbound base, 3 mi. waterbound macadam, 10 mi. gravel, and 1 mi. stone. There are forty county projects carried out under state approval and inspection.

Traffic Center Lines on Roads

Committee report submitted May 10 to the annual meeting of the National Highway Traffic Association in New York, by Frank T. Sheets, State Superintendent of Highways of Illinois.

THE USE of traffic center lines on highways is becoming more and more popular in the United States. In the case of a road having a paved width sufficient to accommodate two lines of traffic the safety of the highway users may be increased from 25 to 50 per cent by the addition of a traffic center line. This conclusion has been reached after an observation of the habits of traffic on two-track roads where a center line has been introduced. Further, it is based upon the unsolicited complimentary remarks which have been received from the traveling public immediately after such a line was introduced.

When a traffic center line is used the drivers no longer pass each other with a more or less uncertain clearance between the vehicles, but approach each other with confidence, using the center line as a positive visible gage on the driver's side, and knowing that the clearance thus afforded will insure absolute safety in passing, without any danger of running off the unseen outside edge of the pavement.

On curves, the traffic center line is of even greater advantage than on the tangents, and even if not used on the latter it should be painted on all curves having a radius less than 1,000 ft. This center line should extend not less than 400 ft. beyond each end.

In the case of the so-called non-rigid or flexible types of pavement construction on macadam or other flexible bases the use of traffic center lines might tend to force traffic into well defined lanes and thus cause rutting or undue wear. However, on heavily traveled roads the safety of the traveling public is of greater importance than the safety of the pavement surface. In the case of the so-called rigid types of pavement, such as portland cement concrete, brick, bituminous concrete or sheet asphalt on a concrete base, which are the predominating types in this country, the traffic center line will materially increase the structural safety of the pavement by tending to eliminate travel near the extreme edges of the pavement, where the outside edges and the unprotected corners caused by construction joints or by transverse contraction cracks are the most dangerous and critical sections from a structural standpoint.

Center Joint a Guide—One of the embarrassing defects encountered in concrete pavement slabs having a width greater than 16 ft. is the formation of unsightly longitudinal cracks brought about by the combined stresses produced by nature and traffic. To eliminate such cracks the center of the pavement must be thickened to a dimension not justified by economy. However, this may easily be circumvented by introducing a longitudinal center construction joint dividing the normal two-track country pavement having a width of 18 ft. into two 9-ft. sections. Slabs 9 ft. in width have never caused any difficulty so far as longitudinal cracking is concerned. By proper interlocking and tying together of these two 9-ft. strips the interior portion of the pavement may be made practically as strong as an unbroken slab, and certainly far more efficient than a pavement divided by an irregular longitudinal crack. This center construction joint may be kept filled with bituminous material and painted with a line approximately 3 in. in width. In this manner, the traffic center line and the longitudinal construction joint may be introduced in one operation, with the result that the unsightly longitudinal cracking is eliminated, traffic safety is increased, and highway engineers may cease to perpetuate the indefensible evil practice of causing doubt, criticism, and mistrust in the mind of the traveling public by designing and building pavements which fail structurally by longitudinal cracking even before traffic is introduced.

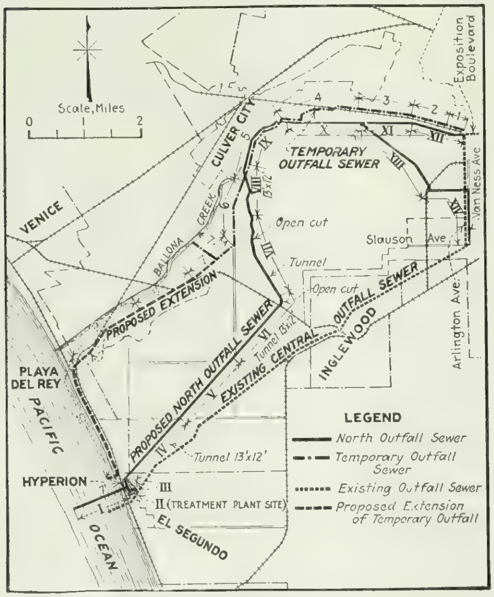
The combined center line construction joint and painted traffic center line are being used in Illinois on all pavements built on the 4,800-mile state trunk line highway system, which is being pushed to completion at the rate of 1,000 miles per year, and also on all county roads in the state

Los Angeles Sewage Disposal Plans Assuming Final Form

Trunk Sewers, Screens, and Ocean Outfall—Venice Co-operation May Make Temporary Sewage-Works Unnecessary

By W. T. Knowlton
Engineer of Sewers, Los Angeles, Calif.

Since a report by the writer on the construction of the new Los Angeles outfall sewer and sewage treatment plants, published late last year (abstracted in *Engineering News-Record*, Dec. 28, 1922, p. 1116), plans and specifications for most of the different sections of the new outfall have been prepared. The total length of the new outfall will be 15.4 miles, of which 7.2 miles will be of a semi-elliptical design with a height of 12 ft. and a width of 13 ft. Most of this portion of the sewer will be laid in tunnel, only two miles being in open cut. The remaining portion of the new outfall, Sections IX to XIV inclusive, will be a circular sewer, varying from 4 ft. 9 in. to 8 ft. 6 in. in diameter. The general location of the new sewer is shown on the accompanying map, the different sections being indicated by Roman numerals. The map also shows the temporary outfall which is being built along Ballona Creek to relieve the present emergency until the larger outfall can be finished.



PRESENT AND PROPOSED SEWER OUTFALLS AT LOS ANGELES

City sewage received by the central outfall sewer shown at the extreme right edge of the map is now delivered to the ocean at Hyperion. Pending construction of the large outfall sewer (shown by solid lines with contract sections indicated by Roman numerals) a temporary pipe line of smaller size is being built along Ballona Creek (indicated by dash-and-dot and broken lines and by Arabic numerals).

Three types of construction are under consideration for the circular sections of the permanent outfall: (1) A brick arch resting on a concrete invert and base, with vitrified brick for the entire inner circle; (2) a segmental block resting on a concrete base and with concrete reinforcement on the sides; and (3) precast reinforced-concrete pipe with a vitrified-tile lining, this type also resting on a concrete base. For the 12 x 13-ft. sections the choice will be between (1) a brick arch on a concrete base with vitrified brick for the inner ring and (2) large segmental block for the upper quadrant and segmental block lining for the remainder of all of the interior surface above the concrete base, with concrete reinforcement on all sides excepting the upper quadrant.

The depth of the sewer in Sections X to XIV, inclusive, will average 18.3 ft. Borings indicate that considerable ground water will be encountered in all of these sections. On Sections VII to IX, inclusive, ground water will probably be encountered at irregular intervals. Borings made not far from the sewer line in Sections IV to VI indicate that sand and no water will be found. Arrangements for making connections at the upper ends of Sections XII and XIV with the existing outfall sewers are planned upon the completion of the new outfall. No direct house connections are planned to be made to this new sewer, except as has been mentioned and except for a connection to be made at the upper end of Section VIII with the sewers of Culver City.

During the first four months of this year considerable progress has been made on the temporary outfall sewer, the contract sections of which are shown by Arabic numbers on the map. Plans for Sections 5 and 6 have been made and a contract has already been awarded for Section 5. Sections 1, 2 and 3 of the temporary outfall have been completed and it is expected that Section 4 will be completed by July 1. Upon the completion of Section 5, the temporary outfall will carry the excess flow of sewage from the present outfall at Arlington Ave. and Rodeo Road to a point below Culver City. The approximate cost of Sections 1 to 5 inclusive is $282,200 and the length 5.36 miles.

The original plan of having the flow of sewage in this temporary outfall treated and then discharged into Ballona Creek will probably be abandoned, if arrangements which have been considered are made with the City of Venice. These arrangements would cover rights-of-way across that part of the City of Venice called Playa del Rey, so as to permit of the extension of the temporary outfall from the treatment plant site south of Culver City to Playa del Rey, and thence south to the Hyperion property of the City of Los Angeles. This change will relocate Section 7 and add Sections 8, 9 and 10. After giving the City of Los Angeles these rights-of-way, the City of Venice would expect to receive a permit to discharge the sewage from the City of Venice into the temporary outfall at Playa del Rey.

The capacity of Sections 7, 8 and 9 will be the same as that of section 6, namely, 45 sec.-ft., as no sewer connections between Culver City and Playa del Rey will be made to this temporary outfall sewer. Furthermore, Sections 6 to 10, inclusive, of this sewer will be under pressure, so that a suitable type of construction must be provided. The present plan is to use either wood-stave or reinforced-concrete pipe for Sections 7 to 9 inclusive, and reinforced concrete for Section 10, the reason for the latter type for Section 10 being that it will be laid along the coast where the use of wood stave would not be applicable.

The bond issue for $12,000,000 voted on August 29, 1922, was planned to cover the construction costs of the new outfall sewer, the temporary outfall to and including the treatment plant south of Culver City, also the treatment plant at Hyperion. With the omission of the treatment plant south of Culver City, this bond issue will be sufficient to cover the proposed extension of the temporary outfall to Playa del Rey, and thence to Hyperion.

Work on Section II at the lower end of the new north outfall sewer has already been started, this section covering the removal of the sand hills where it is planned to install a sewage-screening plant. The contract for Section II includes excavating and dumping into the ocean approximately 700,000 cu.yd. of material. The contract price for this section is $97,704, or approximately 14c. per cubic yard.

Plans and specifications for the pipe proposed for the ocean end of the new outfall sewer, Section I, have been prepared. Although cast-iron pipe was originally planned for this section, it has been decided recently that an alternative installation of precast reinforced-concrete pipe could be used in place of cast iron. The internal diameter of this pipe is 84 in. for the first 5,145 ft. from shore, at which point the depth is about 50 ft. Here the 84-in. pipe will divide into two 60-in. branches at right angles to each other and 45 deg. from the main line axis. These 60-in. branches will each be extended 283 ft. further from shore where the depth is approximately 56 ft. Special fittings for the pipe at the lower ends of these two branches will be made so that the sewage will discharge upward at a point about 3 ft. above the ocean bottom. The pipe of Section I will be laid just below the ocean bottom and be protected against tidal action by bulk concrete and backfill. Novel methods have been devised for the laying of this line by submerging caissons carrying three lengths fastened together on shore.

Borings made below the ocean indicated that the bottom is sand for a depth of at least 10 ft. below the floor, and in some places these borings indicate nothing but sand for a depth of 20 ft. Soundings made show the ocean floor to have a slope of about 1 per cent from high tide outward to and beyond the proposed ends of Section I.

Section III of the north outfall includes the different portions of the screening plant and work incidental thereto. Plans and specifications for the south portion of the screening plant have been completed and bids therefor were opened by the Board of Public Works on May 7. These screens will be of the horizontal-drum type and the screenings will be removed by elevators to a dryer, or to beds where they can be covered. Other plans for this section include the connecting sewers, buildings, and road work.

The policy of the city will be to do all this sewer work by contract if the proposals received are not excessive. The preparations of all plans and the construction work to follow are under the general supervision of Major John A. Griffin, city engineer.

Work Resumed on 89 Forest Road Projects

The Bureau of Public Roads of the United States Department of Agriculture reports that there are 89 projects involving 717 miles of road upon which work is being resumed and a number of new projects for which contracts have been let and that 175 projects involving 1,487 miles of forest road have already been completed.

Snow Survey and Stream Runoff Forecast in Nevada for 1923

STREAM FLOW in Nevada during the coming spring and summer is likely to approximate normal conditions, according to the April forecast of J. E. Church, Jr., Reno, Nev., who is in charge of the co-operative snow survey conducted jointly by the State of Nevada and the Nevada section of the U. S. Weather Bureau. This snow-survey system has been described in *Engineering News-Record* of Oct. 23, 1919, p. 766; Sept. 9, 1920, p. 429, and Feb. 10 and 17, 1921, pp. 244 and 300. A summary of the report is given below:

The snow cover in the Central Sierra varies from 99.4 per cent in the Yuba-Truckee basins in the north to approximately 92.0 per cent in the Stanislaus-Tuolumne-Walker basins in the south. No shrinkage is probable in the percentage of runoff indicated by the snow cover, for 75 per cent of the normal April-July precipitation fell during the first week of April and further precipitation may reasonably be expected. However, since the snow cover is below normal, a late runoff seems improbable. In fact, the extraordinarily high density of the snow cover April 1 and its consequent inability to retain water by capillarity indicates a somewhat earlier runoff than would otherwise occur. Only summer and autumn rains can keep the streams at late normal stage.

The snow cover in the Humboldt basin varies from 82.9 per cent on the northern feeders to 103.1 per cent on the southern, or an average of 93.0 per cent for the basin. The snow cover of the Little Humboldt basin is somewhat heavier, being 117.6 per cent. The April-July precipitation in the Humboldt basin gives no assurance as yet that shrinkage can not occur there in the runoff. Under maximum shrinkage, the loss should not exceed 25 per cent of normal, leaving a net runoff of at least 68.0 per cent in the Humboldt River at Palisade, and 92.6 per cent in the Little Humboldt River at the head of Paradise Valley.

Contrary to age-long tradition, the loss in water content of snow in the Humboldt quadrangle must be due to high relative density which deprived the snow cover of its spongy character and ability to hold melting water in suspension. This extraordinary density was due to the lack of snowfall in February and March, which gave the earlier snow an opportunity to ripen without addition of new snow to decrease the average density. If the usual amount of new snow had fallen in March, the lower and compact snow would probably have been insulated against the normal temperature then prevailing. A loss of this nature has never previously been detected during the fifteen years of the snow studies.

Forecast—Since both the temperature and the elevation of the snow line were normal in March, no increase in the April flow can be expected from the deficient runoff of March, which was due mainly to the almost complete lack of precipitation during this and the previous months. In fact, owing to the abnormal density of the snow cover, some of the water belonging normally to the April flow ran down in March or saturated the soil. This occurred at elevations as high as 8,000 ft. However, this loss has been eliminated from the April-July estimate.

Moreover, in the Central Sierra the heavy precipitation of 3.01 in. at Tahoe City April 1-7, which amounted to 75.8 per cent of the normal for the entire period of April-July, indicates that no shrinkage in the stream flow below the percentage indicated by the snow cover will probably occur, and that such shrinkage at most can not exceed 20 per cent for Lake Tahoe and 10 per cent for the streams.

However, in the Humboldt Basin, the precipitation thus far in April has been too light to give any assurance against possible shrinkage. While the runoff can now be closely forecasted in the Central Sierra, only the extremes of runoff in the Humboldt Basin can be given at the present time, a more definite forecast being deferred until a later date.

Thin Concrete Revetments on the Sacramento River

Two Inches of Reinforced Gunite in Test Section—Mistakes in Methods Used—Concrete Slab for Second Section

As an experiment in checking the erosion of the banks of the Sacramento River, below Sacramento City, a section of one of the slopes was covered with a gunite revetment placed during the winter of 1922. The specifications called for a 2-in. layer of reinforced gunite of 1:3 mix, placed directly on the slope which was a mixture of fine sand and coarse gravel. The revetment was about 540 ft. long and from 40 to 60 ft. wide. The gunite was placed down to the water's edge and there terminated without any protection. No provision was made for expansion joints nor was any method used whereby the thickness of the slab could be determined. It also appears that the specified proportions for the gunite were not maintained throughout, that they sometimes dropped as low as 1:9.

The heat and floods of the following season brought out the defects in the method used. Expansion cracked and broke the slab at many points where, instead of being 2 in. thick, it is only ½ in. thick. Then the floods scoured out the openings so made and also cut away the sand and gravel under the lower edge of the revetment, allowing portions of it to drop down and break off.

GUNITE BANK PROTECTION WITH CONCRETE TOE WALL

Benefiting by the experience so gained, the damaged revetment was later protected along its edges and at the toe by a wall 2 to 4 ft. deep, and all the holes were repaired by a new layer of gunite of the proper thickness and proportions. This work was done in October, 1922. Since then the revetment has successfully withstood the attacks of the river. But, as a whole, the experiment in using gunite was so unsatisfactory that in extending the revetment upstream for a distance of 600 ft. a 4-in. layer of concrete was used. This new slab is provided with a toe wall and with longitudinal expansion joints every 20 ft., and one horizontal expansion joint about 25 ft. above the toe wall. The cost of this new extension was 14c. per square foot while under favorable conditions the cost of the gunite work was from 17 to 19c. per square foot.

In fairness to gunite it should be said that the partial failure of this piece of revetment does not necessarily prove that gunite might not be as satisfactory as a concrete slab if placed in the summer or fall, at low water, with proper toe protection and expansion joints, and proper thickness and uniformity of mixture.

CONCRETE PROTECTION—EXTENSION OF GUNITE WORK

A small section of gunite bank protection was placed in October, 1919, in front of the irrigation pumping plant on the Sacramento River levee of Reclamation District No. 1,000, and has proved entirely satisfactory.

The information in the above report was taken from a letter by Melville Dozier, Jr., general manager, The Reclamation Board, Sacramento.

Public Water Supplies in Pennsylvania

From the forthcoming report of the Pennsylvania Department of Health

At the close of the year 1920 there were 150 filtration plants on public water-works in Pennsylvania. In each of the two succeeding years 7 additional plants were put into operation. At the close of 1922 the total was 163, one plant having been abandoned during 1922, the district formerly served from this plant being supplied with filtered water from another source.

Of chlorinating plants there were 154 in place at the end of 1920, this including modern-type chlorine gas outfits and also chlorinated lime plants, ranging from a simple arrangement of barrels to the more permanent concrete or wooden tanks. During 1921, 59 additional plants were built and in 1922 the total was further increased by the installation of 38 plants. Accordingly, at the end of 1922, there were 247 chlorinating plants on the public waterworks in Pennsylvania, 2 having been abandoned during 1921 and 2 others in 1922.

CITY POPULATION IN PENNSYLVANIA SERVED BY PUBLIC WATER

	Population	Per Cent
Urban	6,190,000	72
Rural	2,530,000	28
Total	8,720,000	100

SERVED BY PUBLIC SUPPLIES

	Population	Per Cent
Urban	6,190,000	100
With filtered water	4,330,000	70
With chlorinated only	1,430,000	23
With untreated	430,000	7
Total	6,190,000	

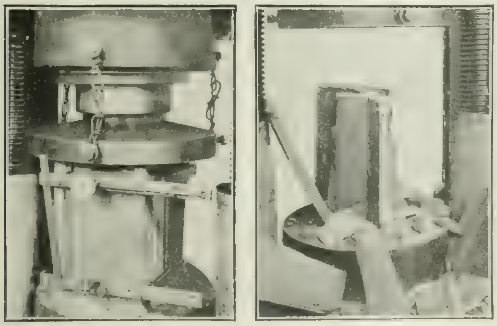
There are slightly more than 650 public water-works in Pennsylvania and of this total at the close of 1922 there were 410 having either filtration or chlorinating apparatus as an essential part of their equipment.

Cement Gypsum Caps Best for Tests of Hollow Building Tile

Bureau of Standards Tests Tile with Various Cappings—Caps of 3:1 Portland Cement-Gypsum Give Highest Strength

TESTS recently reported before the American Ceramic Society by Harry D. Foster of the Bureau of Standards, and shortly to be published in the *Journal* of that society, clear up the difficulties that have heretofore affected tests of hollow building tile with respect to the proper way of providing an end bearing for the tile in the tests. Large differences in test results and other discrepancies have caused many disputes, and it has long been suspected that the nature of the end bearing of the tile as provided by the tester was responsible for these variations.

In the Bureau tests, different tiles were capped with either neat portland cement, 2:1 or 3:1 mixtures of cement and gypsum, or straight gypsum, or the ends of the tile were ground plane and were not provided with mortar capping. They were tested at different ages from the time of molding the cap, the ages ranging from one to three hours for gypsum and up to 10 days for neat portland cement capping. No difficulty was found in obtaining consistent results and good compression failures as shown typically by the right-hand view herewith.



TILE UNDER TEST AND TYPICAL FAILURE

It was found that capping of 3 parts of cement to 1 part of gypsum, the tile being tested at the age of seven days, gave the highest strength. Neat gypsum or cement-gypsum mixtures at one to three hours gave about 88 per cent, and neat portland at 10 days and cement-gypsum capping at three days about 93 per cent of that strength. With the softer caps and with the neat portland cement cap, snapping sounds due to adjustments at the high spots were heard at earlier periods of the tests than with a cement-gypsum cap seven days old. In the case of the neat cement cap this is attributed to the yielding consistency of the cement, permitting the tile to sink through the capping material in the process of molding, so that not much thickness of cap is left at the projecting points of the tile, while with the softer capping materials a certain slipping action is introduced. Comparative tests of capped tile and tile with ground ends tested without caps showed no decided difference in strength. There was apparently no large amount of lateral restraint at the bearing faces, in the case of the tile with ground ends, as indicated by the fact that parallel tests of tile 6 in. and 12 in. high gave identical results.

Hydraulic bearings for the tile were not found to be satisfactory. If the bearing was of such character as to give reasonably even bearing on the tile, it had a sufficiently large lateral expansion to set up stresses tending to split the tile.

Measurements of the relative deformation of the capping and of the tile itself in the compression tests showed that with neat gypsum and with cement-gypsum mixtures at ages up to three hours the compression of the cap was much larger than the compression of the tile, while with the cement-gypsum mixtures at ages of three days and upwards and with the neat cement cap the total deformations of cap and of tile were the same.

It was concluded from the tests that consistent and high results can be attained with capping of a mixture of three parts of portland cement to one part of gypsum, aged seven days before the test. Where immediate testing is required, a cap of neat gypsum should be used, and the test should be made not earlier than one hour after molding the cap; the result will be smaller than with the cement-gypsum cap at greater age.

The method of molding the caps used in this test series is described as follows: The bearing surface and adjacent parts of the tile were first coated with shellac to keep the tile from absorbing water from the capping material. Then a quantity of capping material mixed to a consistency slightly thinner than normal was spread on a glass plate coated with oil; one bearing surface of the tile was then set in this plastic material and, the tile being held vertical, a single firm pressure was applied. As soon as this cap had hardened sufficiently so that the tile could be moved, the other bearing surface was capped in the same way. The caps so formed were 1/16 to 1/8 in. thick. With neat gypsum and cement gypsum mixtures, a capped tile could be removed from the plate within 15 min., but with neat cement the tile could not be removed for from six to eight hours.

Motor Truck Competition with Railways

COMPETITION of highway motor truck service with the railways is the subject of a statement in the annual report of the New York, New Haven & Hartford R.R. for 1922, as follows:

> The competition of motor trucks still continues during favorable weather, to the lessening of your company's revenue and the detriment of the highways over which they run. There are signs that public opinion is coming to realize that if it is to have efficient rail transportation it must not handicap the railroads by subsidizing the motor trucks. Such a subsidy is created by maintaining highways free of any charge more than a nominal one, and by shifting to the taxpayers the expense of keeping up these highways, a considerable part of which falls upon the tax-paying railroads who are thus handicapped by a subsidy which they pay to their competitors.
>
> Common justice should impose upon the operators of motor trucks who offer themselves to the public as common carriers, the same duties and liabilities as are imposed upon common carriers by rail. The necessity of their operation in the public interest should be first established by a state public utility commission. The continuity of operation upon a regular schedule in bad weather, as well as good, should be imposed upon them as upon the railroads and they should be made to pay for their use of the highways. The handling in Connecticut of the problems of jitney competition with street railways points the way to a similar treatment of motor trucks.

Flexible Propelling Gear of Large Navy Yard Crane

Special Wheel Support and Drive for Operation on Curves and to Carry Great Load on 22-Ft. Wheel Base

EXTREME requirements as to load capacity and reach, combined with limitations as to wheel load, were specified by the U. S. Government last year in calling for the bids for a self-propelling outfitting crane of the luffing-boom type for the Boston Navy Yard. As the dock on which it was to operate was not designed for very great concentrated loads, a large wheel base was required. The crane also had to be capable of traveling on a curve of minimum radius 78½ ft., under full load at extreme reach. In order to meet these requirements it was necessary to provide a large number of wheels, as shown by the view, Fig. 1, with the load properly equalized, and to arrange them in swiveling groups for curve flexibility. For sufficient tractive power to make the crane able to propel itself on the curve under the worst position of loading a large proportion of the total number of wheels had to be driven.

These various requirements were met by a new construction of the crane carriage, designed by the builders of the crane, the McMyler-Interstate Co., of Bedford, Ohio. In this construction the carriage is supported on thirty-two wheels, an equalized group of eight wheels under each corner, all arranged in swiveling two-wheel trucks. Four wheels of each group are driven, or half the total number of supporting wheels. As the driven wheels change position with respect to the carriage frame on curves, the propelling power is conveyed to them by sliding drive-sleeves on transverse shafts made flexible by pairs of universal joints.

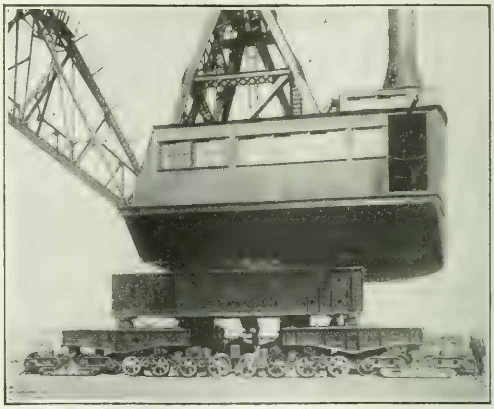


FIG. 1—CARRIAGE OF 50-TON NAVY YARD CRANE

What was specified in regard to loads and reaches to govern the design of the crane in question is represented in the general elevation drawing, Fig. 2: 50 tons at 90½ ft. radius on a main hoist, 15 tons at 129½ ft. radius on an auxiliary hoist, and 5 tons at 133 ft. radius on a whip hoist, all fixed on the jib. The loads are stated in gross tons (2,240 lb.). The drawing indicates by dotted lines the extreme position of the jib, and by solid lines the working position in which the specified reaches are obtained; the height of hook lift in this position is given. With the small wheel base of 22 ft., the amount and position of the counterweight are so adjusted that the center of gravity of the

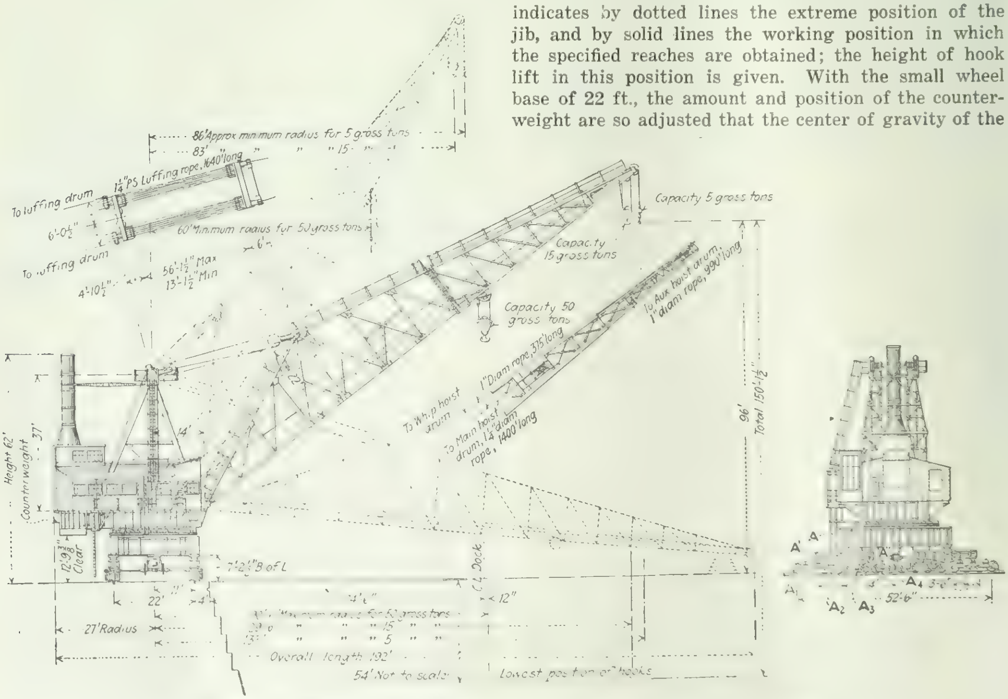


FIG. 2—EXTREME LOAD POSITIONS OF LARGE LUFFING-JIB CRANE

To provide for the great overturning moments on a wheel base only 22 ft. square, it was necessary to distribute the load over thirty-two wheels. The crane must operate on a curve of 78½-ft. radius.

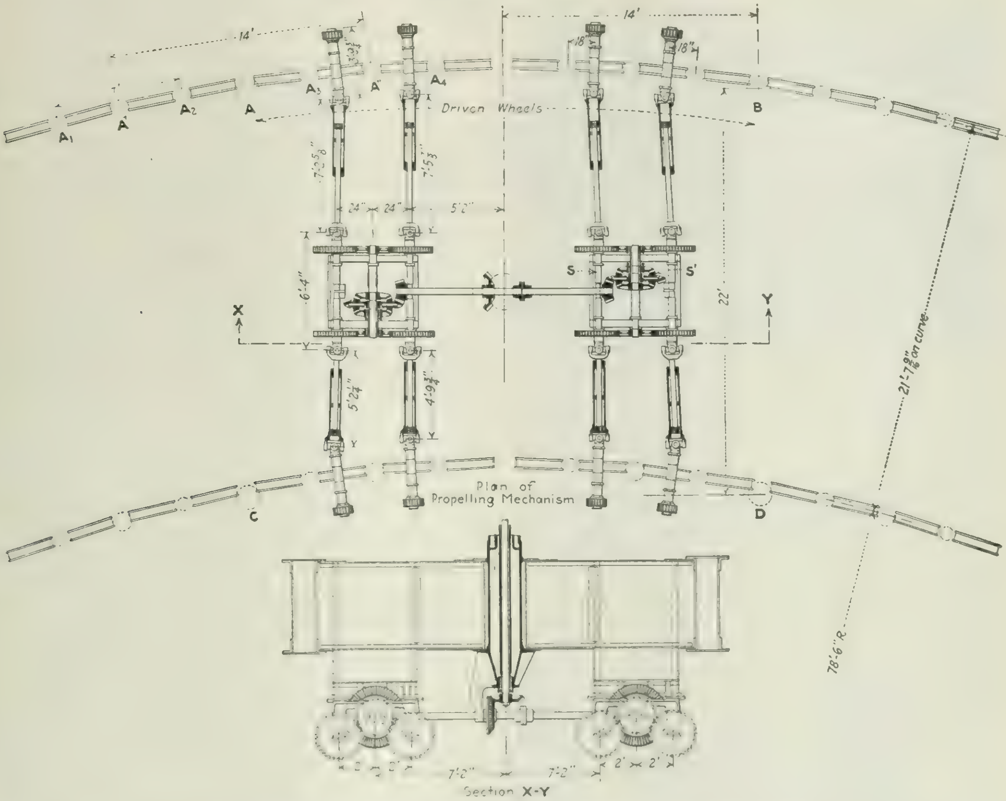


FIG. 3—FLEXIBLE PROPELLING DRIVE OF CRANE ON MAXIMUM CURVE

The thirty-two wheels are arranged in four groups, each group separately equalized. Positions of equalizer and truck pivots are shown by small circles between wheels. The eight inner wheels on each side, four of each group, are driven by the four transverse shafts through sliding sleeves and universal joints.

rotating superstructure remains within the roller circle under all load conditions, after taking account of a 5 per cent impact allowance and wind pressures of 30 lb. and 15 lb. for unloaded and loaded conditions respectively.

In designing the running gear of the crane, consideration had to be given to the fact that the dock was not designed and built to carry excessive concentrated loads, as well as to the fact that the track included a curve of 78½ ft. radius. These conditions called for a large number of wheels, to distribute the load over a considerable length of track.

In Fig. 3, a plan of the wheel arrangement, it is to be understood that the main carrying platform of the crane, a stiff plate-girder assemblage, is supported at its four corners by the main equalized pivots, A, B, C and D, as indicated in the elevation in Fig. 1. A main equalizer beam built of structural steel transfers the load of the corner to secondary pivots A' and A'', from where subsidiary cast steel equalizers further distribute the load to truck hangers A_1, A_2, A_3, and A_4, respectively. By means of the two-wheel truck frames these hanger loads are each divided equally among two wheels. Thus the entire wheel support is freely adjustable laterally and vertical for either rail independently.

How the four driven wheels of each corner group shift from their tangent position when on curved track is indicated for one group by dash lines representing the normal position of these wheels. In order to transmit the propelling power to the wheels, the two cross shafts S and S' have their end sections fitted with two universal joints and are furthermore made telescopic, the outer part being a sleeve which slides on the inner part (Fig. 4).

Power is supplied to this propulsion system by bevel gearing from a vertical shaft extending through the king pin of the rotating superstructure. A 12x12-in. reversing engine in the machinery house is geared to this vertical shaft. Swinging is provided for by a 9x10-in. reversing engine driving two vertical pinion shafts engaging a circular rack cast on the outer edge of the fixed turntable track segments. The other functions of the crane are taken care of by a 12x12-in. nonreversing engine and a 6x8-in. engine of the same type, the latter driving only the whip hoist. The main engine drives by two interlocked band friction clutches the main and auxiliary hoist drums, and by jaw clutch and worm gearing the two topping lift drums.

It should be noted that the crane turntable is carried by forty conical cast-steel rollers arranged as in swing-bridge practice around the outside of a trussed structural steel ring girder and held to a central spider

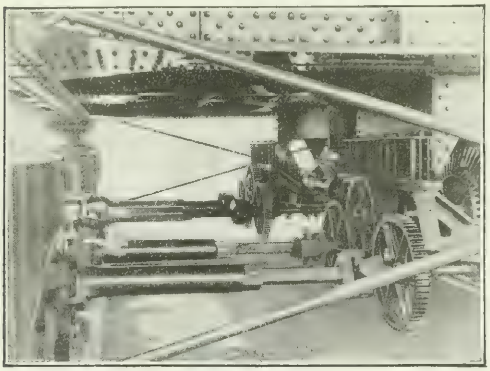


FIG. 4—SLIDING-SLEEVE DRIVE OF CARRIAGE

by independent radius rods. Under maximum working conditions, with full load assumed to be carried by ten rollers (one-fourth of the circle) under the front of the turntable, each roller carries a load of 84,000 lb. These rollers are 15 in. in outer diameter and 7½ in. wide on the face. The vertical equalizer pivots have roller thrust bearings, to minimize friction in rounding curves.

Since the Boston Navy Yard crane was built, a second machine of substantially identical construction has been built for the Puget Sound Navy Yard. According to reports received by the builders, the performance of both machines has been in all respects satisfactory, and in particular the operation of the flexible wheel base and the propelling system has met expectations fully.

FIG. 5—CRANE ALONGSIDE DOCK

Bad Packing-Box Practice Causes Large Losses

In a recent address on research in the field of wood, C. A. Plaskett, of the Forest Products Laboratory, said, concerning the unsatisfactory state of the art in the field of packing boxes: "It is conservatively estimated that the economic loss to the industries of the United States due to poor packing, poor containers, unnecessary first cost, freight paid on containers which are too heavy or of two great volume, etc., is not less than $500,000 per day. If the methods of nailing boxes and reinforcing them with metal binding as recommended by the Forest Products Laboratory saves but one per cent of these losses, the saving would be over $1,800,000 a year."

Lumber—Our Declining Production Demands Forest Culture

Peak of Production Occurred in 1907—Center of Production Shifting to the Pacific—No New Fields Available

EVENTS of outstanding significance both to the lumber industry and the public which it serves are signalized in the statistics of two recent years of American lumbering, abstracted as follows in Department of Agriculture Bulletin No. 1119—"Lumber Cut of the United States, 1870-1920":

> The first year was 1907, when the highest point in lumber production was reached, and the production curve started on a long, steep, downward slant, the end of which can not be determined. The second was 1920. The census of that year brought out three facts which are not only important but ominous when considered in relation to each other and to the events of preceding years.
>
> 1. Production continued to decrease in the face of an accumulated need for the use of lumber which is unparalleled.
>
> 2. The average value of lumber at the mills continued to rise to a point far above the high mark set in 1919. There was, in fact, an upheaval of lumber prices such as had never before been experienced, culminating in a peak which dwarfed the previous peaks, and followed by a decline as rapid as the rise. This spectacular event is of more than passing interest, both as an historical fact and as a symptom of economic stress. Yet in fundamental importance it is far surpassed by the third fact, namely that—
>
> 3. Lumber production increased in 11 Western states, but only one Eastern state cut more than in 1919. In the other 36 states production decreased. This is fresh evidence of the shift of the main center of lumber production from the southern pine belt to the West. It means not only that the great consuming centers of the East must haul a heavy percentage of their lumber twice as far as before, but also that we are now tapping our last reserve of virgin softwood forest.
>
> This change comes at the end of 300 years of exploitation. It touches the welfare of every individual in our growing population. What does the future hold for us? What steps should be taken to meet national needs? The bare figures suggest questions of this kind but do not answer them. For that reason it is pertinent to discuss with the statistics of 1920 the related conditions in production, prices, and supply.
>
> The production of lumber in 1920 was 33,800,000,000 ft.b.m., which is 2.2 per cent less than the production in the previous year. This, in itself, does not seem a great reduction. The feature of real meaning with regard to production is that 1920 shows one more slip downward, and that we have reached a point where the cut is 27 per cent less than the peak production which occurred in 1907. Figure 1 shows graphically the decline of the last 13 years. While it was not continuous, its trend is unmistakable and its amount notable. The average rate of reduction is 2 per cent per year.
>
> This persistent decline in lumber production is the more worthy of attention because the population of the United States has increased by 15 per cent in the last decade. There now exists an amount of unsatisfied demand for construction unequaled at any previous period in our history. Normally, under such conditions, considerable increase would be expected. It is possible, of course, that with the increase of urban residence, under building restrictions, more brick, stone, steel, and concrete are being used for modern types of dwellings. It is also true that the best grades of the most desirable species are no longer so readily obtainable. The substitution of other materials is probably one reason for the decreasing use of wood by an increasing population. But there is at least one other cogent reason, and that is the steadily increasing cost of lumber to the consumer.

In spite of the fact that 60 per cent of the total cut of the country is made in the large and efficient plants

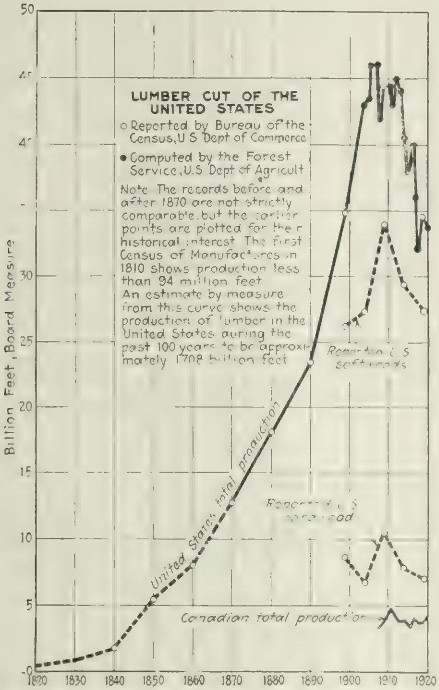


DIAGRAM SHOWING THE DECLINE IN PRODUCTION SINCE 1907

which have a capacity of 1,000,000 ft. of lumber a day, the average price of lumber at the mill in 1920 was $38.42 per thousand ft.b.m. This is an increase of $8.21 over 1919 and is the highest average ever recorded. This is largely due to the conditions which developed after the war and to the shifting of the center of production to the Pacific coast.

For 100 years the lumber industry has been in the process of migration from one forested region to another. The first lumbering took place along the Atlantic coast, from Maine southward to the Royal Colonies in Virginia and the Carolinas. But lumbering as we now know it did not get under full headway until nearly the middle of the last century, with the introduction of improved forms of machinery and large merchant mills. As the first cut of pine in the more thickly settled coast regions drew near its end the exploitation of the white pine forests of the Lake states began and the hardwood regions of the central Appalachians were opened to the market. As the cut of the Lake states drew to its close many lumber manufacturers of that region removed their operations to the South and began the attack upon the great belt of long-leaf pine stretching from Virginia to Texas. Each of these moves increased the distance between the centers of production and the centers of consumption. Now four-fifths of the original southern pine is gone, and there is in progress a marked drift of lumbermen from the Southern states to the Pacific coast, and to the northern part of the Rocky Mountains.

The most significant change resulting from the shift is the increased distance between the main center of production and the consuming centers of the country. Not quite 50 per cent of the lumber produced in the United States is consumed in the states north of Tennessee and east of Iowa. Heretofore the average haul of timber to this region has been between 500 and 1,000 miles. Hereafter a large amount of the supply will have to be hauled between 2,000 and 3,000 miles, although a considerable portion of the western timber may come by sea through the Panama Canal to the East coast markets. In the years when much more timber was accessible to water-borne traffic, transportation cost from $1 to $3 per thousand feet. In the year of this report it costs about $9 per thousand from the South and $20 from the Pacific coast to New York.

The seriousness of this situation is emphasized when we realize that the long step to the Pacific coast is the final shift in the migration of the lumber industry, unless Americans should desire to cross the Pacific in the search for new sources of lumber. The coast has the last large supply of North America, and the chances for securing softwoods elsewhere are not favorable, although the suggestion has repeatedly been made that once the native forests are exhausted we have only to purchase our lumber from other countries.

We must have huge quantities of softwood timber, the best of all woods for general purposes. The remaining pine, fir, spruce, and larch of the world are gathered in three great bodies. One is in northwestern America and Canada, another in Scandinavia and Finland, and the third in European and Asiatic Russia. There is little hope from Canada, for her so-called limitless forests are rapidly being developed to their capacity for the needs within the British Empire. The Alaskan forests are better adapted to pulpwood than to lumber.

The forests of Siberia are ringed about by the nations of Europe and Asia, some of which already have an eager eye upon this timber because it is essential to their participation in world trade. All of these nations are in greater actual need for timber than the United States.

It is practically certain that China, with her hundreds of millions, will develop industrially. Although for the present she imports from America, when ours is gone she will probably requisition great quantities of the Siberian timber.

Add to this the import demands of Japan and England, and the lesser requirements of Australia. Nearly 40 per cent of all human beings live within 2,500 miles of this timber, and even England, the most distant nation of those mentioned, is nearer to it than is Chicago.

Forest Culture—Obviously then it would be unwise to depend upon importation for any large part of our future lumber supply and forest culture in the United States is inevitable.

Price pressure will attend to that. Once our house is put in order, timber will no longer be the volunteer product of the public domain, but a crop, planted, tended, and cut as regularly as those of the farms. It may never again be as plentiful or as cheap as in the past, but after a while there will be enough, and perhaps some to spare for less fortunate countries. Thus, muddling through in Anglo-Saxon fashion, we shall finally bridge the gap between the pioneer methods of the past and scientific use of forest lands.

It is by no means a cheerless future that lies before us. On the contrary, it is full of promise—after the pinch is past. It means restoration instead of destruction. It means permanence of the lumber industry instead of sawmills wandering from end to end of the country. It means the steady flow of national wealth from the great areas now treeless which once nourished the magnificent forests of the past. It guarantees work as essential and constructive as that of the farmer, with steady wages for hundreds of thousands of men. For many it will prove an opening door of opportunity to get away from the cities and back to the land. The secondary industries which would spring up would provide work, wages, and prosperity for additional hundreds of thousands of skilled artisans.

The need is plain. With every passing year it becomes more urgent, for timber is the slowest of all crops to mature, and the mills are cutting four trees for every one restored.

The task is great. Yet the obstacles are not insurmountable. On the other hand, there is not much latitude of choice, for America must have timber and the only way to get the amount needed is to grow it. Our timber supply and our wheat supply stand in the same category.

Progress in Water-Works Standardization

Abstracts of Fourteen Reports at Detroit Convention A.W.W.A.—Co-operation with N.E.W.W.A. on Meter Specifications, Meter Rate Slides and Statistical Report Forms, and with A.P.H.A. on Water Analysis Standards

Standard Contract Forms
Meter Specifications
Watershed Protection
Industrial Wastes
Cast-Iron Pipe
Records and Reports
Meter Rate Slides
Drinking Water Standards
Standard Analysis Methods
Purification Plant Loads
Colloid Chemistry and Water Treatment
Water Waste Control
Distribution Systems
Service Pipes

The Standardization Council created two years ago with George W. Fuller as chairman has formed and is directing and co-ordinating the work of seventeen committees. Progress reports from a dozen of these committees were before the convention for discussion—either as printed in the May or earlier issues of the association's Journal, with revision or extension in the case of some of the earlier reports, or as more recent reports. Two committees of longer standing also presented reports: one on Standard Form of Contract and one on Meters, the last-named having acted jointly with a similar committee of the New England Water Works Association. Abstracts of technical papers and discussions at the A.W.W.A. convention appeared in our issue of May 31, p. 962. —EDITOR.

Standard Form of Contract

THROUGH J. Waldo Smith, chairman, and John M. Goodell, secretary, this committee asked tentative approval (which was given by those present) of a short Universal Contract Agreement and a longer set of Universal General Conditions (preprinted from *Journal* A.W.W.A., July, 1923) framed by the Joint Conference on Standard Construction Contracts which consists of representatives of the nine associations, including the A.W.W.A., Am. Soc. C.E., A.I.A. and Assoc. Gen. Contrs. of America.

* * *

Meter Specifications

THE association adopted the meter specifications already adopted by the N.E.W.W.A., these being the joint work of committees of the two bodies. F. A. Barbour, Boston, is chairman of the A.W.W.A. committee.

* * *

Watershed Protection

THIS committee (W. L. Stevenson, chairman) presented again some topics for discussion which were submitted at the Philadelphia convention. (For the latest report see *Journal* A.W.W.A., May, 1923.) Particular attention was invited to the problems of relatively small watersheds "exposed to pollution, where filtration is not practiced but the conditions are such that moderately satisfactory water-supply" can be had if due care is given to watershed protection. The committee does not believe that it is often practicable to buy much or all of the land on this type of watershed; nor does it think the purchase of marginal strips about the reservoirs is of more than doubtful value in the majority of cases.

Discussion: In an extended discussion, Allen Hazen, New York, said that one reason for buying land in watersheds is to prevent future occupancy. Agreement with this was expressed by John Chester, Pittsburgh, and B. C. Little, Rochester. H. F. Ferguson, Springfield, Ill., said that in states like Illinois, where there are few natural reservoirs available for recreation, watershed control is of growing importance. In the Decatur district, the watershed has been zoned as to fishing, bathing, etc. The State Board of Health suggested that bathing be prohibited at any point nearer the water intake than ten miles but in view of local sentiment the district authorities cut this to 1½ miles against which the board made no objection since the matter is chiefly one of sentiment. C. A. Holmquist, Albany, N. Y., stated that the water-supplies of ninety-eight municipalities in New York State are protected by rules drawn by the State Health Department. George R. Taylor, Scranton, Pa., said that marginal purchases prevent trespass and discourage building near the reservoir.

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Industrial Wastes

PROF. Edward Bartow, Iowa City, Iowa, urged co-operation between state boards dealing with health, fish, etc., and manufacturers in the study of industrial wastes. J. N. Chester, Pittsburgh, and C. M. Saville, Hartford, outlined proposals made in their states for drastic legislation against industrial wastes and these and other speakers said that such extreme measures would kill industry and depopulate whole sections. (See *Journal* A.W.W.A., May, 1923, for reprint, with additions of lengthy report submitted in 1922; Almon L. Fales, chairman.)

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Revision of Standard Specifications for Cast-Iron Pipe and Specials

THIS report was devoted chiefly to Dr. Richard Moldenke's report to the Foundrymen's test bar committee. In 1916 the A.W.W.A. committee submitted a tentative draft of revised specifications which included chemical requirements of the metal. These requirements met with strong opposition from the manufacturers. The committee then turned its attention to "a progressive relation between deflection and load in test bars" and in 1922 proposed that 1 x 2 x 26-in. bar placed flatwise on supports 24 in. apart and tested transversely to destruction "shall develop a breaking load of not less than 1,900 lb. with a deflection at this load of not less than 0.3 in., while for bars breaking at higher loads there shall be an "additional deflection at the breaking point equivalent to 0.025 for each 200 lb. of breaking load above 1,900 lb." Under the existing A.W.W.A. specifications it is possible to run up the strength at the expense of the deflection.

The tests by Dr. Moldenke were financed by the foundry men. The first series of tests (made in 1921 and reported by the A.W.W.A. committee in 1922) showed that a large percentage of the iron from eight different foundries would have been condemned under the proposed specifications outlined above. The second or 1922 series of tests, made with a different cupola mix ("ordinary rich pig mixture") showed poorer results than the first set, the first set showing an average breaking load of 2,080 lb. and a deflection at breaking of 0.358, against 1,995 lb. and 0.301 for the second series, while in the second series less than half of the bars would have met the present 1,900-lb. load and 0.3-in. deflection requirement. Dr. Moldenke found that to enable 75 per cent of the bars tested by him to pass the deflection of 1,900 lb. load would have to be lowered to 0.22 in. "Your committee cannot accept this deflection as a reasonable basis for specifications." Furthermore "your committee is of the opinion that the irons tested by Dr. Moldenke are somewhat lower in average strength and substantially lower in average deflection than those produced at the time the original specifications were written and for some years thereafter."

Some years ago T. H. Wiggin (a member of the A.W.W.A. committee) in work for the Metropolitan Water Board of Boston, found that the average breaking load for more than 3,500 test bars was 2,190 lb. and the average deflection 0.385. W. W. Brush, also a member of the committee, has for some years specified a deflection of 0.3 in. at 2,000 (as compared with the 1,900 lb. of the committee) and a flexure increment of 0.03 in. for each 200 lb. of additional breaking load.

In April, 1923, the manufacturers agreed to submit within six months a tentative draft of revised specifications based on that proposed by the A.W.W.A. committee in 1916. The American Engineering Standards Committee has recently taken up the task of standardizing cast-iron pipe. The chairman of the A.W.W.A. committee has accepted a place on the committee just named as a representative of the association.

Approval of the general stand taken by the committee was voiced by several who discussed the report. The chairman of the committee is F. A. Barbour, Boston.

* * *

Standards for Satisfactory Drinking Water

THROUGH Abel Wolman this committee submitted for study and discussion the preliminary report of the bacteriological sub-committee of the Public Health Service's advisory committee (abstracted in *Engineering News-Record*, May 24, p. 929, in report of conference of State Sanitary Engineers).

Discussion: An extended discussion of the proposed new bacterial standard was opened by H. E. Jordan, sanitary engineer, Indianapolis Water Co., who is a member of the A.W.W.A. committee. He urged that the standard was too rigid, in proposing that not over 10 per cent of the tubes examined should show B. Coli., and suggested 20 per cent as a substitute. Mr. Jordan stated that the public water supplies of Boston, Providence, New York, Philadelphia, Cincinnati, Toledo and Milwaukee would not meet the 10 per cent limit; that these cities had an aggregate population of 9,500,000 in 1920; and that their 1922 typhoid death rates ranged from 3.8 for Toledo to 2.2 for New York, 1.4 for Boston and 0.0 for Providence. It was urged that these seven cities, whose water supplies could not be certified under the proposed standard, are protecting the health of their residents "if epidemiological evidence amounts to anything"; and that to make these waters ideal would require expenditures that would not produce results measurable by the typhoid death rates.

MacHarvey McCrady, Montreal, a member of the A.W.W.A. Committee, said he would not wish to accept a bacterial standard until the field survey, chemical and physical standards were before him. C. A. Emerson, Jr., Philadelphia, said that while the bacterial standard is only one of four proposed yet it is now being put out definitely. When the Treasury standard was first put out it was to govern railway water supplies only but it was seized upon for municipal supplies and has been accepted by the courts. The sub-committee feared that if 20 per cent were the limit short lapses would be allowed, so proposed two classes, one for a larger and one for a smaller number of samples. Why not adapt the 20 per cent limit proposed by Mr. Jordan? Lyle L. Jenne, sanitary engineer, Philadelphia Bureau of Water, felt that every city would wish to attain each of the four standards—bacterial, field survey, chemical and physical. The number of typhoid cases in Philadelphia in different parts of the year is in inverse ratio to the number of B. Coli in the water. He favored the 20 per cent limit.

E. Sherman Chase, of Metcalf & Eddy, Boston, after reviewing some B. Coli and typhoid statistics, concluded there was no relation between the two. C. M. Baker, Madison, Wis., asked whether the same bacterial standard should be used for all classes of sources of supply and urged the use of common sense in applying standards. W. W. Brush, New York, thought the proposed standard should be broadened in its application. Dr. Frank E. Hale, New York City, considered the proposed standard too high. N. J. Howard, Toronto (a member of the A.W.W.A. Committee), said that the discussion showed no relation between coli and typhoid. So high a standard as is proposed may result in heavy chlorination, bad tastes, and the use of other than the public water supply.

In closing the discussion, Abel Wolman stated that the sub-committee did not base its recommendation on typhoid figures and has no data for correlating B. Coli and typhoid. B. Coli was adopted as affording the best available evidence of the presence of fæces in water. The cities which Mr. Jordan cites do not meet the old standard, he said. Replying to some interjected remarks by two or three speakers to the effect that those who had spoken against the new standard did not represent the consensus of opinion, Mr. Wolman said that perhaps he had been lax in not rallying favorable opinion for the standard as effectively as Mr. Jordan had unfavorable.

* * *

Essential Data for Water Records and Reports

FOR the sub-division on municipally-owned works, George H. Fenkell, Detroit, reported a form much like that of the N.E.W.W.A., and stated that his committee is working with one from the N.E.W.W.A. J. N. Chester, for the sub-division on privately-owned works, raised a point as to the two sub-divisions which led George W. Fuller, chairman of the Standardization Council, to state that the two sub-divisions should agree on general principles, then work out details to suit the two classes of ownership. This was agreed to.

* * *

Quantities for Slides in Meter Schedules

ALLEN Hazen, chairman, submitted and the association adopted a standard quantity-slide plan on which to base meter rates, the rates being left to local determination. Except for method of statement and the offering of a fourth quantity for use if desired in cities having very large consumers, the slides are the same as those adopted by the N.E.W.W.A. in 1916. (See preliminary report, *Journal* A.W.W.A., July, 1922, for review of the N.E. scheme.) The original three slides (on the monthly basis) were (1) for all water consumed up to 25,000 gal.; (2) for the next 225,000; (3) for the next 2,250,000 gal. The fourth slide covers all water consumed above 2,500,000 gal. a month. Where bills are sent out quarterly or yearly the slide quantities are increased accordingly. In all cases the payments for water consumed are to be in addition to the service charge based on the size of the meter.

The unit prices at each step in the slide are left to be fixed for each city, but with the following general recommendation: That wherever possible fractions of cents be not used; that the intermediate price (on the original three-slide plan) be to the nearest cent half way between the (1) and (3) rate. In other words, consideration should be centered on the domestic and the manufacturing rates. A ratio between the rates for (1) and (3) of about 2 to 1 is suggested and between (1) and (4) of 3 to 1.

In the case of municipal plants where the costs of water mains, services and meters and the repairs of services and meters are charged against the consumers a single rate per 1,000 gal. may be satisfactory (i.e., no slide). The service charge seems to be the point on which public opposition has centered.

The standard slide has been adopted by sixteen cities and companies, applicable to a total population of more than 3,000,000. Among the cities is Detroit, Mich., where the standard will go into effect July 1.

Discussion: J. N. Chester said he had sixteen communities to add to those reported by Mr. Hazen.

Standard Methods of Water Analysis

THE part of this report of greatest general interest as brought out by its chairman, Jack Hinman, Iowa City, Iowa, and emphasized also by Mr. Fuller, is that following advances by a similar committee of the A.P.H.A. the two committees have agreed to join forces in revising and publishing the "Standard Methods of Water Analysis" adopted years ago by the A.P.H.A. and revised from time to time by its committees.

* * *

Practicable Loading for Purification Processes

EXTENSIVE data gathered by members of the committee (E. E. Wall, St. Louis, chairman) were submitted as a progress report (see *Journal* A.W.W.A., May, 1923) but as yet the committee is not ready to draw conclusions.

* * *

Colloid Chemistry Water and Purification

THE value of the hydrogen-ion method of control varies greatly with the kind of water. It seems more applicable to water of low than of high alkalinity and is useful in determining whether to use an acid alum for coagulation and in adjusting the rate of chlorination. R. S. Weston, Boston, is chairman of this committee.

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Water-Waste Control

THROUGH its chairman, W. W. Brush, New York City, a lengthy report was presented (see *Journal* A.W.W.A., May, 1923). The fact that one city has as low or a lower rate of consumption than another means nothing. The proper comparisons are between night and day rates, district rates, domestic and industrial rates. Water wasted is water not drawn to serve a useful and legitimate purpose. Water unaccounted for is that part of the water flowing into the distribution system which is not delivered to the consumers. Water slippage should be separately reported. Data on the proper size of taps are few. It would seem that ⅝- or ¾-in. taps might be adopted as the minimum size. A fairly liberal size of taps and services and a cutting down on meter sizes is suggested, since a large meter can be substituted readily while a larger service and tap cannot.

Discussion: Edward S. Cole, New York, urged the importance of recording the volume of water supplied to large customers. This is generally a simple matter. Frequently the larger meter accounts are kept in a separate ledger. Charles S. Foreman, Kansas City, Mo., reported a classification of metered accounts into manufacturing, commercial and residential. Water consumption and revenue are run off on the same adding machine.

The proper sizes of services and meters and the relation thereto of flushometer closets were discussed at length. Mr. Foreman said these depend on pressure and other local conditions. At Terre Haute, Ind., said Dow R. Gwinn, with 45 lb. pressure in the residence district and for an eight-room house, a ¾-in. tap and service gives good results. C. M. Saville, Hartford, said that the advent of flushometer closets calls for larger meters. He has given up arguing that larger meters increase the amount of unrecorded water since he ran parallel tests of ⅝-, ¾- and 1-in. meters of four different makes and found all within the specification limits of accuracy. John N. Chester, Pittsburgh, Pa., declared himself as becoming an advocate of larger services and meters. If there is a graduated service charge and a minimum meter rate he would let the consumer have whatever size of service and meter he wants, but he realized that this matter is a special problem in some cities.

Aquaphones for detecting leaks are the best available device in noisy Manhattan, said W. W. Brush, New York. The electric leak detector has been found useful in locating known leaks at Windsor, Ont., reported D. McLean Hanna, but it can be used only where quiet prevails; even rain will prevent its use.

Physical Standards for Distribution Systems

THIS committee (through L. Chevis, St. Louis, Mo., in the absence of G. Gale Dixon, chairman) submitted three new items of terminology (in addition to those printed in *Journal* A.W.W.A., January, 1923). Distribution rather than equalizing or service reservoir was advised; zone is defined as an area situated between certain approximate elevations served by an independent portion of the distribution system (adapted from Turneaure and Russell's "Public Water Supplies,") and the several zones should be numbered from lowest to highest, preferably by districts; relay pumps are those that lift water from one zone to another.

* * *

Standardization of Services

A QUESTIONNAIRE will be necessary before a report can be formulated, reported John Diven, chairman of this committee.

Reproduction-New Theory of Value Upheld By Supreme Court

Rule Laid Down by Justice Harlan in Smyth-Ames Case Confirmed by Majority With Justices Brandeis and Holmes Dissenting

IN AN IMPORTANT decision handed down on May 21 the United States Supreme Court reaffirmed the famous Smyth-Ames decision of Justice Harlan that present value is the proper basis for public utility rate-making. The decision is equally important because of the extended criticism of that ruling by Justice Brandeis, concurred in by Justice Holmes.

The court reversed the Supreme Court of Missouri which had upheld an order of the Missouri Public Service Commission directing the Southwestern Bell Telephone Co. to reduce its rates. Justice McReynolds, in delivering the opinion said:

From the evidence submitted it was obvious that the commission undertook to value the property without according any weight to the greatly enhanced costs of material, labor, supplies, etc., over those prevailing in 1913, 1914 and 1916. As a matter of common knowledge, these increases were large. Competent witnesses estimated them as 45 to 50 per centum.

In *Wilcox v. Consolidated Gas Co.*, this court said, "There must be a fair return upon the reasonable value of the property at the time it is being used for the public. . . . And we concur with the court below in holding that the value of the property is to be determined as of the time when the inquiry is made regarding the rates. If the property, which legally enters into the consideration of the question of rates, has increased in value since it was acquired, the company is entitled to the benefit of such increase." In *The Minnesota Rate Cases*, this was said, "The making of a just return for the use of the property involves the recognition of its fair value if it be more than its cost. The property is held in private ownership and it is that property, and not the original cost of it, of which the owner may not be deprived without due process of law."

It is impossible to ascertain what will amount to a fair return upon properties devoted to public service without giving consideration to the cost of labor, supplies, etc., at the time the investigation is made. An honest and intelligent forecast of probable future values made upon a view of all the relevant circumstances, is essential. If the highly important element of present costs is wholly disregarded such a forecast becomes impossible. Estimates for tomorrow cannot ignore prices of today.

Witnesses for the company asserted—and there was no substantial evidence to the contrary—that excluding cost of establishing the business the property was worth at least 25 per cent more than the commission's estimates, and we think the proofs show that for the purposes of the present case the valuation should be at least $25,000,000.

After disallowing an actual expenditure and some other items not presently important, the commission estimated the annual net profits on operation available for depreciation and return as $2,828,617.60—approximately 11⅓ per cent of $25,000,000. That 6 per cent should be allowed for depreciation appears to be accepted by the commission. Deducting this would leave a possible 5⅓ per cent return upon the minimum value of the property, which is wholly inadequate considering the character of the investment and interest rates then prevailing. . . . It must never be forgotten that while the state may regulate with a view to enforcing reasonable rates and charges, it is not the owner of the property of public utility companies and is not clothed with the general power of management incident to ownership.

The Minority Opinion—The court was unanimous as to the reversal but Justice Brandeis, with whom Justice Holmes concurred, filed a minority opinion as follows:

I concur in the judgment of reversal. But I do so on the ground that the order of the state commission prevents the utility from earning a fair return on the amount prudently invested in it. Thus, I differ fundamentally from my brethren concerning the rule to be applied in determining whether a prescribed rate is confiscatory. The court, adhering to the so-called rule of *Smyth v. Ames*, and further defining it, declares that what is termed value must be ascertained by giving weight, among other things, to estimates of what it would cost to reproduce the property at the time of the rate hearing.

The so-called rule of *Smyth v. Ames* is, in my opinion, legally and economically unsound. The thing devoted by the investor to the public use is not specific property, tangible and intangible, but capital embarked in the enterprise. Upon the capital so invested the federal Constitution guarantees to the utility the opportunity to earn a fair return. Thus, it sets the limit to the power of the state to regulate rates. The Constitution does not guarantee to the utility the opportunity to earn a return on the value of all items of property used by the utility, or of any of them. The several items of property constituting the utility taken singly, and freed from the public use, may conceivably have an aggregate value greater than if the items are used in combination. The owner is at liberty, in the absence of controlling statutory provision, to withdraw his property from the public service, and, if he does so, may obtain for it exchange value. But so long as the specific items of property are employed by the utility, their exchange value is not of legal significance.

The investor agrees, by embarking capital in a utility, that its charges to the public shall be reasonable. His company is the substitute for the state in the performance of the public service; thus becoming a public servant. The compensation which the Constitution guarantees an opportunity to earn is the reasonable cost of conducting the business. Cost includes not only operating expenses, but also capital charges. Capital charges cover the allowance, by way of interest, for use of the capital, whatever the nature of the security issued therefor; the allowance for risk incurred; and enough more to attract capital. The reasonable rate to be prescribed by a commission may allow an efficiently managed utility much more. But a rate is constitutionally compensatory, if it allows to the utility the opportunity to earn the cost of the service as thus defined.

To decide whether a proposed rate is confiscatory, the tribunal must determine both what sum would be earned under it, and whether that sum would be a fair return. The decision involves ordinarily the making of four subsidiary ones:

1. What the gross earnings from operating the utility under the rate in controversy would be. (A prediction.)

2. What the operating expenses and charges, while so operating, would be. (A prediction.)

3. The rate-base, that is, what the amount is on which a return should be earned. (Under *Smyth v. Ames*, an opinion, largely.)

4. What rate of return should be deemed fair. (An opinion, largely.)

A decision that a rate is confiscatory (or compensatory) is thus the resultant of four subsidiary determinations. Each of the four involves forming a judgment, as distinguished from ascertaining facts. And as to each factor, there is usually room for difference of judgment. The first two factors do not ordinarily present serious difficulties. But doubts and uncertainties incident to prophecy, which affect them, can, often, be resolved by a test period; and meanwhile protection may be afforded by giving a bond.

The doubts and uncertainties incident to the last two factors can be eliminated, or lessened, only by redefining the rate-base, called value, and the measure of fairness in return, now applied under the rule of *Smyth v. Ames*. The experience of the twenty-five years since the case was decided has demonstrated that the rule there enunciated is delusive. In the attempt to apply it insuperable obstacles have been encountered. It has failed to afford adequate protection either to capital or to the public. It leaves open the door to grave injustice. To give to capital embarked in public utilities the protection guaranteed by the Constitution, and to secure for the public reasonable rates, it is essential that the rate-base be definite, stable, and readily ascertainable; and that the percentage to be earned on the rate-base be measured by the cost, or charge, of the capital employed in the enterprise. It is consistent with the federal Constitution for this court now to lay down a rule which will establish such a rate-base and such a measure of the rate of return deemed fair. In my opinion, it should do so.

The rule of *Smyth v. Ames* sets the laborious and baffling task of finding the present value of the utility. It is impossible to find an exchange value for a utility, since utilities, unlike merchandise or land, are not commonly bought and sold in the market. Nor can the present value of the utility be determined by capitalizing its net earnings, since the earnings are determined, in large measure, by the rate which the company will be permitted to charge; and thus, the vicious circle would be encountered.

. . . .

There is another potent reason why, under the rule of *Smyth v. Ames*, the room for difference in opinion as to the present value of a utility is so wide. The rule does not measure the present value either by what the utility cost to produce; or by what it should have cost; or by what it would cost to reproduce, or to replace it. Under that rule the tribunal is directed, in forming its judgment, to take into consideration all those and also, other elements, called relevant facts.

. . . .

Many commissions, like that of Massachusetts, have declared recently that "capital honestly and prudently invested must, under normal conditions, be taken as the controlling factor in fixing the basis for computing fair and reasonable rates."

To require that reproduction cost at the date of the rate hearing be given weight in fixing the rate-base, may subject investors to heavy losses when the high war and post-war price levels pass—and the price trend is again downward. The aggregate of the investments which have already been made at high costs since 1914, and of those which will be made before prices and costs can fall heavily, may soon exceed by far the depreciated value of all the public utility investments made theretofore at relatively low cost. For it must be borne in mind that depreciation is an annual charge. That accrued on plants constructed in the long years prior to 1914 is much larger than that accruing on the properties installed in the shorter period since.

That part of the rule of *Smyth v. Ames* which fixes the rate of return deemed fair, at the percentage customarily paid on similar investments, at the time of the rate hearing also exposes the investor and public to danger of serious injustice. If the replacement-cost measure of value and the prevailing-rate measure of fairness of return should be applied, a company which in 1920 for additions to plant raised $1,000,000 on a 9 per cent basis, by a stock issue or by long-term bond issue, may find a decade later that the value of the plant (disregarding depreciation) is only $600,000, and that the fair return on money then invested in such enterprise is only 6 per cent. Under the test of a compensatory rate, urged in reliance upon *Smyth v. Ames*, a prescribed rate would not be confiscatory, if it appeared that the utility could earn under it $36,000 a year; whereas $90,000 would be required to earn the capital charges. On the other hand, if a plant had been built in times of low costs, at $1,000,000, and the capital had been raised to the extent of $750,000 by an issue at par of 5 per cent 30-year bonds and to the extent of $250,000 by stock at par, and ten years later the price level was 75 per cent higher and the interest rates 8 per cent, it would be a fantastic result to hold that a rate was confiscatory, unless it yielded 8 per cent on the then reproduction cost of $1,750,000. For that would yield an income of $140,000 which would give the bondholders $37,500; and to the holders of the $250,000 stock $102,500, a return of 41 per cent per annum. Money required to establish in 1920 many necessary plants has cost the utility 10 per cent on 30-year bonds. These long-time securities, issued to raise needed capital, will in 1930 and thereafter continue to bear the extra high rates of interest, which it was necessary to offer in 1920 in order to secure the required capital. The prevailing rate for such investments may in 1930 be only 7 per cent, or indeed 6 per cent.

. . . .

In essence, there is no difference between the capital charge and operating expenses, depreciation and taxes. Each is a part of the current cost of supplying the service; and each should be met from current income. When the capital charges are for interest on the floating debt paid at the current rate, this is readily seen. But it is no less true of a legal obligation to pay interest on long-term bonds, entered into years before the rate hearing and to continue for years thereafter; and it is true also of the economic obligation to pay dividends on stock, preferred or common.

. . . .

Where the financing has been proper, the cost to the utility of the capital, required to construct, equip and operate its plant, should measure the rate of return which the Constitution guarantees opportunity to earn.

The adoption of the amount prudently invested as the rate-base and the amount of the capital charge as the measure of the rate of return would give definiteness to these two factors involved in rate controversies which are now shifting and treacherous, and which render the proceedings peculiarly burdensome and largely futile. Such measures offer a basis for decision which is certain and stable. The rate-base would be ascertained as a fact, not determined as matter of opinion. It would not fluctuate with the market price of labor, or materials, or money. It would not change with hard times or shifting populations. It would not be distorted by the fickle and varying judgments of appraisers, commissions, or courts. It would, when once made in respect to any utility, be fixed, for all time, subject only to increases to represent additions to plant, after allowance for the depreciation included in the annual operating charges. The wild uncertainties of the present method of fixing the rate-base under the so-called rule of *Smyth v. Ames* would be avoided; and likewise the fluctuations which introduce into the enterprise unnecessary elements of speculation, create useless expense, and impose upon the public a heavy, unnecessary burden.

. . . .

What is now termed the prudent investment is, in essence, the same thing as that which the court has always sought to protect in using the term present value. Twenty-five years ago, when *Smyth v. Ames* was decided, it was impossible to ascertain with accuracy, in respect to most of the utilities, in most of the states in which rate controversies arose, what it cost in money to establish the utility; or what the money cost with which the utility was established; or what income had been earned by it; or how the income had been expended. It was, therefore, not feasible, then, to adopt, as the rate basis, the amount properly invested or, as the rate of fair return, the amount of capital charge. Now the situation is fundamentally different. These amounts are, now, readily ascertainable in respect to a large, and rapidly increasing, proportion of the utilities.

. . . .

The amount and disposition of current earnings of all the companies are also known. It is, therefore, feasible now to adopt—as the measure of a compensatory rate—the annual cost, or charge, of the capital prudently invested in the utility. And, hence, it should be done.

Value is a word of many meanings. That with which commissions and courts in these proceedings are concerned, in so-called confiscation cases, is a special value for rate-making purposes, not exchange value.

. . . .

The rule by which the utilities are seeking to measure the return is, in essence, reproduction-cost of the utility or prudent investment, whichever is the higher. This is indicated by the instructions contained in the Special Report on Valuation of Public Utilities, made to the American Society of Civil Engineers, October 28, 1916, Proceedings, Vol. 42:

"So long as the company owner keeps a sum equivalent to the total investment at work for the public, either as property serving the public, or funds held in reserve for such property, no policy should be followed in estimating depreciation that will reduce the property to a value less than the investment . . ." (p. 1726).

"Estimates of the cost of reproduction should be based on the assumption that the identical property is to be reproduced, rather than a substitute property" (p. 1719), . . . "although such a substitute property, much less costly than the existing plant, might furnish equal or better service, it is not reproduction of service, but of property, that is under consideration; and clearly the estimate should be of existing property created with public approval, rather than of a substituted property" (p. 1772).

If the aim were to ascertain the value (in its ordinary sense) of the utility property, the inquiry would be, not what it would cost to reproduce the identical property, but what it would cost to establish a plant which could render the service, or in other words, at what cost could an equally efficient substitute be then produced. Surely the cost of an equally efficient substitute must be the maximum of the rate-base, if prudent investment be rejected as the measure. The utilities seem to claim that the constitutional protection against confiscation guarantees them a return both upon unearned increment and upon the cost of property rendered valueless by obsolescence.

Track Elevation at Indianapolis

At the last session of the Indiana legislature a new track elevation law was passed which gives the city of Indianapolis authority to order track elevation work and to carry it out where the railroad companies are financially unable to do the work, charging the cost 50 per cent against the city and 50 per cent against the companies. This law was necessary as the next large project is the separation of grades on the Indianapolis Union Belt R.R., which circles three sides of the city. As this railroad has been put to heavy expense on the track elevation through the union station and downtown district, which is approximately finished, it could not afford additional work on the present basis of the company paying 75 per cent and the city 25 per cent. Plans are now being made by the city.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

How Can We Stop Duplication of Orders?

Sir—We are in accord with your editorial, "How Can We Stop Duplication of Orders." Too many contracts are made between manufacturers and contractors which mean very little, if anything. Contracts should be drawn more specifically and there should be penalties on both sides if the contract is not properly fulfilled. It sometimes happens, however, that a general contractor will secure a contract and make his purchase in good faith, and the project may then be suspended, in which case we feel that there should be some recourse for the contractor as long as he dealt sincerely. We are also of the opinion that the contractor should be reimbursed if the manufacturer does not deliver his goods at the time specified.

We hope that through your influence some good will come and that the duplication of orders may be abolished. Yours for more stable conditions in the building industry.

Henry W. Horst Co., General Contractors,
Rock Island, Ill., May 25. By A. E. Horst.

Sir—The editorial in the *Engineering News-Record* of April 26 is first-class both in form and substance. The practice of duplication of orders for construction materials came up for discussion at a board meeting of the Associated General Contractors of America on May 14 in New York City. I had not known of the practice before that time, and while some of the members of the Board knew of it, it developed that not one member of the board present had indulged in the practice. The duplicating of orders should, of course, be stopped, and the way to stop it is that outlined in the editorial.

Minneapolis, May 25. W. O. Winston,
Chairman Board of Directors,
Winston Bros. Co., Constructors.

The International Railway

Sir—Your recent article on the Pan-American Railway or the International Railway, as South Americans prefer to call it, has undoubtedly been read with great interest by all those who have the intelligent development of South America at heart.

Practically no one expects that such a project would at the present time be considered financially feasible as a complete undertaking. It is recognized, however, as being a very sensible general plan which is rapidly attracting the attention of most all governments who might be served thereby. The extension of the Argentine railways to Santa Cruz de la Sierra is a very live project. The same is true of the extension of the Bolivian Railways from Cochabamba to Santa Cruz and hardly six months have passed since the last studies were made of the route from Corumbá, Brazil to Santa Cruz. Tremendous interests are involved in these three parts of the southern end of the line, parts which total nearly 1,000 miles. Very careful reconnaissance has been made for perhaps another 1,000 miles to the north. Large tracts of land have been purchased by well informed investors and it is toward this northern section that construction work on the Yungas lines in Bolivia has been done.

Certainly reconnaissance, nor investments in land, does not imply prompt construction. The purchase by well informed investors does, however, imply a sense of security that a line will ultimately be built in that general zone.

A great difficulty in the maintenance of interest in the so-called Pan-American Railway over a period of a quarter of a century, has been the general recognition of the improper location first proposed. For many years persons discussing this problem seemed to feel that the location had been finally determined along the back bone of the Andes. Unfortunately, some people with sound arguments against the original line complain about any project under that name. Very few thinking people ever imagined that 4,000 miles of railway might be built merely because it would be a link in the Pan-American Railway. The railway as indicated generally by Mr. Morris will undoubtedly be built because it is of political and economic importance to every country along the route to do so. Mr. Morris' plan is more of a resumé of what is in the minds of thinking men in South America who have more or less authority, than a carelessly thrown together scheme. No doubt he will be accused of dreaming but he is a very well informed engineer with years of South American railway experience behind him and the dreams of such men oftimes come true. You have done at least one thing in this article and that is to merely show by comparison, to those who know the problem, the utter futility of ever expecting a railway line of any importance along the back bone of the Ecuadorian Andes.

New York, V. L. Havens,
June 2, 1923. Editor, *Ingeneria Internacional.*

Sir—The article appearing in your issue of May 10, 1923, p. 837, entitled "Propose Restudy of Pan-American Railway Project" leaves the impression that the alternative route called "South American International R.R." is far superior to the original line of the "Intercontinental Ry." located at the close of the nineteenth century and generally known as the "Pan-American Ry."

I had the opportunity to make a thorough study of the original route and came to the conclusion that it is by far the most suitable location, which opinion was fully corroborated by my experiences in the affected countries, where I was engaged on various railroad projects.

The merits of the old location become more apparent by comparing both lines, especially as far as the territory served is concerned.

Particularly open to the criticism is the section of the "South American International R.R." passing through Ecuador, Peru, Brazil and Bolivia. The major portion of this district is a virgin jungle having a hot and damp climate with evidence of fever; besides this whole region represents the most sparsely populated zone in South America inhabited principally by savage Indian tribes.

The only points worth mentioning along the central section of the alternative route are Iquitos in Peru (population 12,000), Cruzeiro do Sul in Brazil (5,000), and in Bolivia the cities of Trinidad (6,000) and Santa Cruz (30,000). There is a provision to connect the upland centers of Ecuador and of Peru by lengthy branches but judging by the usual rate of progress these important facilities will not be available for several decades to come.

Even after the delayed completion of the proposed branches—what a runabout way from Buenos Aires to La Paz, to Lima and to Quito along the "South American International R.R." As an example, the distance between Buenos Aires and Lima would be approximately 1,300 mi. longer than the same route along the original "Pan-American Ry."

However, it must be admitted that the central portion of the alternative route passes through a district of tremendous future possibilities. It is essentially a rubber country with excellent opportunities for cultivation of cacao, coffee, sugar cane, tobacco and other tropical products and with an indication of mineral wealth. But judging from my experience the developing of this rich zone will be very slow. The main problem is the absolute lack of labor. It is aggravated by the long distance and the quality of the nearest labor market. The Quechua Indian from the western Andean uplands is the nearest labor element available but from previous experience [illegible] in lowlands even for increased wages, which by the way are already much higher than those of the laborers employed in rubber plantations of the Amazon basin.

Another very important feature of the problem is the competition of the waterway transportation. Without doubt the increased production of this zone will bring into existence many new steamship lines and the subsequent competition between all water routes on account of the volume of traffic and low operating expenses will cut the present high water transportation rates below those of the proposed "South American International R.R.," in which case this railroad would carry only insignificant traffic between adjacent river ports. Of course there is a possibility that after many years the volume of business is bound to increase to such an extent that the railroad in question could cut the through rates and successfully compete with the water transportation.

As far as horizontal and vertical alignment is concerned it must be admitted that the alternative route, thanks to the topography, has an advantage over the original line. But the steep grades on the old location do not represent any economic handicap when we consider the fact that the sections of the "Pan-American Railway" already built have very steep gradients yet are showing a satisfactory revenue from operation.

At present almost 50 per cent of the "Pan-American Ry." is built, leaving approximately 2,700 mi. to be completed. On the other hand about 3,500 mi. must be constructed of the "South American International R.R."—and including all the necessary connections to Lima and to Quito this distance increases to almost 5,000 mi. About 1,500 mi. of this larger mileage represents difficult construction equally as costly as that of the "Pan-American Ry." By simple deduction it is apparent that it will be impossible to build the remaining 3,500 mi. of the alternative route representing easier construction at the same cost as the rest of 1,200 mi. of the original line.

The summary of the above should be enough to convince anyone that the "South American International R.R." should not be constructed as a substitute of the original "Pan-American Ry." The excessive construction cost, the unsuitable territory traversed and the absence of any revenue for a long period of years are the main arguments against it.

The economic railroad program for South America should be as follows:

(1) To complete the original "Pan-American Ry." as soon as possible.

(2) To connect this system with the eastern lowlands by branches crossing the Andes, and to develop these districts intensively.

(3) After many years, when the conditions warrant it, to build a trunk line along the route of the proposed "South American International R.R.". **J. A. Lenecek,**

New York, May 24, 1923. Erie R.R. Co.

Decentralization and the Association's Experience

Sir—Referring to your editorial of May 17, p. 859, entitled "A Turning Point," and the report of the American Association of Engineers convention on p. 888, I wish to comment on a few of the points which you have brought out.

The Association, as you have pointed out, made a radical departure and attempted a difficult experiment two years ago, in this acting against the advice of many of its friends and going contrary to the experience of similar organizations. It was in effect an almost hysterical plunge, not clearly thought out in advance, but initiated and carried through by men who were impatient of the progress made and believed that a short cut to success could be found. Perhaps it is as well for engineers in general and for all similar organizations throughout the country that the experiment was made, if others are saved from repeating the error. Everything possible was done to insure success, but in vain. Practically everyone who has studied the methods and results is now convinced that the principle is wrong and that a strong organization cannot be created and maintained along the lines of decentralization then adopted.

The theory was that the local chapters had developed (or could be developed) to a point where they could carry on the work of the Association more effectively than the central organization. A few chapters have succeeded, but the fact remains that without the continual inspiration and support from headquarters the ordinary chapter quickly loses interest, uses time and money on personal or trivial details, and loses sight of the great objectives. The result is such as might be attained if each company or battalion of an army should be left to itself to carry out the plan of attack; or if each selling agency of a big corporation were left to develop its own business methods. In short, the experiment begun two years ago swung the organization from the path of onward, effective progress, accompanied by rapid growth, to a weak and irresolute decentralization, with rapid loss of membership.

It is to be noted that this loss of membership was accentuated by the economic conditions of the country but the loss would not have been as great if the board of directors and committees at headquarters had possessed influence and authority such as they had during the previous years.

Now that the experiment has been fairly tried and the results are apparent, the lesson taught should be made of value. The board of directors, to whom is entrusted the immediate future of the organization, should take advantage of this bitter experience. Having seen how near the organization has been to the edge of the precipice they can and should so direct affairs as to keep away from similar danger in the future, and return to methods which have proved successful in this and other organizations. They must take a stronger and more constructive hand in affairs, and try to impress on individual chapters their ability and duty to carry out the large ideals of service to the members.

"Money is the root of all evil." Or, more nearly applicable to present conditions, the inability or unwillingness to plan and use wisely the money made available to the chapters has brought about the downfall of many of them, and has resulted in conditions little short of scandalous.

One of the objectives of the chapter organization of engineers has been that of making these chapters capable of giving something comparable to a post-graduate education to young engineers—notably in the matter of public relations, and in financial affairs. Experience has shown that there is great need of such education. The disappointment of the past two years may be turned to good account if the membership can be aroused to an appreciation of the need of handling financial affairs in a more effective manner. To do this, the membership must have a larger appreciation of the fact that financial integrity is as important as technical ability, and that lack of such integrity comes more largely from ignorance and carelessness than from moral defect.

One of the points that should be brought out is that every dollar collected in the name of the American Association of Engineers must be effectively devoted to the purposes of the organization; this purpose can be determined only by the board of directors. Money apportioned to any chapter belongs to the organization, and there is a moral as well as legal obligation on the part of that chapter's officers to devote this money to the purposes stated in the constitution, and approved by the elected officers of the national body. Nothing, perhaps, caused a deeper feeling of sorrow than to learn that some of the chapters had utilized the funds raised for these large purposes for personal or trivial ends, with a disregard of larger moral obligations. There is no doubt that this was done in ignorance, but it has aroused a question as to whether the decentralized association has been effective in maintaining a high standard of integrity in money matters, at least among engineers. This is a question which may be asked of all organizations of this kind made up of professional men who have not had consistently inculcated the fundamentals of the highest ethics in regard to monetary affairs. **F. H. Newell,**

Washington, May 19, 1923. Consulting Engineer.

Business Men Would Save M. D. & V. R.R.

Business men of Philadelphia and Baltimore are planning to save the Maryland, Delaware & Viriginia R.R. either by forming a new company to purchase it or by getting the Pennsylvania R.R. to purchase it. The M. D. & V. R.R. was recently purchased by E. B. Leaf Co. for scrap.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Construction of 205 Milles of second track has been authorized by the Atlantic Coast Line Ry. since 1922 and work has been commenced on some portions. About 45 miles of second track were laid last year on the main line between Richmond and Jacksonville.

Among the New York State Bills signed by Governor Smith was the Donohue bill proposing an issue of $50,000,000 bonds to construct buildings for institutions for care, support and training of wards of the state, the proposal to be submitted to the people at the general election in 1923.

Construction Cost is $1,000 per Mile greater than last year for standard 18-ft. cement roads, according to Earl Crawford of the Indiana State Highway Commission. Stone and gravel are 10c. a ton more, and cement 15c. a barrel more, the producers claiming that the increased cost is principally due to increased labor costs.

To Supply Nearly 10,000,000 gal. of water, the daily consumption of its Altoona shops, the Pennsylvania R.R. Co. plans to build a masonry dam 400 ft. long and 78 ft. high across Tipton Run at a point about ten miles east of Altoona. The reservoir so formed will have a surface area of 32 acres and a capacity of 250,000,000 gal. of water. The water from Tipton Run is suitable for railway purposes without treatment.

Both Vehicular Tunnel Bills, passed at the recent session of the New York legislature, were vetoed by Governor Smith last week. One bill called for the construction of twin tunnels to be driven somewhere between 23rd St. and 42nd St., Manhattan, and to be constructed and operated by private capital, and the second bill proposed tubes entering Manhattan in the vicinity of 125th St., to be constructed jointly by the states of New York and New Jersey. Both bills were explained in detail in *Engineering News-Record*, March 1, p. 411.

The Members of the New Mexico Highway Commission appeared in person before the Secretary of Agriculture in Washington on May 31 and urged that they be permitted to depart in certain particulars from the seven per cent system. While Secretary Wallace took their petition under advisement, it is regarded as practically certain that it will be denied. It has been the policy of the Bureau of Public Roads to be very liberal in allowing course construction to proceed. It is practically certain, however, that the regulations would not be liberalized to the extent desired by the New Mexico Commission.

To Electrify All Railroads in New York City

The Kaufman bill, providing for the electrification of all railroads within the limits of New York City, has been signed by Gov. Smith. The bill calls for the work to be completed by Jan. 1, 1926. The magnitude of the changes required by this bill can be judged by the fact that, exclusive of the New York Central which gave no figure as to the estimated cost of the work, the total cost will be $52,000,000. The bill was favored principally by Manhattan interests which desire the removal of steam locomotives from along the west shore of the island. It was opposed by the railroads and by Brooklyn business interests who maintain that at this time the money could be better spent on other facilities.

New York State Reorganization Bill Signed by Governor

The reorganization bill, known as the public works law, passed at the last session of the New York State Assembly, was signed last week by Governor Smith. The bill, as outlined in *Engineering News-Record*, May 17, p. 895, invests the existing State Department of Public Works with new powers and transfers thereto certain bureaus and commissions which now exist as independent agencies reporting only to the Governor, and creates certain other departments and offices. Thus, there is transferred to the Department of Public Works all the powers and duties of the commission on boundary waters between the United States and Canada, of the State Department of Highways, of the Interstate Bridge Commission, of the trustees of public buildings, and of the superintendent of public buildings.

Terms of office of the heads of these departments or of the members of any boards or commissions involved, and of any officers within boards transferred to the Department of Public Works expire July 1, when the act becomes effective. The law provides, however, that heads of bureaus to be transferred may be retained, though in the new position such bureau chiefs report to the superintendent of public works.

A. P. H. A. to Meet in Boston Week Beginning October 8

The fifty-second annual meeting of the American Public Health Association will be held in Boston during the week beginning Oct. 8. Headquarters will be at the Copley Plaza Hotel. There will be the usual laboratory, vital statistics, sanitary engineering, public health administration, industrial hygiene, food and drug hygiene section meetings.

Am. Soc. C. E. Nominations for Officers Are Announced

Francis Lee Stuart, with 537 votes, and C. E. Grunsky, with 285 votes, are the two official nominees for president of the American Society of Civil Engineers, in the ballot canvassed June 1. Only 1339 ballots were received out of a total membership of around 10,000.

Other officers nominated, according to the constitutional provision whereby those receiving 5 per cent of the votes cast in their respective zones and districts are entitled to a place on the ballot, follow:

For Vice-President, Zone I		Total
Lincoln Bush	284	
Scattering	84	368
For Vice-President, Zone IV.		
George G. Anderson	170	
Oscar S. Bowen	111	
Scattering	53	334
For Director, District 1	(Two to be elected)	
Paul G. Brown	119	
Thaddeus Merriman	128	
Scattering	134	381
For Director, District 4		
G. H. Blakeley	8	
Robert Farnham	34	
John Meigs	12	
Scattering	12	66
For Director, District 11		
Arthur O. Ridgway	113	
Scattering	7	120
For Director, District 14		
E. A. Hadley	5	
Alexander Maitland, Jr.	62	
C. F. Maitland	5	
Scattering	21	93
For Director, District 15		
J. M. Howe	70	
J. H. Brillhart	43	
Scattering	5	118

Those receiving less than the necessary 5 per cent have been grouped under the heading "Scattering."

American Concrete Institute to Hold Twentieth Anniversary

The twentieth annual convention of the American Concrete Institute is to take place in Chicago, Feb. 25-28, 1924. The board of direction of the institute has already initiated plans for an extraordinarily large meeting in celebration of the twenty years of progress. It is intended to hold in connection with the convention an exhibit of specimen concrete to include finished product, models, drawings, and photographs, which will effectively visualize the progress of twenty years in methods and in achievement. It is not intended to have a commercial exhibit such as was common in cement shows of the past, but to have the exhibition under the auspices of the institute with no space for sale.

"Progressives" Hold Railroad Valuation Conference

Resolution Passed Demanding I.C.C. Conform to Requirements of Valuation Act

Special Correspondence

A conference called by the so-called "progressive" group of congress, in co-operation with some seven governors of Western and Southern states, was held in Chicago on May 25 and 26 for the purpose, as stated in the conference call, of considering certain criticisms directed at the work of the Interstate Commerce Commission in carrying out the provisions of the valuation act of 1913 for the valuation of the steam railroad properties of the United States.

At the opening session of the conference, which was held in the city council chamber and open to the public, there was an address of welcome by Hon. William E. Dever, the newly-elected mayor. The principal speakers at the two public sessions were Senator LaFollette of Wisconsin, Mayor Hylan of New York city, Governor Sweet of Colorado and William Jennings Bryan. The conference was attended by upwards of 100 delegates, including senators and representatives, governors and other state officials, mayors of cities, editors of farm papers and officers of agricultural associations, representatives of railway labor organizations, and others. There were no delegates from the railroad or transportation interests as such. An attempt on the part of the Chicago Association of Commerce through a committee of prominent local business men under the leadership of the traffic manager of that association to secure a hearing was unsuccessful. This attempt took the form of submitting a set of inquiries to the conference. This communication was not answered in the open meeting but by a written reply drafted by the conference at its final executive session. Owing in part to the prominence given by the local press to this heckling incident scant attention was given in the published accounts of the conference to the resolutions adopted regarding the matter which brought the delegates together. These resolutions, which are quoted in full below, refer to valuations of public service properties generally, although in the official call of the conference attention was centered on the valuation of the steam carrier properties, now said to be nearing completion.

MR. BRYAN'S ADDRESS

Interest in Mr. Bryan's address at the closing public session related mainly to his frank avowal on the relative status of the reproduction cost as against the money outlay theory and to his reference to his own advocacy of the former theory when serving as counsel for the estate in the famous *Smyth-Ames* valuation litigation in the late nineties,—in effect taking issue with the vigorous stand in favor of investment costs taken by Senator LaFollette and by the conference, as reflected in the resolutions made public after adjournment, which are given in full below:

"*Whereas*, The Interstate Commerce Commission is engaged in fixing the valuation of the railroads by authority conferred by Congress, but has failed to comply with many of the mandatory requirements of the valuation act of 1913, particularly in—

"1. Not ascertaining the original cost of railroad properties;

"2. Not ascertaining the amount and value of public donations to the railroads;

"3. Not reporting the methods whereby it arrives at the values fixed; and

"*Whereas*, This valuation work is nearing completion and important precedents will be established in decisions now imminent; and

"*Whereas*, The ascertainment of the actual private investment prudently made in the railroad properties is the primary duty imposed upon the commission, and its failure to perform this duty in compliance with the law will make it impossible to protect the public interest in these valuations and may result in increasing unjustly transportation rates to an amount estimated at not less than $500,000,000 annually; and

"*Whereas*, The principles established in decisions affecting railroad rates must necessarily have a vital bearing upon the determination of the fair and just rates and charges for street railway, telephone, water, gas, electric light and power and other public utility services, and it is important that the public be protected against excessive rates and charges for these services;

"Therefore, be it resolved by this conference that

"1. Representatives shall present to the Interstate Commerce Commission a formal demand that it comply with the requirements of the valuation act.

"2. Upon failure to comply, representatives of this body shall prosecute such legal proceedings as may be necessary to compel acquiescence.

"3. The permanent organization of the conference through its executive committee shall support and direct the conduct of proceedings to accomplish the purposes herein set forth and shall be authorized to employ such legal counsel, engineering, accounting and other expert assistance as will be necessary to carry out this program.

"The conference is further authorized to investigate and take such action regarding other aspects of the transportation problem as may be found advisable to protect and advance the public interest and prepare and promote the adoption of legislation adapted to that end, and do all in its power to increase public information on factors which affect the vital interests of producers, consumers and distributors in economical, efficient transportation service."

Los Angeles Loses Power Suit

The United States Supreme Court on May 21 denied the petition for a writ of *certiorari* presented by the City of Los Angeles in an endeavor to secure a review of the power site condemnation case recently decided adversely to the city by the United States Circuit Court. The city had been endeavoring through this suit to condemn a power site on the Owens River belonging to the Southern Sierras Power Co. and which the city desired to use for power development purposes. The action of the Supreme Court virtually confirms and renders final the decision of the lower court which was, in effect, that no showing had been made that public use by a municipality, such as the City of Los Angeles, was more necessary than that of a utility, privately owned, serving other cities. See *Engineering News-Record*, Sept. 15, 1921, p. 452.

Des Quinze Falls, Que., Project to Produce 20,000 Hp.

The Quinze Power Co., Ltd., has been incorporated by interests associated with the Northern Canada Power Co., with headquarters in Toronto, to develop the Des Quinze Falls on the Quinze River, Quebec. Contracts have been let for the development of a first unit of 20,000 hp. Morrow & Beatty have obtained the contract to build the plant; and Sutcliffe & Neelands, associated with Gordon Summers, have been engaged to survey the transmission line to the Porcupine district.

Wendover Road in Utah Approved as Federal-Aid Project

The Secretary of Agriculture has approved the Wendover Road in Utah as a federal-aid project. This decision based on that provision in the law which empowers the states to lay out its seven per cent system followed an all-day hearing at which representatives of the Lincoln Highway Association urged Secretary Wallace to select as the federal-aid project the highway which runs southwestwardly from Salt Lake City to Ibapah on the Utah-Nevada line. The Governor of Utah, the chairman of the State Highway Commission, the chief highway engineers and others testified in favor of the Wendover route. The plan of the Lincoln Highway Association was opposed by the interested public agencies in Nevada and California as well as by those of Utah. The Wendover road connects in Nevada with a cross-state road which follows the valley of the Humboldt River and which joins the Lincoln Highway at Wadsworth, Nev.

Illinois Central R.R. Plans $41,000,000 Improvements

Important improvement work in progress and contemplated for the Illinois Central R.R. system during the present year, exclusive of equipment, will involve the expenditure of more than $41,000,000, according to an outline furnished by C. H. Markham, president of the road.

The largest item is the construction of the new 173-mile line from Edgewood, Ill., to Fulton, Ky., giving a new main-line route and utilizing the Metropolis Bridge over the Ohio River. The Chicago terminal system comes next with $8,000,000 for the lake front improvement work and part of the electrification project. As on most large railroads at this time additional trackage is an important item, 83.6 miles of second, third and fourth tracks are being planned at an estimated cost of $6,189,600. For freight yards the amount is $3,589,000, mainly for the Markham terminal yard at Chicago, and for yards at East St. Louis, Ill.; Frogmoor, Tenn., and Council Bluffs, Iowa. Next to this comes $3,150,000 for line revision near Central City, Ky., and grade reduction at Paxton and Magnet Hill, Ill., a total of 13.5 miles.

Track elevation at Harvey and Champaign, Ill., is estimated at $1,845,000; signal work, $998,000, and docks and coaling stations $508,000. This last item includes improvements at the Stuyvesant Docks, New Orleans, and coaling stations at Council Bluffs, Iowa, and McComb, Miss.

Rudolph Hering Is Dead

Succumbs in New York City—Began Engineering Career in 1868

Rudolph Hering, long recognized as the dean of American sanitary engineers, died after a short illness in New York City May 30. At his funeral June 1, there were present representatives of the American Society of Civil Engineers, the American Public Health Association, the American Water Works Association, the Engineers' Club of Philadelphia, and other organizations. Besides the reading of the funeral service, there were addresses by Charles Whiting Baker, lately editor of *Engineering News* and *Engineering News-Record*, and a neighbor of Dr. Hering while the latter lived in Montclair, N. J., and by George W. Fuller, New York City, who was for a number of years in partnership with Dr. Hering.

BORN IN 1847

Rudolph Hering was born on Feb. 26, 1847, in the city of Philadelphia. He was the son of Dr. Constantine Hering, for many years an eminent medical practitioner in Philadelphia, besides being prominent in the early history of homeopathy in America. Rudolph Hering's early education was received in private schools in Philadelphia. In 1860 he was sent to Dresden, Germany, for professional studies. He graduated as a civil engineer from the Royal Saxon Polytechnic College at Dresden in 1867. He took as the subject of a thesis at that institution "Art as Applied to Engineering." The honorary degree of Doctor of Science was conferred on Mr. Hering by the University of Pennsylvania in 1907.

Mr. Hering's work as an engineer began in 1867 on surveys for Prospect Park, Brooklyn, under the late C. C. Martin. Here he served as chainman, rodman and leveler. From 1868 to 1871, he was engaged on surveys and construction of Fairmont Park, Philadelphia. Starting here on a topographical survey of the park area, Mr. Hering suggested that a plane table be used. His immediate superior agreed, but said that there was no one at hand who knew how to use that instrument. When he remarked that he could use it, he was given the opportunity. As a continuation of park work on a larger scale, Mr. Hering helped to survey Yellowstone Park, serving as one of the two astronomers to the expedition

BRIDGE WORK UNDERTAKEN

On re-entering the service of the engineering department of the city of Philadelphia in 1873 Mr. Hering was made resident engineer in charge of the Girard Ave. bridge, then the largest highway bridge in America. He had specialized in bridge engineering while at the technical school in Dresden and thus it appeared to him that his aspirations were being fulfilled. but in 1875 he was transferred to sewer work in Philadelphia, thus entering upon what proved to be his career in the field of sanitary engineering. While engaged in sewer work in Philadelphia he did some remarkable work in the standardization of sewer cross sections. In [illegible] and again early in 1880 he tried to get a commission from the city of Philadelphia to go to Europe in order to study foreign sewerage practice. He failed in this attempt, but soon after his second trial he got an introduction to Dr. John F. Billings, surgeon-general, United States Navy, and at that time vice-president of the National Board of Health. There followed the desired commission. The result of this trip was a valuable report on sewerage practice in Europe which was printed by the National Board of Health in 1881.

Mr. Hering's long years in professional work for himself began with the opening of an office in New York City in 1882 as a civil and sanitary engineer. Almost immediately, however, he was called back into the service of Philadelphia, for which city he made extensive investigations into water supply during the period from 1883 to 1886. No immediate use was made of these studies, but later on they proved of value when he joined with other engineers in a report which led to the construction of a water filtration plant for Philadelphia.

Dean of American Sanitary Engineers

DR. RUDOLPH HERING

One of the high points in his career was his service in 1886-7 as chief engineer of the Chicago Drainage and Water Supply Commission. This resulted in his recommending disposal of the sewage of Chicago by dilution, the dilution to be afforded by reversing the flow of the Chicago River from Lake Michigan to the Mississippi. In Mr. Hering's report of 1887 he presented a sewage dilution formula in very simple and practical terms consisting of the requisite volume of diluting water for each thousand persons contributing sewage. This formula was made the basis of the design of the Chicago drainage canal years afterwards and its underlying principles, or at least those of sewage disposal by dilution, may be said to have been substantiated by the decision of the United States Supreme Court in the suit brought by the city of St. Louis, Missouri, against the Chicago Sanitary District to enjoin the discharge of the sewage of Chicago into the Mississippi system. Another contribution to the science of sewerage and sewage disposal was made by Mr. Hering later on in 1887 in the form of rainfall studies included in a report to General Newton, then commissioner of public works of New York City. By this time he was known throughout the United States as a leading consultant in sewerage and water supply. It was a longer and harder matter to win recognition as an expert on the collection and disposal of garbage and other municipal refuse. For years he was a veritable apostle of scientific means of handling these city wastes. He laid the fundamental principles of this branch of sanitary engineering before the people of this country in papers and reports to the American Public Health Association, of which organization he was for many years one of the few engineer members. A notable report to the association on the subject was made by Mr. Hering in the nineties which contained many valuable data collected by him—as was the case in so much of his pioneer work—wholly at his own expense. Unfortunately, this report was never published. Subsequently, he received now and then a commission as engineer to report on city refuse disposal and for a considerable number of the later years of his active professional work he was one of the few American sanitary engineers to whom cities could go with confidence for expert advice in garbage and refuse disposal. The fruits of his long years of study and thought on this subject, reinforced by repeated visits to England and the Continent of Europe, during which he made minute studies of various types of refuse destructors, appeared in 1921, with many later and supplementary data, in the monumental book entitled "Collection and Disposal of Municipal Refuse," written in collaboration with Samuel A. Greeley.

PARTNERSHIP WITH FULLER

After working for many years along the old-time line of consulting engineer with a small personal staff, Mr. Hering entered into a partnership with George W. Fuller, which continued for the period covered by the ten years ended in 1911. During this time the firm did a vast amount of important sanitary engineering work. This line was continued from 1911 to 1915 by a second partnership, with John H. Gregory. After the dissolution of the Hering and Gregory partnership in 1917, Dr. Hering, as he had become in 1907, did less and less active work as a consulting engineer. Much of his time went into the book on refuse disposal, already mentioned, and a part of it was devoted to a somewhat lengthy trip abroad from which Hering returned a few months before his death.

Particular satisfaction was taken by Mr. Hering in his final recognition by the membership of the American Public Health Association by electing him as president for 1913-14. A year or so earlier he had been made the first chairman of the newly organized Sanitary Engineering Section of the American Public Health Association and from the formation of that section until his death he was a member of its committee on garbage and refuse collection and disposal. Hering joined the American Society of Civil Engineers in 1876; was director in 1891, and in '97-'99, and vice-president in 1900-01. He was also a member of the Institution of Civil Engineers and various other technical associations.

A widow and five children survive Dr. Hering, one of the sons being a New York architect.

Random Lines

How They Go About Building Subways in New York

SCENE: A CONFERENCE BETWEEN THE OFFICIALS OF THE CITY AND THE TRANSIT COMMISSION.

Mr. Hulbert (President of the Board of Alderman): He isn't fair. He smiles cynically when he says he will go into a conference.

Mr. McAneny (Chairman of the Transit Commission): I won't tell you what my smile meant, Mr. Hulbert, but I'll admit I was looking at you.

Mr. Hylan (His Honor, the Mayor): The more I hear you talk the less confidence I have in you.

Mr. McAneny: You may observe, Mr. Mayor, that in my desire to have courtesy in this hearing I do not give my opinion about you.

* * *

Out in New Jersey it hasn't rained in two months. A puddle big enough to fill a good hip flask can't be found within fifty miles of New York. But the native mosquitoes, who apparently never have read the entomological books and don't know that they must have stagnant water to breed in, are daily appearing in increasing numbers. What New Jersey needs is a school where mosquitoes may learn where baby mosquitoes come from.

* * *

The Truth About Architects

The other day the Boston *Herald* carried a leading editorial entitled "On Bridges, Architects and Engineers." It served two purposes—it filled over a column of reading matter that otherwise would have taken some thinking and it raised to unholy wrath every engineer in the paper's clientele. "One sees an announcement" says the editorial "that a bridge is to be constructed and then follows the statement that the engineers are preparing the drawings. Why engineers? . . . Architects as a body have the advantage over the engineer. They are better trained, they have a wider field in which to practice and this gives them more training. . . . They are generally drawn from men of high intellectual ability" and more in the same vein not answering the rhetorical question of the second sentence but proving the worthiness of the architect as a bridge builder. So far none of the infuriated engineers who have sought out the editor of the *Herald* has been able to inflict the bodily harm intended—but that is because he has retreated to the refuge of his sanctum whence he is vainly seeking to extract an apology from the high school sophomore who wrote the editorial that afternoon the editor was out on Devonshire St. admiring the intellectual way the architects were putting down those funny foundations of the First National Bank Building.

* * *

Rupert Hughes has written a new best seller in which the New York water supply competes against sex as the major interest. If we can only get enough novelists to take engineering seriously the profession may in time amount to something.

A. S. M. E. Holds Convention in Montreal

The annual convention of the American Society of Mechanical Engineers was held at the Mount Royal Hotel, Montreal, May 28-31, with an attendance of about 250 from all parts of the United States. Members of the Engineering Institute of Canada took an active part in the proceedings.

The technical program gave special prominence to papers on hydro-electric development in view of the many important enterprises of that character now under way. O. P. Hood, chief mechanical engineer of the U. S. Bureau of Mines, presented a paper on "Lignite Char," its production and possibilities, showing how lignite might be made a marketable fuel without resorting to the briquetting process, which was followed by a discussion.

A paper prepared by Julien C. Smith, vice-president of the Shawinigan Water and Power Co., dealt with power development in Quebec. He estimated the potential electric energy of the province at approximately 13,000,000 to 15,000,000 continuous kilowatts, the available commercial waterpower being about 4,500,000 kw. of continuous power, and outlined the various companies engaged in power distribution and the difficulties they had encountered. H. R. Naylor, assistant works manager of the Angus shops of the Canadian Pacific Ry., gave a description of steel car construction. R. B. Wolf, of New York, treated of "Management Engineering in the Paper Industry." The development of hydro-electric power plants in Ontario was set forth in a paper by Frederick A. Gaby of Toronto.

At the session of the thirtieth Fred W. Cowie, consulting engineer to the Montreal Harbor Commission, presented a comprehensive paper on the port of Montreal, describing its growth and progress during the last hundred years and the measures taken to overcome climatic difficulties. The afternoon was devoted to excursions and visits of inspection to industrial plants. The principal feature of the concluding day of the convention was an address on aircraft by J. A. Wilson, secretary of the Canadian Air Board, showing what had been done during the last three years in the adaptation of aviation to peace-time purposes.

The nominating committee made the following selections for 1924 officers: President, Fred R. Low, editor *Power;* vice-presidents, George I. Rockwood, M. L. Cooke, W. J. Sando and treasurer, W. H. Wiley.

Highway Officials Association Fills Vacancies

Vacancies on the executive committee of the American Association of State Highway Officials have been filled as follows: Lewis D. Blauvelt, state highway engineer, Colorado, to succeed D. P. Olson; W. S. Keller, state highway engineer, Alabama, to succeed G. P. Coleman. Mr. Blauvelt's term expires in 1926 and Mr. Keller's term in 1927. The executive committee approved the appointment of Clifford Older, state highway engineer, Illinois, to represent the Association on the Standards Committee of the American Engineering Standards Committee. Mr. Coleman presented his resignation as chairman of the executive committee.

Florida East Coast Ry. Plans

Improvement work on the 1923 program of the Florida East Coast Ry. includes the following items, in addition to numerous sidetracks and yard track extensions: Grade reduction and long passing track at White City; engine terminals at New Smyrna in connection with recent extension of freight yards; extensive bridge work at South Jacksonville and Little River; new departure tracks for the freight yards at New Smyrna, South Jacksonville and Fort Pierce. Construction of 20 miles of the new line from Okeechobee to Miami (see *Engineering News-Record* of March 8, p. 459) is already under contract and it is planned to build 15 miles more to Pahokee.

Shasta Route Blocked by Railroad Tunnel Fire

Fire in the timber lining of a Southern Pacific R.R. main line tunnel 10 miles north of Redding, Calif., on May 22 caused a cave-in that for several days blocked the Shasta Route which is the only direct rail connection between California and the Pacific Northwest. A shoofly built around the tunnel was put in service on May 29 at which time the hauling of baggage and mail by motor trucks for a distance of 29 miles around the blocked tunnel was discontinued. Passengers were not taken over the truck route, instead, until the shoofly was completed, they walked a distance of 200 yd. around the tunnel on an easy grade, thus transferring to trains on the far side of the blocked tunnel. Endeavor was concentrated on getting the shoofly in operation so that trains could go through, and on May 28 no prediction as to date of reopening the tunnel was offered by company officials.

This fire brought out comment on the importance of completing the Natron cut-off, a projected secondary route over the Siskiyous to the east of the present line and on which considerable construction work has already been done.

To Stabilize Construction by Analysis and Forecast

As a means of preventing inflation in the construction industry a special committee of the American Construction Council, following a meeting in New York May 31, at which Secretary of Commerce Hoover was present, has announced a plan for keeping the public informed of conditions with regard to labor and materials. The program involves the collection and analysis of statistics which will form the basis of a weekly forecast covering the United States as a whole and also individual districts. The membership of the council's special committee, which met at the office of Franklin D. Roosevelt, president of the council, included Edwin F. Gay, of the New York *Evening Post;* M. C. Rorty, president, National Bureau of Economic Research; Brig.-Gen. R. C. Marshall, Jr., general manager, Associated General Contractors of America, and Noble Foster Hoggson, chairman of the council's executive committee. Secretary Hoover was accompanied by Dr. John M. Gries, chief of the Division of Housing and Construction of the U. S. Bureau of Standards. The program recommended to flatten out the peaks and valleys in the building industry has received Mr. Hoover's endorsement.

Engineering Societies

Calendar

Annual Meetings

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; Annual Convention, Ithaca, N. Y., June 20-23.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, Annual Convention, Chicago, July 11-13.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

The Associated General Contractors of America recently organized a chapter at Houston, Tex., with Bailey Houx as president, Charles K. Horton as vice-president, H. C. Vogt, secretary, and Thomas L. Murray, treasurer.

The Columbus, Ohio, Engineers' Club at a recent meeting installed the following officers for the coming year: H. D. Brunning, president; C. D. McGuire, secretary; Ross Purdy, treasurer; and W. H. Dittoe and G. F. Schlesinger, vice-presidents.

The Providence, R. I., Engineering Society will on June 9, 1923, for its annual automobile outing trip go to Fairbanks Farm, Greene, R. I., the home of Frederick R. Inman. Return will be by way of the Scituate dam.

Personal Notes

John Paul Davis, city engineer, Logansport, Ind., has resigned to accept a position with the Bowyer Construction Co., Newcastle, Ind., with which he had previously been connected.

W. H. Ellison and Earle Russell of San Francisco, Calif., have formed a partnership for the practice of structural engineering, with a San Francisco office in charge of Mr. Ellison and a Los Angeles office in charge of Mr. Russell.

Col. W. W. Crosby, formerly of Baltimore, and now superintendent of Grand Canyon National Park, Arizona, returned last week from a trip around the world, during which he took advantage of his visit to the Orient to study highway conditions there. He made stops in Hawaii, Japan, the Philippines, Hong Kong, the Malay States, Ceylon, and Suez, and then went to Seville to attend the International Road Congress. He is now in Washington and expects to return to the Grand Canyon shortly.

Carl P. Hubbard has left Lockwood, Greene & Co., to enter the organization of Stone & Webster, Inc., of Boston, Mass. Mr. Hubbard is a graduate of Tufts College. Following his graduation he obtained a broad experience in construction work with the Aberthaw Construction Co. of Boston and with Lockwood, Greene & Co. At the beginning of the war he enlisted as a private in the First Reserve Engineers of New York which later became the Eleventh Engineers. He went to France with this regiment, was commissioned as first lieutenant soon after his arrival and was later promoted to a captaincy. After being discharged from the army he was made resident engineer for Lockwood, Greene & Co., later becoming supervision engineer stationed at Chicago. He is now in the Chicago branch of the Stone & Webster organization.

Major Graham A. Bell has resigned as vice-president of the Canadian National Railways in charge of finance, and resumed his former office as deputy minister of railways and canals for the Canadian Government. The post of vice-president in charge of finance and accounts will remain unfilled for the time being and under the direction of President Thornton.

Andreas Baalsrud, Norwegian director of public roads, who is traveling in America investigating problems of highway construction, is visiting Winnipeg, Can., to confer with the Manitoba highway commissioner and engineers.

Norman F. Brown, vice-president of the Dravo Contracting Co., Pittsburgh, Pa., has resigned and will engage in private practice in Pittsburgh as a consulting engineer dealing with railroad and transportation problems and municipal work.

William T. Crowley, city engineer of Lock Haven, Pa., has resigned to become associated with the Smallman Brice Construction Co., as general superintendent of construction on a large reinforced-concrete warehouse at Birmingham, Ala.

Major General Lansing H. Beach, the Chief of Engineers, is paying a personal visit to Missouri River points.

E. L. Hoopes, division engineer, Pennsylvania R.R., has been transferred from Grand Rapids, Mich., to Columbus, Ohio.

L. L. Mills, city engineer of San Rosa, Calif., has resigned to enter private practice, effective June 1.

Seaton Schroeder, Jr., has opened a consulting engineering office in the Victory Bldg., Philadelphia, Pa., for surveys, investigations, reports, industrial design and supervision. Mr. Schroeder was connected with the Civil Engineering Corps of the Navy during the war and later with the Turner Construction Co. and William T. Anderson, Inc.

Lynch Construction Co., Inc., announce the occupation on May 1 of new offices at 1619-1623 Pershing Square Bldg., New York City.

The James H. Herron Co., Cleveland, announces that it has associated with it George W. Helling, who will assume charge of the department of steel and concrete inspection.

Warren J. MacEvoy and Harry E. Nonemaker, Newark, N. J., have formed a partnership, the MacEvoy Construction Co., for concrete building construction. Mr. MacEvoy has been in charge of the new $2,500,000 Center Market at Newark, for the Clifford MacEvoy Co., and Mr. Nonemaker, prior to being superintendent for the same project was connected with the Industrial Engineering Co., New York City.

R. W. E. Bowler has been appointed division engineer of the Pennsylvania R.R. at Grand Rapids, Mich., succeeding E. L. Hoopes, transferred.

Major George J. Richards has succeeded Major Hodges as U. S. Engineer at Memphis, Tenn., in charge of the first and second districts of the Mississippi River Commission. Major Hodges is transferred to Fort Sam Houston, Texas.

R. C. Starrett, field engineer for the Merced Irrigation District at Merced, Calif., has been appointed chief engineer of the district, filling the vacancy caused by the death of Rex C. Starr.

F. A. Rhodes has been reappointed city engineer and city manager of San Diego, Calif.

Obituary

Thomas M. Arthur, contractor, West Toronto, Ontario, died May 20, aged 62 years. Mr. Arthur was for some years associated with the civil engineering staff in the early activities of the Canadian Pacific Ry., Iron Mountain division, and later was connected with the Duluth, Mesaba & Northern Ry. on the Iron Mountain division.

Charles W. Knight, of the civil engineering firm of C. W. Knight & Son, Rome, N. Y., died recently at the age of 76 years. Mr. Knight had been engaged for fifty years in the design and building of many of the large sewer and water systems in New York State.

Lewis Neil Hopkins, assistant engineer, Syracuse office of the New York State Highway Department, died recently of injuries sustained in a motor accident at Cortland, N. Y. Mr. Hudson came to New York from Baltimore.

Myron Lewis Thompson, Brooklyn, N. Y., for many years construction engineer with the Standard Oil Co., died May 26, aged 60 years. In his work for the Standard Oil Co. Mr. Thompson traveled all over the world. Several years ago he joined the engineering staff of the Texas Oil Co.

Herman C. Schneider, East Orange, N. J., died May 20, at the age of 52. He was founder of the Herman C. Schneider Building Construction Co. of Newark, N. J., which began the project of the Robert Treat Hotel, and also erected theaters, schools and apartment buildings in Newark.

Prof. Ernest D. Partridge, Brigham Young University, Provo, Utah, died recently in a Denver, Rio Grande & Western train wreck near Price, Utah, while en route to the American Association of Engineers convention at Norfolk, Va. He was professor of agricultural engineering at Brigham Young University and was in charge of the engineering and mathematics courses. After the meeting of the A.A.E. he was to have visited several Eastern colleges and then to have returned to the Agricultural College at Ames, Iowa, to spend three months specializing on road building problems, under a scholarship recently granted him.

Robert A. [illegible], for twenty years surveyor of White County and city engineer of Monticello, Ind., died May 21 at Richmond from a stroke of apoplexy.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Asphalt Conference Cuts Varieties to Ten

Elimination of Eighty Grades Made by Unanimous Adoption of New Scale of Penetration Limits by Users and Producers

Engineering News-Record Staff Report

USERS and producers of asphalt for street and road work, in conference with the Division of Simplified Practice of the U. S. Department of Commerce in Washington, D. C., May 28, agreed by unanimous vote to limit the varieties (as determined by the penetration test) of asphalt for all purposes of paving to 10 standard ranges of consistency, thus eliminating about 80 varieties called for in highway and paving specifications during 1922, according to a survey of shipments made by the producers. The new scale of penetration limits comprises 9 grades for paving purposes, (Table 1A), and 4 grades for brick and block joint filler shown in Table 1B; only one of the joint filler grades, however, is different from those in Table 1A. The action of the conference is in line with Secretary Hoover's program for the elimination of waste in industry and will be submitted for ratification to all of the state highway departments, city and county engineers, engineering societies concerned with asphalt specifications, and producers of asphalt. In the event of approval by 80 per cent of the list canvassed the new scale of consistencies will be issued in pamphlet form by and with the approval of the Department of Commerce as one of its series of simplified practice recommendations.

The conference last week, following one on April 24 limited to asphalt producers, was attended by official representatives of the American Society of Civil Engineers, the American Society for Municipal Improvements, state highway departments, municipal street and paving bureaus, the U. S. Bureau of Public Roads, the U. S. Geological Survey and the Chamber of Commerce of the United States. The action of the conference marks a definite step forward in the simplification of highway specifications for asphalt and, if ratified, will result in a marked reduction of wasteful practices in the operations of production. When the case for fewer grades of asphalt was presented and discussed in *Engineering News-Record* of Sept. 28, 1922, p. 539, and subsequent issues, it was stated that "multiplicity and non-uniformity of specification requirements have reached a point which demands nation-wide co-operative action on the part of engineers, contractors, and producers to secure a reduction in the number of different grades of asphalt called for without in any way lowering the quality of construction involved." As a means of improving the conditions thus outlined the action of the conference comes as the initial decisive move.

Table 1—Penetration Limits for Asphalt

Approved by Conference of Users and Producers at Washington, D. C., May 28, 1923.

A.—Asphalt for Roads and Pavements

25-30	85-100
30-40	100-120
40-50	120-150
50-60	150-200
60-70	

B.—Asphalt for Joint Filler

30-50	60-70*
50-60*	85-100*

*These three grades the same as in tabulation in above.

Table 2—Penetration Limits, Tentative Standards, American Society for Testing Materials

25-30	70-90
30-40	90-120
40-50	120-150
50-60	150-175
60-70	

The meeting last week, at which William A. Durgin, chief of the Division of Simplified Practice, presided, was arranged primarily to secure agreement between the producing and the consuming interests, which were about equally represented. As a basis for discussion, R. M. Hudson, of the Commerce Department, presented the results of a survey of asphalt shipments in 1922 (by percentages) submitted according to an agreement reached by the producers at their meeting with the Division of Simplified Practice April 24. The figures showed a total of 88 grades for paving asphalt and 2 additional grades for brick and block filler, or a total of 90, based on returns from 14 producing companies, representing a large proportion of the country's output. Approximately 81 per cent of shipments fell within the penetration ranges in the scale of grades tentatively adopted by the American Society for Testing Materials and approved in April by the producers. The number of different grades which raise the total to 90 are found principally in the remaining 19 per cent of shipments. These figures were cited by Prevost Hubbard, of the Asphalt Association, as conclusive evidence of the feasibility of eliminating excess varieties, and reinforced the statistics presented at the April 24 meeting by Col. R. Keith Compton of the Baltimore Paving Commission.

CHANGES IN A.S.T.M. SCALE

Opening the discussion from the consumer's point of view, Col. Compton stated that in general there was no objection to the A.S.T.M. penetration scale. On his suggestion the state and city engineers withdrew from the meeting for a brief conference, which resulted in an endorsement of the scale with the elimination of the 70-90 grade and several other changes. William H. Kershaw, of the Texas Co., pointed out that there was practically no demand for the 80-90 grade. After further discussion, the grades 70-90, 90-120, and 150-175 were eliminated and for them were substituted grades of 85-100, 100-120, 120-150, 150-200. With these changes, the scale of penetration limits shown in Table 1A was approved.

It was emphasized by Mr. Durgin that the ladder of standard grades will accomplish its object only if purchasers of asphalt adhere strictly to it by calling for and accepting material within the range of limits shown. In specifying, for example, the 40-50 grade, the highway engineer is, in effect, calling for 45 penetration with a tolerance of 5 points above and below that figure. To emphasize this point, Mr. Durgin rearranged the figures of Table 1 to indicate the practical working out of the new scale.

Along the same lines, Mr. Kershaw made a plea for an adherence to the ladder in Table 1, saying that "if purchasers attempt to work out refinements in the scale approved the result of this conference is nil." The approved scale of penetration limits, on motion of R. S. Townsend, of the Atlantic Refining Co., becomes effective for deliveries after Jan. 1, 1924.

In the discussion preceding the adoption of Table 1 a number of points covering the production and use of asphalt were touched upon. Speaking for the U. S. Bureau of Public Roads, A. T. Goldbeck said that the penetration ranges tentatively approved by the A.S.T.M. coincided with those of the Bureau. In selling asphalt to meet a 10-point range in penetration limits, according to Mr. Kershaw, the refineries actually hold to a narrower range to allow for slight variations and to make sure that the product will fall within the ranges specified. The practice in Chicago, according to Edward N. Eaton, of the Board of Local Improvements, is to specify for sheet asphalt a penetration of 50, with a definite leeway up or down. New York City, according to Dr. Felix Kleeberg, of the Department of Public Works, has

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Standard Dimensions for Face Brick

At a preliminary meeting at the Department of Commerce May 11 between a committee of the American Face Brick Association, J. W. Ginder, chairman, Specifications Committee of the Supervising Architect's Office, Treasury Department; A. L. Harris, American Institute of Architects, Washington, Paul E. Holden, U. S. Chamber of Commerce, and R. M. Hudson of the Division of Simplified Practice, it was resolved that the Department of Commerce be asked to call a general conference consisting of representatives of face and common brick manufacturers, architects, contractors, builders, and federal representatives some time during the week of June 18 to consider the adoption of the following standard dimensions for face brick: Rough face brick "approximately 8x2¼x3¾ in. Smooth face brick "approximately 8x2¼x3⅞ in.

A partial survey recently conducted by the American Face Brick Association showed that 167 plants throughout the United States manufactured 39 different sizes of rough brick during 1922, and that 141 plants manufactured smooth brick in 36 varieties.

recently standardized asphalt specifications for the five boroughs of the city in which an odd-scale penetration—that is, 35-45, 45-55, etc.,—was adopted. From the producer's point of view, Herbert Spencer, Standard Oil Co. (New Jersey), spoke of the undesirability of having the stills make special runs to produce asphalt of non-standard grades. Another disadvantage under the same head is the resulting inability to make deliveries quickly from stock.

JOINT FILLER

The conference also adopted four standard penetration limits for brick and block joint filler, as indicated in Table 1B. This table, it will be noted, adds only one new grade to the nine shown in Table 1A. This additional grade, of 30-50 penetration, is intended primarily for brick pavement; the other three grades—50-60, 60-70, and 85-100—are intended for admixture with sand to form an asphaltic grout for use in stone block construction. The three latter grades, while they are included in Table 1A, are repeated in Table 1B to indicate to the paving engineer the complete range of four standard grades of material for joint filler.

After the approval by the conference of the penetration scale for paving asphalt and for joint filler, Prevost Hubbard, of the Asphalt Association, was appointed to bring the action of the conference before the forthcoming annual meeting of the American Society for Testing Materials. The Department of Commerce will transmit to highway officials and producers throughout the country the results of the action of the conference with regard to a standard scale of penetration limits and ask for endorsement.

PERSONNEL OF CONFERENCE

For the American Society of Civil Engineers and also the American Society of Municipal Improvements, Col. R. Keith Compton, Baltimore Paving Commission, was the official delegate. J. H. Cranford was the delegate of the Federated American Engineering Societies. Irving W. Patterson, chief engineer, represented the Rhode Island State Highway Department. The state highway departments of Pennsylvania and New Jersey were represented, respectively, by Malcolm H. Ulman and Fred H. Baumann. Municipal paving departments were represented by Dr. Felix Kleeberg, New York, Edward N. Eaton, Board of Local Improvements, Chicago, and George Cobb, Baltimore Paving Commission. For the U. S. Bureau of Public Roads A. T. Goldbeck and B. A. Anderton attended.

For the producers the representatives were: H. R. Gundlach, U. S. Asphalt Refining Co. and the Interocean Oil Co.; C. N. Forrest and C. M. Foster, Barber Asphalt Co.; W. H. Kershaw, the Texas Co.; Herbert Spencer, Standard Oil Co. (New Jersey); Burton L. Boye, Standard Oil Co. (New York); Irvin K. Giles and R. S. Townsend, Atlantic Refining Co.; Leroy M. Law, New Orleans Refining Co.; H. T. Hulin, Mexican Petroleum Corp.; Prevost Hubbard, Asphalt Association.

Other interests represented at the conference were the Chamber of Commerce of the United States by E. W. McCullough; National Slag Association, by H. J. Love; *Engineering News-Record*, by R. K. Tomlin, Jr.; U. S. Geological Survey, by Frank J. Katz, and K. W. Cottrell.

Strong Paper for Cement Bags

To insure against breakage during shipment and handling on the job, the Atlas Portland Cement Co. has adopted an extra heavy old manila rope fibre paper for its bags. A sample of the paper is employed as the cover of the company's bi-monthly publication, the "Contractors Atlas," as a means of acquainting cement users with the quality of the material in the new containers. Paper made from new manila fiber, it is stated, is not as strong as that manufactured from fiber taken from old rope. Before being made into bags for cement the paper is carefully tested by the paper manufacturer and when the bags are received at the cement plant samples are submitted to the laboratories for test to insure adequate strength.

For cement users who are considering whether or not to order shipments in paper bags the following advantages for the paper containers are advanced: With the non-returnable paper bag there is no loss from stolen or damaged cloth cement bags. The expense of cleaning, sorting, bundling and storing cloth bags is eliminated. Freight charges for hauling empty cloth bags are wiped out. Paper bags, it is claimed, are more easily handled on the job for there is no time lost in untying and shaking; a paper bag may be ripped open, allowing the cement to slide easily into the loading skip of the mixer.

Functions of Trade Associations Indicated by Vote

Approval of the existence of properly functioning trade associations for each important branch of industry and commerce in the country was voted by business organizations affiliated with the Chamber of Commerce of the United States in a recent preliminary referendum canvass of answers to eight propositions taken from the report of the special committee created by action of the Board of Directors of the National Chamber in 1922 to "make a general survey of trade associations, consider activities of trade associations which are in the interest of the public and of the fields of enterprise which are represented." The committee expressed itself as of the opinion "that, while a minority of trade associations may have engaged in practices which have laid them open to complaint under the law with respect to restraints of trade, the vast majority have proved their great value for the advancement, day by day, of the processes of production and distribution."

COMMITTEE'S RECOMMENDATIONS

The committee laid down as its recommendations three rules with relation to the statistical activities of trade associations, as follows:

"Reports of members to their association should be accurate and sufficiently complete to prevent misconstruction.

"As distributed to the membership, the statistics should not be accompanied with any interpretation or other comment which could induce or facilitate concerted action on the part of members.

"All statistics regarding prices should be confined to closed transactions, and should not refer to pending transactions or future transactions."

To Cut Roofing Varieties

At a convention of the Prepared Roofing Association in Washington May 23, the organization adopted resolutions favoring a reduction in varieties from 27 to 10. A committee will draft resolutions and a plan for elimination which will be carried forward in co-operation with the Division of Simplified Practice of the Department of Commerce.

Business Notes

CHAUSSE OIL BURNER CO. has been incorporated in Michigan to manufacture oil-burning apparatus for asphalt street repairing, for installation in electric railway cars, for production of house furnace burners and the manufacture of oil-burning hand torches. The company is incorporated for $100,000 and its officers are W. McK. White, president, W. G. Chausse, vice-president, Wray P. White, secretary. Offices have been opened in Detroit and plans are being made for the location of a factory either in Detroit or in a nearby city.

H. E. MARKS CORP., Pittsburgh, manufacturer of gypsum roofs, announces the appointments of Henry M. O'Grady, as sales representative in Richmond, Va., and adjacent territory, and of William B. Smith as district sales representative in Texas and Louisiana, with headquarters in San Antonio.

EDWARD L. SOULÉ CO., San Francisco, has established an office at Fresno, to care for the iron and steel requirements of the San Joaquin Valley. Floyd T. McKune is the local representative. The Soulé company is preparing plans for a fabricating shop and warehouse to be located at Fresno to serve the district from Modesto to Bakersfield.

GEORGE C. JONES, INC., New York, announces that Frank C. Boes has joined the organization in the capacity of treasurer, in direct charge of sales of road-building machinery and construction equipment.

COMBUSTION ENGINEERING CORP., New York, manufacturer of stokers and other power-plant equipment, announces the appointment as its Southern agent of T. J. Cleary, Candler Building, Atlanta, Ga.

SOUTHERN PINE ASSOCIATION, New Orleans, has established a branch inspection office at 2030 Grand Central Terminal Building, New York City, with T. M. Cook, inspector in charge. The object of the new branch is to give quicker and more efficient service to lumber buyers in New York, Brooklyn, and New Jersey shipping points.

ASPHALT ASSOCIATION, J. E. Pennybacker, secretary, announces the creation of two new district offices for field work and the appointment of two field engineers to succeed James R. Valk, deceased, and John B. Hittell, resigned. A third district engineer will be appointed shortly. The southeastern district has been moved from Atlanta, to Charlotte, N. C., and placed in charge of Lloyd D. Smoot, of Washington, D. C., formerly general superintendent of the Atlantic Bitulithic Co. Mr.

Smoot's career has included 7½ years of service as Director of Public Works at Jacksonville, Fla.

As successor to John B. Hittell, who resigned recently as district manager in Chicago to accept reappointment to his old position as chief street engineer, Chicago Board of Local Improvements, the Asphalt Association has appointed George W. Craig, for the past ten years city engineer of Calgary, Canada. From 1909 to 1913 Mr. Craig was chief engineer for the city of Omaha, Neb. From 1907 to 1909 he was engaged in engineering and contracting as a member of the Katz-Craig Contracting Co.

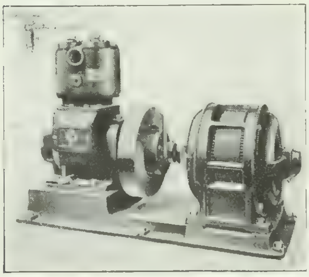
Arrangements are being made by the Asphalt Association to open a new southwestern district office in Kansas City, Mo.

Gibb Instrument Co., Bay City, Mich., manufacturer of electric welding equipment, has been appointed distributor of the General Electric Co.'s arc welding electrodes in the Middle West.

Equipment and Materials

New Air Compressors Directly Connected to Motors

The Chicago Pneumatic Tool Company has recently developed a line of high-speed compressors which can be directly connected to electric motors or internal combustion engines by means of flexible couplings. Because of the speed restrictions imposed by the limited area of the compressor valves used, the company states, such combinations heretofore have been unavailable and as a result, belt drive and, in some instances, gear drive have been employed.



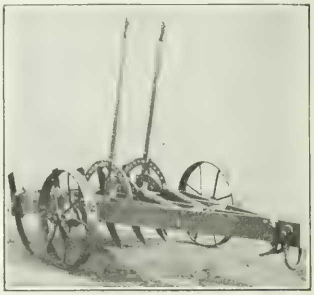
The new compressors are of the vertical, duplex, single acting, water-cooled type, fitted with Simplate flat-disc inlet and discharge valves. The straight and uniform lift of these valves affords a maximum of effective valve area which makes possible the speed at which these compressors operate.

The machines are built in three sizes, having piston displacements of 128, 160 and 210 cu.ft. per minute, and are suitable for working pressures of 150 lb. per square inch. The standard speed of these sizes is 600 r.p.m. Standard equipment includes a hand starter for the motor and an inlet valve unloader for the compressor.

For those places where the demand for air is intermittent the motor can be furnished with an automatic starter which starts and stops the unit within predetermined pressure limits. When this type of starter is used, the compressor is equipped with a centrifugal unloader which automatically relieves the compressor of its load while the motor is starting up or shutting down —a condition which is essential to the successful operation of any automatically controlled compressor. A water control valve is also furnished which is operated by air pressure governed by a centrifugal unloader and since the lubrication is accomplished by a combination pump and splash system, the unit is automatic, as it accurately controls the electric current, air delivered, circulating water, and lubrication.

New Subgrade Scarifier

For use in scarifying the subgrade of roads preliminary to mechanical subgrading the Lakewood Engineering Co., Cleveland, has developed the Graderooter, shown in the accompanying illustration. This equipment is new this season and is designed to stand up under severe use on all kinds of scarifying work encountered on the average road job. Some contractors are using the machine in place of a rooter plow. The rooter is furnished with two sets of five teeth each and one special manganese tooth alone for particularly heavy work. The machine weighs 1,300 lb. and can be furnished for tractor or team hitch.



Steam Shovel Clears Snow From Snoqualmie Pass

Equipped with a 4-cu.yd. dipper, five times the size ordinarily employed, an Erie steam shovel of the revolving, crawler-tread type was used in clearing snow from the Snoqualmie Pass through the Cascade Mountains in Washington and opening up the route to traffic on May 15 under a contract between the State Highway Department and Rumsey & Jordan, of Seattle. The shovel started work on a 6-mile stretch of snow-packed road on April 24. Operations were speeded by the large capacity dipper and by the use of the caterpillar type of mounting under the shovel, permitting it to move without delay for laying planking or swinging around mats.

SNOW CLEARED FROM SNOQUALMIE PASS BY STEAM SHOVEL

New Culvert Pipe, in Four Sizes, Has Great Crushing Strength

To meet the demands caused by the present heavy weights of motor trucks on roads the W. S. Dickey Clay Manufacturing Co., Kansas City, Mo., has designed a special culvert material known as triple-strength vitrified clay pipe, made in sizes of 15, 18, 21 and 24 in., with the following specifications:

Diam., in.	Thick., in.	Wt. per ft., lb.	Crushing Strength, lb. per lin. ft.
15	1⅞	100	4,570
18	2	136	6,400
21	2 5/16	186	6,020
24	2½	240	6,440

The advantages of this material for road culverts, its manufacturer points out, include its ability not only to carry heavy loads, but also to resist rust or decay and resist the action of acids.

Publications from the Construction Industry

Concrete Mixers—**T. L. Smith Co.**, Milwaukee, has just issued a 48-p. illustrated catalog devoted mainly to its non-tilting type of concrete mixers. The first portion of the text explains in detail the main parts of the equipment, including drum, discharge spout, frame, driving mechanism, power loader, water measuring tanks, etc. The capacities of the machines illustrated range from 4 to 28 cu.ft. of mixed concrete. The power equipment includes steam and gasoline engines and electric motors. The catalog contains detail specifications of the various mixer types, data on weight and cubical contents, and sketches showing dimensions.

Swimming Pool Sanitation—**Wallace & Tiernan Co., Inc.**, Newark, N. J., has issued a bulletin on the use of its chlorinating apparatus for the sanitation of swimming pools.

Lumber and Its Utilization—**National Lumber Manufacturers Association**, Chicago, announces a series of bulletins on lumber and its utilization. The subjects to be covered are: General information, timber, lumber, construction, fire-prevention, craft and carpentry.

Sluice Gates and Hoists—**Champion Engineering Co.**, Kenton Ohio, is distributing five leaflets illustrating caterpillar types of sluice gates manufactured under the Broome patents. Information is given also on the company's hand and power operated sluice gate hoists.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Average Weekly Value of May Contracts Let About Two Per Cent Heavier Than in 1922

Total of 1,016 Awards During May, Average Value $215,267, Compared With 794 in April, Averaging $250,629

Engineering News-Record Construction Cost Index Number

June, 1923	220.70
May, 1923	216.70
June, 1922	166.62
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number advanced 4 points since last month due to stiffening in labor rates. Prices of basic materials remained unchanged during month. The average rate for common labor is now 53c. Thus, general construction cost is 32 per cent higher than one year ago and 19 per cent under the peak; it is 121 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
May 1923 (5 *issues of E. N.-R.*)	171
April 1923 (4 *issues of E. N.-R.*)	160
May 1922 (4 *issues of E. N.-R.*)	179
1913	100
Yearly	
1922 (entire year)	130
1921 (entire year)	88
1920 (entire years)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 171 for the month of May, and 130 for the whole of 1922, as against 100 for 1913. This means that the actual volume of construction in 1922 (not the mere money-value of the contracts let that year) is 30 per cent above the volume of construction for 1913. Our monthly volume number, 171 for May, 1923, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING MAY, 1923

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total United States	Canada	Total
Water-works	$120,000	$2,244,000	$231,000	$1,445,000	$475,000	$2,457,000	$6,972,000	$357,000	$7,329,000
Sewers	167,000	3,746,000	414,000	3,502,000	500,000	533,000	8,862,000	190,000	9,052,000
Bridges	858,000	137,000	660,000	892,000	706,000	10,395,000	13,648,000	245,000	13,893,000
Excavation, drainage and irrigation	....	....	700,000	275,000	2,423,000	115,000	3,513,000	40,000	3,553,000
Streets and roads	1,316,000	6,417,000	10,402,000	9,215,000	5,471,000	5,446,000	38,267,000	8,261,000	46,528,000
Industrial works	3,575,000	3,537,000	1,399,000	6,195,000	5,893,000	2,251,000	22,850,000	1,030,000	23,880,000
Buildings	9,908,000	30,238,000	6,600,000	22 763,000	4,786,000	7,232,000	81,527,000	7,997,000	89,524,000
Federal government	....	115,000	839,000	92,000	1,558,000	281,000	2,885,000	....	2,885,000
Miscellaneous	115,000	3,984,000	2,568,000	981,000	3,777,000	2,083,000	13,508,000	8,560,000	22,068,000
Total	$16,059,000	$50,418,000	$23,813,000	$45,360,000	$25,589,000	$30,793,000	$192,032,000	$26,680,000	$218,712,000

The total value of contracts awarded on large engineering construction projects, in the five May issues of *Engineering News-Record*, reached $218,712,000 as compared with $198,665,000 in the four issues of April. This represents an average weekly value of $43,742,400 for May, against $49,750,000 during the preceding month.

The weekly average for the month of May, $43,742,400, represents an increase in money value of 2 per cent above the weekly average of $42,889,000 for the corresponding period in 1922.

The number of awards totaled 1,016 during May, with an average value of $215,267 as compared with 794 in April, averaging $250,629 per contract.

Minimum costs observed in Construction News on each class of construction are as follows: Water-works, $15,000; other public works, $25,000; industrial construction $40,000, and commercial buildings, $150,000.

Of the $218,712,000, a total of $26,680,000 represented Canadian awards.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 333 to 348, are the following:

Library, Cleveland, O., for Cleveland Public Library Board, $3,550,000.

Coagulation basins, Cleveland, O., for Baldwin filtration plant, $1,439,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 333 to 348, are the following large projects:

Subway, New York, N. Y., to Patrick McGovern, $5,976,086.

Dock, Superior, Wis., to Pepard and Fulton, $1,000,000.

Labor Rates and Conditions Throughout the Country

The industrial situation is one of doubt. The key lies in the construction industry, where prices of materials and rates of labor have advanced to prohibitive levels. The reaction is a curtailment of new projects where urgency is not essential. The chief reason for high cost is that the building program outgrew the capacity of the industry, so far as labor and materials are concerned.

The "buyers' strike" seems to be confined principally to the New York district, where construction valued at $175,000,000 has been shelved. New York is also the only one of twenty cities reporting monthly to *Engineering News-Record* to show strike conditions in the building trades.

The bricklayers, now on strike, represent the key craft in the New York building trades, which in turn form the basis for similar trades throughout the country. The trouble, therefore, now developing in the key industry may, in a very short time, react unfavorably upon the entire business situation.

The common labor rate for the nation as applied to pick-and-shovel men in construction operations, is placed at 53c. per hr. as against 51c. for the preceding month, according to *Engineering News-Record's* figures. Local

CURRENT BUILDING TRADES WAGE RATES PER HOUR

(Higher rates indicated by +, decreases by—)

Cities	Brick-layers	Car-penters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	+$0.90	$0.70	$0.30	......	$0.65	$0.30@.35
Baltimore	1.50	1.00	.80@1.00	.87½	$0.65	.80@1.00	.30@.50
Birmingham	1.00	.75	.50@1.00	.15@.25	......	1.00	.20@.30
Boston	1.25	1.05	1.00@1.25	.82½	.95	1.12½	.60@.70
Cincinnati	1.25	+1.05	+1.05	+.82½	+1.05	+1.05	.45
Chicago	+1.15	1.15	1.10	......	1.10	1.05	+.85
Cleveland	1.40	1.25	1.25	.87½	1.00	1.25	.87½
Dallas	+1.50	1.00	1.00	.40	.87½	1.00	.30@.50
Denver	1.37½@1.50	1.12½	1.12½@1.18¾	.75@.81¼	1.00	1.15⅝	.35@.55
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	+1.37½	1.00	1.00@1.25	+.90	1.00	+1.07½	+.40@.70
Los Angeles	1.25	87½@1.00	87½@1.00	.62½	.....	1.00	.50
Minneapolis	+1.12½	+.87½	+.87½	+.71½	......	+.87½	+.55
Montreal	+1.00	.65	.50	+.35	.50	.65	+.30
New Orleans	1.00	.85	.90	.65	.80	1.00	.35@.40
New York	1.50	+1.25	1.25@1.50	1.00	1.00	1.12½	.50@.75
Pittsburgh	1.30	1.20	1.12½	+1.00	......	+1.25	+.60
St. Louis	1.50	1.25	1.25@1.37½	+1.25	1.00	1.25	.45@.90
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	1.12½	1.00	1.00	93¾	1.00	1.12½	.50@.62½
Philadelphia	1.37½	1.12½	1.00	.75@1.00	1.10	1.10	.50@.65

building conditions are as follows:

Atlanta—Some building being held up; general feeling of uncertainty in construction field. Carpenters advanced from 70c. to 90c. per hr.

Chicago — Landis Award Board granted carpenters advance from $1 to $1.15 per hr.; bricklayers, from $1.10 to $1.15; caisson workers, from 97½c. to $1.10 and common laborers, from 72½c. to 85c. per hr.

Kansas City—Shortage of bricklayers and carpenters, latter will demand advance of 12½c. per hr., July 1. Structural iron workers will demand increase of 17½c. per hr. Sept. 1.

New York—About 2,000 bricklayers on strike on jobs covered by the Mason Builders' Association. Over $150,000,000 of new construction work affected. Employers offer $10, with bonus of $2 per day, until Jan. 1, 1924. Unions demand $12 per day contract for two years. All bricklayers, however have found work on jobs not covered by the Mason Builders' Association.

Pittsburgh — Scarcity of carpenters and common laborers; enough of other trades. Labor shortage in steel mills probably reached lowest point, as those preferring outdoor employment in Summer have already left the mills.

St. Louis — An acute shortage of bricklayers; offering bonuses of $1 to $3 per day. Structural iron workers also granted a bonus of $1 per day.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron — Market quiet during month; Birmingham base still at $27 for No. 2 foundry. Southern No. 2 iron advanced 50c. in New York and $1 in Philadelphia; gray forge dropped $1.50 in Philadelphia and No. 2 foundry, $1 per ton in Pittsburgh, since last month.

Railway Supplies—Track bolts up 25c. per 100 lb. at Pittsburgh mill. All track supplies higher in San Francisco. No change in ties and rails.

Pipe—Birmingham mill base on cast-iron pipe unchanged since May 3, still $49 per ton on 6-in. and over. Chicago warehouse price up $2 per ton; slight rise in St. Louis. New York warehouse discounts on black wrought-steel pipe, reduced four to five points; galvanized, five to six points, following recent reduction on Pittsburgh basing card. Sewer pipe, 3 to 36-in., lower in Cincinnati and Atlanta; advanced somewhat in Los Angeles and Kansas City.

Road and Paving Materials—Road oils advanced slightly in St. Louis and Dallas, due to reported scarcity of Mexican crude. Asphalt also higher in Dallas and St. Louis but down in Kansas City and Los Angeles. Granite paving blocks up $3 per M. in Cincinnati and 30c. per sq.yd. in Kansas City. Wood block higher in New York and Boston but lower in Kansas City and St. Louis, due to reduction in cost of raw materials in the latter two cities.

Sand, Gravel and Crushed Stone—Gravel advanced 5c. in St. Louis and 10c. per cu.yd. in Minneapolis; declined in Detroit. Sand rose 25c. in both Cincinnati and Minneapolis; advanced slightly in Detroit and went up 5c. per cu.yd. in Dallas due to higher labor costs. Crushed stone, ¾-in., advanced 5c. in St. Louis and 1½-in., 15c. per ton in Cincinnati, during month.

Lime—Both lump and hydrated reported higher in St. Louis, Detroit, Kansas City, Cincinnati, Boston and Minneapolis. Los Angeles reports only decline, that of 25c. per bbl. in common lump.

Cement—Prices stable throughout country. Of thirty cities reporting monthly to *E. N.-R.*, all show no change except Kansas City and Denver. The former reports slight advance and the latter an equally slightly decline.

Structural Steel—Slight improvement in steel buying. Demand principally for tank plates and car material. Minimum on plates remains at $2.50 per 100 lb., Pittsburgh, with some contract tonnages quoted at $2.55@$2.60. Price trend in steel plates taking upward turn. Structurals also firmer; demand somewhat restricted owing to postponement of many new building projects. Bars firmer; buying still at $2.40@$2.50 per 100 lb. at mill.

Brick and Hollow Tile—Common brick up 50c. in Boston, $1.50 in New Orleans, $2 in Cincinnati and $1 per M. in St. Louis due to shortage. Prices dropped, however, 20c. in Dallas, $1 in Kansas City and $2 per M. in Baltimore, where yards have caught up with orders. Hollow tile higher in Cleveland, Atlanta, St. Louis and Detroit; down in Boston and Cincinnati.

Lumber—Pine rose $4.25 per M. ft. in Kansas City on 8-in., and $1.25 on 12-in. timbers, and $1 in Boston on 2-in. dimension lumber; declined 75c. in Detroit on 1-in. boards. Fir advanced $3.50 in Cincinnati on 8-in. timbers and 75c. on 2-in. dimension; dropped 50c. in Minneapolis on 1-in. boards and $1 on 2-in. dimension, also $1 per M. ft. in Denver on 12-in. structural timbers. General price level about the same in other cities, with some soft spots here and there.

Explosives—Forty per cent gelatin dynamite advanced slightly in Cincinnati and Atlanta; no other important changes.

Pine Piles—Price f.o.b. New York up 1½c. per lin.ft. by barge and 1c. by rail, during month. Advances due to wage increases at production points. Northern agents depleting labor supply in Southern cutting areas, to serious degree.

Scrap—Dealers' and producers' prices lower in New York and St. Louis.

Linseed Oil—New York price unchanged in month. Chicago up 12c. per gal. since May 3.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	June 7	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$31.55	$25.52
Northern Basic	32.27	25.02
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	33.27	22.50
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	**34.94**	28.56
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	27.00	17.50
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@ 2.75 sil.)	32 64	26.36
Virginia No. 2 (silicon 2.25 @ 2.75)	**35 17**	28.34
Basic	31 50	23.50@25 50
Gray Forge	*30.00*	25.00
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	33 00	23 50
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	33.01	24 17
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	*31.00*	24.16
Basic	31.00	25.00
Bessemer	31.00	26.96

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh				
	June 7	One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$40.00		$43 00	$43.00
Standard openhearth rails	43.00	40 00	$43 00	43 00	43.00
Light rails, 8 to 10 lb	45.00	30@ 32	2 00*	43 00	43@ 45
Light rails, 12 to 14 lb	45.00	30@ 32	2.00*	43.00	43@ 45
Light rails, 25 to 45 lb	45.00	30@ 32	2.00*	43.00	43@ 45
Rerolled Rails		28.00	.....	.....	.....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In x 8 In by 8½ Ft	7 In x 9 In by 8½ Ft.
Chicago, White Oak	$1 50	$1.65
Chicago, Hardwood and Red Oak	1 25	1 40
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco...... Green Douglas Fir	.84	1 14
San Francisco, Empty Cell Creosoted Douglas Fir	1 70	2 25
St. Louis, White Oak	1 30	1 55
St. Louis (creosoted) (zinc treated)	1.70	2 05
St. Louis, Red Oak, plain	1.20	1.45
St. Louis, Sap pine-cypress	1.05	1.30

TRACK SUPPLIES—The following prices are base per 100 lb f.o.b Pittsburgh for carload lots, together with the warehouse prices at the places named

	Pittsburgh					
	June 7	One Year Ago	Chicago	St Louis	San Francisco	Birmingham
Standard spikes, 9/16-in. and larger	$3 15	$2 25	$3 00	$4 15	**$5 00**	$3 60
Track bolts	**4 25**@4 50	3 00@3 50	4 00	5 15	**6 20**	4 60
Standard section angle bars	2 75	2 40	2 75	4 00	**4 25**	3 00

PIPE

WROUGHT PIPE The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card

BUTT WELD

Inches	Steel Black	Galv	Inches	Iron Black	Galv
1 to 3	62	50½	¾ to 1½	[illegible]	[illegible]

LAP WELD

Inches	Steel Black	Galv	Inches	Iron Black	Galv
2	55	43½	2	[illegible]	[illegible]
2½ to 6	[illegible]	47½	[illegible]	[illegible]	[illegible]
7 and 8	56	43½	[illegible]	[illegible]	[illegible]
9 and 10	54	41½	7 to 12	[illegible]	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	¾ to 1½	30	4
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	**48%**	**50%**	52%
2½ to 6 in. lap welded	**44%**	**47%**	49%

	Galvanized		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	**34%**	**37%**	39%
2½ to 6 in. lap welded	**30%**	**34%**	36%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus **10%**. Cast iron, standard sizes, **21½%** off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

		New York				
	Birmingham Mill	June 7	One Year Ago	Chicago	St. Louis	San Francisco
4 in	$53.00	**$66.50@67 50**	$51.80	**$64.20**	$61.60	$64.00
6 in. and over	49.00	**62.50@63 50**	48 80@49.80	**60.20**	**57.60**	60.00

Gas pipe and Class "A," **$5** per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

	New York					
Size, In.	June 7	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45 00	$40.00	$40 00	$62.50	......	$73.00
4	55.00	50.00	40.00	75.00	$76.50	83 00
5	80.00	80.00	.....	100.00	97.75	108 00
6	105 00	100.00	75.00	175.00	127.50	133.00
8	170.00	150.00	*170.00*	187.50	212.50	199.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St Louis	Chicago	San Francisco	Dallas
3		$0 114	...	..	$0.15	$0 12	......
4	...	.114	$0 10	$0.10	.15	15	$0.12
5		.171	125	.	23	18	.16
6	**$0.24**	.171	150	14	23	.21	.185
8	38	.266	25	225	.35	30	.30
10	57	399	.325	315	.53	.42	.441
12	72	.513	425	.405	.68	.54	567
15	1 13†	.684	.625	.675†	.90	.90	.819
18	1 65†	.95	85	945†	1.25	1.32	1.071
20	1.98†	1 14	1.125	.	1.50	.....	....
22	2 64†	1 52	1.375	1.26†	2 00	..	1.44
24	2 97†	1 71	1.625	1.62†	2 25	2 16	1.89
27	4 81†	2 99	....	2.65†	4 69†	3 00	3.34
30	5 33†	3.312	.	3.25†	5.94†	3 60	4.06
33	6 93†	4.41	....	3.95†	6 88†	.	4.99
36	7.91†	5.0225	....	4.30†	7 50†	.. .	5.42

	3	5	8	12	24	36
Boston	$0 127	$0.195	$0.308	$0.595	$1 975†	$5 90†
Minneapolis		....	40	72	2 55	5.66†
Denver	.135*	.18*	27	47	1 70	....
Seattle	.13		36	72†	2 60†	....
Los Angeles	**13**	165	275	495	1 65	..
New Orleans	.112*	.168*	.28	476	1.182	
Cincinnati	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Atlanta	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.
Montreal, *delivered*	.68‡	.45†	70	1 35	4 50†	
Detroit	117	.1755	273	.5265	2.34†	6 15†
Baltimore	.126	.189	.294	567	1 89	5 4375
Kansas City, Mo	**.15***	**.21***	**33***	**40**	[illegible]	
Philadelphia	124	1871	286	545	1 89†	4 37†

*4-in., 6-in., 9-in., respectively. †Double Strength ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named

		June 7	One Year Ago
New York, 45% asphalt	(at terminal)	$0 0525	$0.05
New York, 65% asphalt	(at terminal)	0525	.045
New York, binder	(at terminal)	[illegible]	.055
New York, flux	(at terminal)	[illegible]	.05
New York, liquid asphalt	(at terminal)	[illegible]	06
[illegible]		**0565**	.05
[illegible]		**0535**	
Chicago, 40-50% asphalt		[illegible]	.05
Chicago, 60-70% asphalt		[illegible]	.0525
[illegible]		**049**	.10
[illegible]		**0455**	.13
[illegible]		**061**	[illegible]
San Francisco, binder, per [illegible]		[illegible]	[illegible]

* [illegible] per ton

ASPHALT—Price per ton in packages (350-lb. bbl. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Mexican*)	$19.00	$15.00
Boston (*Mexican*)	21.00	17.00
Chicago (*Stanolind*)	22.25	16.00
San Francisco, *f.o.b. refinery*, Oleum, Cal	17.00*	11.00*
Dallas, (*Texas*)	**27.10**	**21.10**
Seattle, "*D*" *grade* (*California*)	24.75	20.50†
Denver (*California*)	24.00	...
Minneapolis *f.o.b. Twin Cities* (*Stanolind*)	25.45	19.10
St. Louis (*Mexican*)	**32.50**	**27.50**
Baltimore (*Standard Oil*)	21.00	15.00
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	26.00	23.50
Detroit (*Mexican*)	22.47	18.40
Cincinnati (*Kentucky Rock*)	22.50	19.50
Maurer, N. J. (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	21.50	18.50
Philadelphia (*Mexican*)	21.00	18.00
Kansas City (*Texas*)	*27.30*	*22.30*
Los Angeles "*D*" *grade* (*California*)	*17.00*‡	11.00‡

*Freight to San Francisco, 80c. per ton.
†F.o.b. Richmond, Cal.
‡F.o.b. El Segundo refinery.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade 1)	5-in. granite, 30 blocks per sq yd.	$134.50 per M.
Chicago	About 4x8x4 dressed	3.50 per sq.yd.
	About 4x8x4 common	3.10 per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M.
Boston	5-in. granite 28 blocks per sq yd.	$130.00 per M.
Atlanta	Granite	2.66 per sq.yd.
Detroit	5-in. Granite	$106.00 per M.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	100.00 per M.
New Orleans	Granite, 4 x 8 x 4	3.25 per sq.yd.
Cincinnati	Granite	$138.00 per M.
St. Louis	4x8x4 dressed	3.10 per sq.yd.
	4x8x4 common	2.90 per sq.yd.
Kansas City	Granite	3.55 per sq.yd.
Philadelphia	Granite	134.50 per M.

FLAGGING—

New York	Bronx, 4 ft wide	$0.22 per sq.ft.
	Manhattan, 4 ft. wide	.22 per sq.ft.
	Queens, 5 ft wide	.24 per sq.ft.
	6x24-in. cross-walk	1.10 per lin.ft.
Chicago	18 in. wide	per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 80c.; 5 x 20 in., Queens, 85c. *St. Louis*: Class "A" straight, delivered, 5 x 16 in., $1.40 per lin.ft. *Chicago*: 5 x 8 in., $1.65; 6 x 8 in., $1.95 per lin.ft. delivered.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	**$2.69**
New York (*delivered*)	3½	16	3.19
Boston	3½	18	**2.65**
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50
St. Louis	3½	16	*2.60*
St. Louis	4	16	*2.95*
Seattle	4	16	Off market
Minneapolis	3½	16	2.62
Atlanta	3½	16	2.00
New Orleans	3	16	2.45
New Orleans	3½	16	2.65
New Orleans	4	16	2.95
Dallas	4	18	3.90
Baltimore	3½	16	none used
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	3½	16	2.38
Kansas City	4	16	*2.75*
Philadelphia	4	18	

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In.		Gravel ¾ In.		Sand	
	June 7	One Year Ago	June 7	One Year Ago	June 7	One Year Ago
New York	$2.25	$1.75	$2.25	$1.75	$1.25	$1.00
Denver	1.90	2.50	1.90	2.50	1.00	1.10
Chicago	2.00	1.80	2.00	1.80	2.00	1.80
St. Louis	**2.40**†	1.25†	2.45	1.30†	2.10†	1.10†
Seattle	1.25	1.25	1.25	1.25	1.25	1.25
Dallas	2.25	2.25	2.25	2.25	**1.95**	2.25
Minneapolis	**1.85***	1.50	**2.10***	1.50	**1.25**	1.00*
Cincinnati	1.50†	1.87½	1.50†	1.87½	**1.50**†	1.43
San Francisco	2.15	2.25	2.15	2.25	1.50	1.50
Boston	**1.50**†	**2.40**	**1.50**†	**2.40**	1.20†	1.65
New Orleans	2.85	2.08½	2.85	2.08½	1.25	1.35
Los Angeles	0.75*	1.50†	0.85*	1.50†	1.10†	1.35†
Atlanta	1.90†	1.85†	1.90†	1.85†	1.24†	1.15†
Detroit	*1.62*	2.00	*1.62*	2.00	**2.02½**	2.00
Baltimore	1.86	1.40	2.06	1.60	0.80†	2.00
Montreal	1.25†	1.25†	**1.50**†	1.50†	1.25†	1.25†
Birmingham (Crushed slag used instead of gravel)					1.45†	1.25†
Philadelphia	1.85	1.50	1.95	1.55	1.90	1.60
Kansas City	1.60	2.00	1.60	2.00	0.66†*	1.20

New York—Grit, $1.75 per cu. yd.; ready mixed, $2.25
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit.
† Per ton.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In.		¾ In.	
	June 7	One Year Ago	June 7	One Year Ago
New York	$1.65	$1.65	$1.75	$1.75
Chicago	2.00	1.60	2.00	1.60
St. Louis *delivered*	2.10	1.65	**2.35**	1.65
Dallas	2.50	2.73	2.50	2.73
San Francisco	2.15	2.25	2.15	2.25
Boston, *delivered*	1.75*	3.00*	1.75*	3.00*
Minneapolis, *at plant*	2.00	2.00	2.25	2.25
Kansas City	1.50	2.10	1.50	2.10
Denver	3.50	3.50	3.50	3.50
Seattle *delivered*	3.00	3.00	3.00	3.00
Atlanta	2.00*	1.90*	2.00*	1.90*
Cincinnati	**1.90***	1.75	*1.90**	1.75
Los Angeles	1.60	1.75*	1.60	1.85*
Detroit	1.75	1.90*	1.75	1.90*
Baltimore	2.50	1.75*	2.55	1.65*
Montreal	1.80*	2.00*	1.90*	1.60*
Birmingham *delivered*	3.20	3.20	3.10	3.10
Phildelphia	1.80*	1.70*	1.65*	1.55*
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	3.25*	3.00*	3.25*	3.00*

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$**1.40**	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa	*0.85*	*0.90*	**2.50**	
Birmingham, Ala	**1.05**	**1.15**	**2.05**	*0.80*
Buffalo, N. Y., and Erie, Pa	1.25	1.25	2.25	1.25
Cleveland, Ohio	**1.45**	**1.45**	**1.45**	**1.25**
Eastern Pa. and Northern N. J	1.20	1.20	**2.50**	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25
Longdale and Glen Wilton, Va	1.25	1.25	2.50	1.00
Toledo, Ohio	1.50	1.50	1.50	1.50

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$18.20	$13.10	$3.75*	$3.00@3.25*
Chicago	20.00	20.00	1.50†	1.50†
St. Louis	**23.20**	**20.00**	3.75*	3.00*
Boston	22.00	15.00	**4.25***	**2.50***
Dallas	22.50	.	.	2.50†
Cincinnati	16.80	**13.40**	....	
San Francisco	22.00	16.00	....	1.75†
Minneapolis	25.50	21.00 (white)	**1.70**†	**1.50**†
Denver	24.00	.	....	2.70†
Detroit	**21.00**	**20.00**	...	**20.00**‡
Seattle *paper sacks*	24.00	.. ..	2.80†	
Los Angeles	.....	.	....	*2.75**
Baltimore	24.25	17.25	2.55	...
Montreal	21.00	21.00		11.00‡
Atlanta	23.50	15.00	2.35†	1.50†
New Orleans	.....	.....	2.40†	.
Philadelphia	16.00	15.00	13.50‡	12.50‡
Kansas City	**28.00**	24.00	3.12*	**2.96***

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.70, Sheboygan $1.60. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	June 7	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.50	1.60
Atlanta (Magnolia)	11.00 per ton	11.00 per ton
Cincinnati (Utica)	1.72	1.77
Boston (Rosendale)	2.60	0.80 per bag
St. Louis (Carney)	**2.85**	2.10

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	June 7	One Month Ago	One Year Ago
New York, del. by truck	$2.70@2.80	$2.70@2.80	$2.40@2.50
New York, alongside dock to dealers	2.30	2.30	2.10
Jersey City	2.48	2.48	2.32
Boston	2.80	2.80	2.50
Chicago	2.20	2.20	2.07
Pittsburgh	2.24	2.24	2.12
Cleveland	2.46	2.46	2.36
Detroit	**2.48**	2.47	2.37
Indianapolis	2.41	2.41	2.31
Toledo	2.48	2.48	2.39
Milwaukee	2.37	2.37	2.26
Duluth	2.14	2.14	2.04
Peoria	2.41	2.41	2.18
Cedar Rapids	2.48	2.48	2.31
Davenport	2.43	2.43	2.24
St. Louis	2.35	2.35	2.21
San Francisco	2.71	2.71	2.83
New Orleans	3.30	3.30	3.00
Minneapolis	2.39	2.39	2.34
Denver	2.85	2.85	2.90
Seattle	2.90	2.90	2.94
Dallas	2.25	2.25	2.25
Atlanta	2.85	2.85	2.34
Cincinnati	2.54	2.54	2.45
Los Angeles	3.20	3.40	3.30
Baltimore	2.65	2.65	2.50
Birmingham	2.50	2.50	2.27
Kansas City	**2.45**	2.42	2.40
Montreal	2.25	2.25	2.50
Philadelphia	2.41	2.41	2.21
St Paul	2.39	2.39	2.34

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind	$1.95	Hudson, N. Y.	2.20
Universal, Pa	2.00	Leeds, Ala	2.20
Steelton, Minn	1.95	Hannibal, Mo	2.10
Fordwick, Va	2.20	Lehigh Valley District	2.10
Mitchell, Ind	2.10	Wyandotte, Mich	2.30
Iola, Kan	2.10	Alpena, Mich	2.10
Mason City, Ia	2.10	Richard City, Tenn	2.20
La Salle, Ill	$2.10	Kingsport, Tenn	2.20

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago Mill	Warehouse: New York	Warehouse: St. Louis	Warehouse: Dallas	Warehouse: San Francisco
032	22	$0 95	$1 02	$1 24	$1 04	$1 12	$1 16
049	28	1 20	1 30	1 58	1 32	1 38	1 47
068	35	1 47	1 59	1 94	1 62	1 67	1 81
093	45	1 89	2 04	2 50	2 08	2 00	2 32
126	57	2 34	2.53	3 09	2 59	2 55	2 88
153	68	2 79	3 02	3 60	3 08	3 15	.....
180	78	3.20	3 47	4.22	3 54	3 47	.....
245	103	4 22	4 57	5 60	4 66	4 58	.....
287	119	4 88	5.28	6 44	5 39	5 26	6 00
336	138	5 66	6.13	7.39	6 25	6 11	.....
395	160	6.56	7.10	8.67	7.25	7 12	.....
PAVING							
036P	17	$0 72	$0 78	$0.95	$0 79	$0 76	.....
053P	24	1.02	1 10	1 35	1 12	1 07	.....
072P	31	1 29	1 40	1 71	1 42	1 39	.....
097P	40	1 66	1 80	2 20	1.83	1 98	.....
049R	24	..	1 10	....	1.12	1 07	.....
067R	31	..	1 40	....	1 42	1 39	.....
089R	40	...	1.80	....	1.83	1 90	.

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27Dia.	2.3	$22 00	$21 25	$20 72	$21 43	$25 50
26 "	2.5	22 00	22 50	22 39	20 78	27 58
25 "	3.0	22 00	25 25	24.93	....	30 71
24 "	3.4	24 00	27 25	27.10	24 88	33 16
22 "	4.33	27 00	31 75	32 27	....	35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
¾ and larger..	$2 40@2.50	$2 65	$3 54	$3 32½	$3 35	$3 70	$3 65
⅝	2 45@2.55	2 75	3 59	3 37½	3 40	3 75	3 70
½	2 50@2 60	2 85	3 64	3 42½	3 45	3 80	3 75
⅜	2 65@2.75	2 90	3 69	3 57½	3 60	3 95	3 90
¼	2 90@3 10	2 95	4 04	3 82½	3 80	4.20	4.15

Includes 15c charge for cutting to lengths of 2 ft and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¾ and larger	$2 30	$3.05	$3 40	⅜.......	$2 55	$3 30	$3 65
⅝ in	2 35	3 10	3 45	¼.....	2 80	3 50	3 90
½..........	2.40	3.15	3 50	.....	....	....	....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: June 7	Common: One Month Ago	Common: One Year Ago	Paving Block: 3-inch*	Paving Block: 4-inch*
New York (del.)......	$23 50	$23.50	$23 50	$46 50	$54 00
New York (at dock)...	20.00	20.00	20 00		
Chicago............	11 00	11.00	11 00	34 00	42 00
St. Louis, salmon.	16@18	15@17	14 00	38@40	41 50@44 50
Denver, salmon........	12.00	12 00	12 00		......
Dallas............	13 90	13 10	11 15	33 00	..
San Francisco.........	15 00	15 00	15 00	..	. .
Los Angeles (del.).....	15 00	15 00	15 00	(not used)	
Boston.........	22 50	22.00	16 00	48 25	56 00
Minneapolis (del.)....	17@19	17@19	16@17	.....	....
Kansas City	14 50	15 50	14 50	.	......
Seattle	13 00	13 00	14 00	50 00	.
Cincinnati	20 00	18 00	15 00	45 00	55.00
Montreal	16 50	16 50	16 00	100.00‡	68.00
Detroit (del.)	19 50	17 50@20.00	16 50	38 50	41.50
Baltimore (del.)......	21.00	23 00	20 00	40 00	45.00
Atlanta	14 00	14 00	10 00	[illegible]	45 00
New Orleans......	18 75	17 25	12 50		
Birmingham	12 50	12 50	11.50		
Philadelphia.......	19@25	19@25	16.50@17.50	40 00	48 00
Pittsburgh (del.)	16 00	16.00	16 00		
Cleveland	16 00	16 00			

* For paving blocks 3½x8½x3 and 3x8½x4 respectively. † f.o.b. ‡ Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: June 7 on Truck*	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy, N. J., Factory*
4x12x12	$0 1573	$0 1112	$0 0825	$0 125	$ 092	$0 108	
6x12x12...	2097	1667	1135		126	156	
8x12x12 .	2621	2084	1547	19	170	244	$0 2691
10x12x12 .	..	.	1916	. .	1[illegible]		[illegible]
12x12x12 .		.....	2190	.	23[illegible]		[illegible]

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston	$0.11	$[illegible]	
Minneapolis (f.o.b. cars)	0736	.12125	$0 [illegible]
Minneapolis (delivered) ..	0836	[illegible]	[illegible]
Cincinnati	[illegible]	[illegible]	
Kansas City	083	14[illegible]5	
Denver .	065	.123	[illegible]
Seattle (delivered) . .	11	25	[illegible]
Los Angeles factory . . .	10	17[illegible]	
New Orleans . .	12	23	
Detroit (delivered)	1145	2147	27
Montreal . . .	115	22[illegible]	30
Baltimore	125	.27	
Atlanta	109	1832	.
Dallas .	115		
Birmingham...................	.11	18	
Pittsburgh (delivered)..........	.068	178	179
Cleveland	09	187	

San Francisco, Philadelphia, Chicago and New York [illegible] tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh Mill	Birmingham Mill	Warehouse: New York	Warehouse: Dallas	Warehouse: St Louis	Warehouse: Chicago	Warehouse: San Francisco
Beams, 3 to 15 in .	$2 50@2 60	$2 75	$3 64	$4 50	$3 45	$3.40	$3 95
Channels, 3 to 15 in	2 50@2 60	2 75	3 64	4 50	3 45	3.40	3 95
Angles, 3 to 16 in., ¼ in. thick..............	2 50@2.60	2 75	3 64	4 50	3 45	3 40	3 95
Tees, 3 in. and larger...	2.50@2.60	2.75	3 64	4 50	3 45	3.40	3 95
Plates, ¼ in. thick and heavier . ..	2 50@2.60	2.75	3 64	4 60	3.45	3.40	3 95

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York June 7	Warehouse: New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
¾ in. and larger	$3.25@3.50	$4.40	$3.50	$3.75	$4 15	$5 00	$4.90

CONE HEAD BOILER

¾ in. and larger	$3.35@3 60	$4.50	$3.60	$3.85	$4.25	$5.10	$5.00
⅝ and 11/16........	3.50@3 75	4.66	3 76	4 00	4.40	5.25	5.15
½ and 9/16	3.75@4.00	4.90	4 00	4 25	4 50	5 50	5.40

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire......	$3 00	$3 45	$4.30	$4.25	$3.44	$4.95
Cut........		5.50	5.80	5.75	3.74	5.00

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.50 per roll in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5 75 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., *$6.20*.

ROOFING MATERIALS—Prices f.o.b. New York, in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton......................	$67.50
Tar pitch (in 400-lb. bbl.), per 100 lb	1 62½
Asphalt roofing (in barrels), per ton, f.o.b. plant*......................	38.75
Asphalt felt (light), per ton, f.o.b. plant*..........................	75.00
Asphalt felt (heavy), per ton, f.o.b. plant*..........................	75.00

* Delivered in Metropolitan Dist., $3.00 additional.

WINDOW GLASS—Double strength, box list, united inches, 34, "AA" and "A" grades, at discount of 84 per cent from standard lists, f.o.b. New York; "B" grade less 85 per cent.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10..............	$3 00@3 25	$4.25	$4 15	$5 10	$4 59
No. 12..............	3 10@3 35	4.30	4.20	5.15	4.64
No. 14	3.20@3 45	4.35	4 25	5.20	4 69
No. 16	3.40@3 65	4 45	4 35	5 25	4 79
Black					
Nos. 18 and 20 .	3 70@3 85	4 80	4 85	5 95	4 95
Nos. 22 and 24	3 75@3 90	4 85	4 85	6 00	5 00
No. 26	3 80@3 95	4 90	4 90	6 05	5 05
No. 28	3 85@4.00	5 00	5 00	6 15	5 15
Galvanized					
No. 10	4 00@[illegible]	5 10	5 10	[illegible] 00	5 15
No. 12	4 10@[illegible]	5 20	5 20	6 10	5 25
No. 14	4 10@[illegible]	[illegible]	5 20	6 1[illegible]	5 25
Nos. 17 to 21	4 40@[illegible]	[illegible]		6 40	5 55
Nos. 22 and 24	4 [illegible]	[illegible]	[illegible]	[illegible]	5 70
Nos. 25 and 26	4 7[illegible]	[illegible]	[illegible]	[illegible] 70	5 85
No. 28*	5 00@[illegible]	6 10	[illegible] 10	7 00	6 15

*For painted corrugated sheets add [illegible] 24 gage; for galvanized corrugated [illegible]

LINSEED OIL—These prices are per gallon:

	New York: June 7	New York: One Year Ago	Chicago: June 7	Chicago: One Year Ago
Raw in barrels (5 bbl. lots)	$1 [illegible]	$[illegible]	$1 37	$1 [illegible]

WHITE AND RED LEAD—Base price in cents per pound:

	Red				White	
	June 7		1 Year Ago		June 7	Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	14 50	16.00	12 25	13 75	14.50	12 25
25 and 50-lb. kegs. .	14 75	16.25	12 50	14 00	14.75	12 50
12½-lb. keg	15 00	16 50	12 75	14 25	15 00	12.75
5-lb. cans	17 50	19 00	15.25	16 75	17 50	15 25
1-lb. cans	19 50	21.00	17.25	18 75	19.50	17.25

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$40 00	$41 00	$42.00	$45 00
3x6 and 8	40.00	41.00	42 00	45.00
4x4-6 and 8	40 00	41 00	42.00	45.00
3x10 and 12	40.00	41.00	42.00	45.00
3x14	42 00	42.00	44.00	46.00
4x10 and 12	40 00	41 00	42.00	45.00
4x14	42.00	40.00	44.00	46 00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$42 00	$44.00	$46 00
6x14	47.00	49.00	51 00
8x10	42.00	44 00	46 00
8x14	47.00	49.00	51.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22–24 Ft.	20 Ft. and Under	22–24 Ft.
3x 4 to 8x8	$52 00	$53.00	$52.50	$54.50
3x10 to 10x10	56 00	57.00	55.50	57.50
3x12 to 12x12	60 00	61 00	58.50	60.50
3x14 to 14x14	67 00	68.00	63.50	65.50
3x16 to 16x16	72 00	73 00	68.50	70.50
3x18 to 18x18	86 00	87.00	80.50	81.50
4x20 to 20x20	96.00	97.00	91.50	93.50

*Wholesale price to dealers· to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under.

Other Cities

	8 x8-In. x 20 Ft. and Under				12 x 12-In 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$65 00	$130 00	$60.00	$60 00	$85.00	$150.00
Seattle		31 00				31.00
New Orleans	35 00				40 00	
Baltimore	35.00	53.00	53.00	60 00	50 00	53 00
Cincinnati	42 00	55.00			50 00	
Montreal	50 00	....	. .		90 00	90 00
Los Angeles		53.00				54.00
Denver		43.00	43 00	43.00		43 00
Minneapolis	46 50	43.25	41.50	......	50 00	47.75
Atlanta	38 00	....	..	..	42.00	..
Dallas	48 00				53.00	
Kansas City	50 00	46.50	46.50		60 00	48 50
Birmingham	38 00				45 00	
Philadelphia	47 00	41.50	40 00	45 00	58 00	42 00
Detroit	48.75	53.25			61.75	53.25
St. Louis	46.50	.....			55.00	..

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemloc.	P.	Fir
Boston	$50.00	$90.00	$50.00	$58 00	$105 00
Seattle	.....	28.00	.....	.....	30 00
New Orleans, at mill	80 00	...	.....	39.00	
Baltimore	65.00	44.00	44.00	37.00	50.00
Cincinnati	75.00	120 00	120 00	40.00	40 00
Montreal	.....	50.00	37.00	45.00	45 00
Los Angeles	.....	48.00	..	.....	.. ..
Denver	.....	37 25	37.25		
Minneapolis	47.50	42 75	39.50	43.75	40 25
Atlanta	22.00	.....	.....	32.00	.. ..
Dallas	48.00		.....	51.50	.. ..
Kansas City	48 50	43.50	.....	44.00	45.50
Birmingham	32.00	....	....	42 00	.....
Philadelphia	37.00	43.00	40 00	57.00	41.50
Detroit	54 50	42 00		48 50	43 75
St. Louis	44.00	.....		34 00	. ..

Birmingham—Quotes carload lots, f.o.b. sidings. $1.50 additional per M.ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers price to contractors on large projects.

St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M. ft. additional.

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M. ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0 29
Birmingham	.69	Kansas City	.735
Boston	.365	New Orleans	.515
Buffalo	.26	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.34†
Cincinnati	.29	Philadelphia	.32
Cleveland	.21	St. Louis	.43
Denver	1.27*	St. Paul	.60

* Minimum carload, 40,000 lb.

† Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

June 7	One Month Ago	One Year Ago
$2.65@2.75	$2 60@2 75	$2 00

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	20%
Patent flattened strand, special steel wire rope	20%
Patent flattened strand, iron rope	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ⅝-in., 8 ft., ¾-in., 6; ⅞-in., 4½; 1-in., 3½; 1⅛-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.15½	New Orleans	$0.18½
New York	18½	Los Angeles	18
Chicago	18	Seattle	18
Minneapolis	.20½	St. Louis	.17½
San Francisco	.18	Montreal	.30
Atlanta	.21	Detroit	.19
Denver	.22	Baltimore	.18
Cincinnati	.21	Kansas City	.21½
Dallas	.129	Birmingham	20½
Philadelphia	.18		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin	
	40%	60%
New York	$0.275	$0.30
Boston	.23	.25
Kansas City	.2275	.2375
Seattle	.165	.195
Chicago	.22	.25
Minneapolis	.1967	.2173
St. Louis	.2275	.2525
Denver	.2075	.2325
Dallas	.29	.375
Los Angeles	.17	.20
Atlanta	235	.26
Baltimore	.22	.23
Cincinnati	225	.25
Montreal	.195	.235
Birmingham, *delivered*	.16	.17
New Orleans	.252	.285
San Francisco	.1625	.1925
Philadelphia	.2625	.295

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$17 00	$11.50	$16 00
Stove plate	14.00	12.00	15.00
No. 1 machinery cast	20 00	16 50	20.00
Machine shop turnings	13.00	4.00	12.00
Cast borings	14.00	5.50	13.00
Railroad malleable cast	15.00	12.50	20.00
Re-rolling rails	15.00	13.00	19.00
Relaying rails	.....	30.00	28.50@36 50
Heavy melting steel	14.00	.....	......

SHIP SPIKES—Current prices per 100 lb.:

	San Francisco		Seattle
In.	Galv.	Black	Black
¼	$9 85	$7.65	$8.00
⅜	7.80	6.30	7.75
½	7.75	6 15	7.70

Pittsburgh base in lots of 200 kegs or more, $3.50@3 75.

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AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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Off Into the Mud

"OFF into the mud" was a common phrase of motorists five years ago and expressed their disapproval when at the end of paved city streets they dropped into the mud of unimproved rural highways. The expression is still appropriate, but now, in most of the Northeastern states at least, has a different application. The mud now is not so much on the rural highways as it is on the streets of our villages and smaller cities. If it is not mud that greets the motorist, it is rough, poorly maintained pavements. Today, the rural highways are taking the lead in evenness and comfort and the small towns furnish the contrast by which the state highways are the better appreciated. It is time that the small cities brought their streets to the standards of the state highway systems.

Engineers in Interstate Commerce

NEW YORK'S engineer licensing act has been amended so as to exempt the "practice of professional engineering or land surveying, solely as an officer or an employer of a corporation engaged in interstate commerce." The amendment went through in the last hours of the legislature and was little discussed so that its intent is not clear but the general understanding is that it was intended to apply to railroad engineers. Some engineers in the state, however, are now raising the question of the class covered by the new clause and are suggesting the possibility of its extending to those in the employ of any manufacturing company shipping goods or doing business outside the state. By judicial interpretation interstate commerce has come to mean the transmission of goods and of intelligence between the states. Power transmission is not so clearly established as a part of interstate commerce but it probably will become so in time. There should be no doubt, then, that in New York the engineers of the railroad, power, telephone and telegraph companies operating beyond the state need not be licensed for the work of their own companies. How far beyond these classes the exemption extends remains for the licensing commission to rule and perhaps, later, for the courts to decide. The Sherman Act is based on the application of the interstate commerce clause of the Constitution to general interstate business; possibly the same interpretation will apply to licensing engineers. If it does the New York licensing law becomes ridiculous in its limited control of engineering practice.

National Inter-relations

SLOWLY but none the less surely the Ruhr situation, with its collateral question of reparations, is reaching a solution. Nations move deliberately toward the settlement of their difficulties and they move with due recognition of the many steps each must take before reaching the common ground. France is beginning to appreciate how difficult it is to collect [illegible] with soldiers; Germany knows now how it feels to quarter foreign troops, even in times of peace. Each is prepared to give way somewhat from their pre-occupation period stand and the world can do little but wait until each is satisfied the other will go no further. While it is waiting though it can pray for an early solution because national business cannot become settled until so important an international question is settled. This inter-relation of the business of the world may not always be realized by those whose own business does not go beyond their own borders but it exists nevertheless. In a recent address George M. Roberts, of the National City Bank, points out an instance that exemplifies this excellently. "India and Russia," he said, "never had much direct trade with each other. But one of the principal products of India is tea, and Russia before the war was a great tea consuming country. India sold tea to England and took her pay for it in cotton goods, made in Lancashire. England sold tea to Russia and took her pay in Russian products. The inability of Russia to buy tea affected the ability of India to buy cotton goods with the result that in 1921 Lancashire had the worst year in the cotton goods trade since the American civil war. And the inability of Lancashire to sell cotton goods caused her to cut down her purchases of raw cotton in the United States, with the result that cotton fell from 43 cents a pound in 1920 to 11 cents in 1921, and this loss of purchasing power to the southern farmers affected all the industries of this country."

Constructive Criticism Needed

CONSTRUCTIVE criticism of the Ripley plan of railroad consolidation did not mark the Interstate Commerce Commission's hearings either at St. Louis or Washington. There has been, on the contrary, a great deal of selfish expression and many unsound arguments. Cities complain of prospective loss of the main offices of one or more railways; state public service commissions see certain traffic leaving their states because under consolidation some commodities may be moved by the more direct and economical routes made possible by the consolidation; railroad presidents, blinded by their resentment of the whole plan of government regulation, attempt to obstruct the proceedings by wordy discussions of irrelevant subjects; all lack the vision to see that any move that is sound economically will, in the end, benefit them by benefiting the country as a whole. They fail to appreciate that any temporary loss which they may suffer will be completely recovered in increased traffic that will naturally come with the growth of the country and which will be stimulated by a rejuvenation of our railroad systems, which may possibly come by consolidation. The Interstate Commerce Commission has ample power to see that needed lines will not be abandoned and that rates will not be raised when competition is eliminated. Elimination of duplicate facilities and staffs, and roundabout routing of shipments should be of permanent advantage. These benefits are a part of the proposed plan, which is not perfect but which can be discussed in the mood of constructive criticism. There were men at the hearings who did this, but they are the exceptions — men like Rea, of the Pennsylvania; Smith, of the New York Central, and Colston, of the New York, Chicago & St. Louis. They have come forward with qualified approval of the plan of consolidation and have explained their qualifications clearly. It is to be hoped that as the hearings proceed there will be more witnesses like them. Only thus can we hope for real progress.

Watershed Contamination

THAT utter disregard for watershed sanitation exists in many foreign countries is not realized by most of us. Serious direct contamination of water supplies in North America is a thing of the past except for an occasional example of accident or neglect, and that chiefly in the smaller cities and towns. But in some of the less highly developed countries to the south of us a sense of water-supply protection does not always go hand in hand with the development of that supply. A few weeks ago, for instance, an American engineer stated in these columns that not in his 17 years experience has he seen anything approaching the visible pollution that he noted on the watersheds of Bogota, a South American capital of nearly half a million people. So gross was it that he had his doubts of the efficacy of chlorine alone during the rainy season. Travelers say that were it not for the almost continual cold climate, averaging and rarely exceeding 65 deg. F. in the high plateau on which the city is located, the typhoid and dysentery record of Bogota would be far worse than it is. Happily, the Bogotanos are learning of sanitation, for negotiations with American engineers and contractors have been under way for more than a year which, if consummated, will give the city filters and other modern water-supply equipment. Thus instruction in the technic of engineering goes along with the introduction of engineering machinery and equipment.

Against Price Exchanges

TRADE associations for the exchange solely and privately to the trade of information as to sales and prices are definitely proscribed by the decision of the Supreme Court in the linseed oil case, noted in the news pages. Although the court in so ruling reversed the lower courts its decision is in keeping with the recent trend of decisions in the open-price association cases. It is definitely established now that the exchange of price and stock information either by the ostensible competitors direct or through the medium of an independent agency is in violation of the Sherman Act. The legality of statistical interchange through the medium of a public or private body which will make the data available to both producer and consumer still remains to be seen, for the court specifically refused to rule on such a possibility. Collection and distribution of such information by such an open agent as the Department of Commerce would be a desirable step toward future predictions and the smoothing out of the curve of business, especially if some prediction of demand could also be made. Producers, however, seem to be somewhat fearful of this entry of government into business control, even in a purely statistical function, and the prospects of its immediate adoption are not especially bright.

Arbitration in Contract Practice

AFTER a year, differences have again arisen between the Commissioners of Sewers of Louisville and the contractors who have been building the commission sewers. Arbitrary action, exacting requirements, indecision and delay by the engineers of the commission, it is charged by the contractors, are causing extra expenses which are making work unprofitable at prices which, with reasonable engineering direction, would return a fair profit. Certain contractors as a group have refused to undertake further work for the commission unless it shall write into its contracts a clause providing for arbitration of disputes. With the object of forcing the issue by an appeal to the public, advertisements are being published in the local newspapers.

Criticism of the Louisville sewer contracts is not new. A year ago when the commission-contracts for construction now in progress were first presented, protest was made by local contractors against their drastic powers and the inclusion of an arbitration clause was urged. The situation which developed was discussed editorially in *Engineering News-Record*, Aug. 17, 1922, p. 258. As then stated the request of the contractors for an arbitration clause was refused. The most in this respect that the commissioners would concede was the privilege of appealing from the decision of their engineers to the commissioners themselves. Construction was undertaken with this understanding. Apparently this arrangement has failed to meet the situation. Certainly the contractors who have been working under it for a year are not satisfied. They are again demanding that the written contracts shall provide for arbitration, not by the commission of disputes in which its own engineer is accused, but by an independent body of arbitrators.

As a dispute over the right of specific claims, the Louisville case has no greater significance than a score of others which any contractor or engineer long in practice can recall. It is important solely because arbitration as a provision of engineering contracts is put in question, and because there has come about in a year a pronounced change in the attitude of engineers toward such formal provision for arbitration. This new feeling is largely the result of the work of the Joint Conference on Uniform Contracts. In many meetings the committee of the nine technical societies participating in this conference has laid down a principle of arbitration in engineering contracts:

"The architect (or engineer) shall, within a reasonable time, make decision on all claims of the owner or contractor and on all other matters relating to the execution and progress of the work or interpretation of the contract document. All such decisions of the architect (or engineer) shall be final except as to the element of time and the financial considerations involved, which if no agreement in regard thereto is reached, shall be subject to arbitration."

There is evident in this statement of principle a conscientious effort to safeguard the prerogatives of the engineer in technical matters, progress of work and the results to be obtained which he must maintain if he is to assume responsibility and fear of losing which has been always his main reason for withholding specific provision for arbitration from his written contracts. Limited as it is to the determination of facts in questions of time and compensation, there is nothing in this statement of principle to which fair-minded engineers will object and much less is there anything which need arouse their fear.

Few engineers who have not followed the progress of arbitration in detail realize, besides the advance made by the Joint Conference work, how far ahead it has gone as a recognized principle of contract practice. It is one of the requirements which the Interdepartmental Board of Contracts and Adjustments now engaged in standardizing and harmonizing federal government contracts has laid down as essential. The American Institute of Architects has already a clause substantially the same. Besides the architects two other particpants in the Joint Conference have approved the principle laid down by the committee. Limited arbitration has been indorsed by the Association of State Highway Officials.

There is ample precedent in support of the contention of the sewer contractors of Louisville that an arbitration clause is a desirable addition to the contracts under which they are working. Their procedure in advancing their case is not so well supported. They also have to guard against expecting too much from the privilege of arbitration. There are differences in contractual relations which are arbitrable but they do not include any which prejudice the authority of the engineer over the execution and progress of the work for which he in the last analysis is solely responsible.

Mandatory Engineering

BLANKET legislation with specific intent is always vicious; no better illustration can be found than the Strauss-Kaufman railway electrification bill recently approved by Governor Smith of New York. That bill in effect calls for the electrification before 1926 of all railroads within the corporate boundaries of New York City. It admittedly was designed to put an end to the operation of steam locomotives close to certain high-class residential districts in New York, more especially along Riverside Drive. To gain this end it orders the electrification of some 311 miles of railroad, most of it now on grade with grade crossings, and some of it in remote parts of the city of New York, which has within its limits districts as rural as though they were a hundred miles away from any city much less the largest one on the continent.

Railroad conditions along the west shore of Manhattan Island have long been a disgrace, but the smoke nuisance, the cause of this present action, is not the greatest of them. The whole layout with its numerous grade crossings and tracks which require operation of trains through busy streets is fundamentally wrong. It should have been done away with years ago, as it would have been if the railroad plan submitted in 1911 had been received in the proper spirit and the present administration of New York City had not played politics with the whole situation. If the proposed bill had no effect whatever on the intolerable track condition, it would not be so bad, but unfortunately it has a very serious bearing on it—it will complicate it greatly. To comply with the law the New York Central R.R. must electrify all of its tracks, most of them at street level from Spuyten Duyvil Creek to Canal St., in a time which does not permit of the radical revision of track layout and elevation that is required for a rational solution of the West Side problem. Its only recourse, then, would be to resort to an overhead trolley system with a multitude of poles and vast network of wires stretched down along the side of Manhattan Island, all of which will require an expenditure that will go for nothing in a few years when public opinion forces the removal of the grade operation, as it surely will.

The general ordering of electrification all over the city is no less ridiculous. It is not possible merely to string electric wires along a railroad to have proper electrification. Revision of grade and line go along with the change of motive power. The complete revision necessary for proper electrification is not necessarily demanded everywhere in New York City, any more than it is demanded on all the railroads of the country.

The only justification of this bill may be that it will force some recognition of the necessity of adjusting the difficulties of the railroad and the city in the matter of the West Side problem so that the next legislature may be in a position to repeal the current act in favor of one which will serve as a more rational approach to the problem of proper railroad facilities inside the city of New York. The settling of engineering problems by blanket mandatory legislation will never satisfy anybody.

Why Not a "Sales Engineer"

WITH the intention of provoking thought and discussion rather than of making a dogmatic assertion we ventured editorially to suggest some months ago that the term "sales engineer" was a misnomer and that the engineering profession should discourage its use. The note did bring the desired discussion but it was mostly from men who wear the title "sales engineer" and who felt that their vocation had been unfairly attacked. For the most part they contended that they were both engineers and salesmen and that the very success of their salesmanship depended upon their engineering knowledge and experience. In other words they did not defend their title but their business.

To deny the desirability of engineering experience in certain kinds of selling was and is the farthest from our thoughts. Obviously those who sell an engineering product are best prepared when they know how that product is made and used and can talk the language of its users. The engineer engaged in the honorable and useful business of selling such a product does not lose his membership in the engineering profession. It is when he confuses what he is with what he does and applies to the generic term engineer the descriptive adjective sales that he offends the profession, because he thereby implies that there is a type of engineering essentially involved in the selling of goods. This is not a fact. The process of making a sale is not an engineering one. It is not subject to the same sort of scientific classification as engineering nor does it rest upon the same scientific principles. The word sales is not descriptive of engineering knowledge or practice. Engineers are needed to make certain kinds of sales but their engineering knowledge is applied to the process or material involved and not to the handling of the prospect or the getting of the signature, the technic of which is the essence of salesmanship.

An "engineer-salesman" or a "salesman-engineer" is a legitimate person; there is no such thing as a "sales engineer." This may seem a quibble but to our mind the distinction is vital and its analogy extends to the many other kinds of adjectival engineers whose multiplication can only weaken the engineering profession.

Plate-Girder Design and Detailing—Notes from Practice

Methods of Calculating the Resisting Moment—Strength of Wide Cover Plates—Stiffener Spacing and Rivet Pitch as Governed by Web Shear—Twenty Hints to the Detailer—Torsion in Box Girders

By Robins Fleming
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PLATE-GIRDER design in practice involves a number of difficulties which are either neglected or not fully treated in the existing literature of the subject, extensive as it is. The following notes gathered from observation and experience may be of help in dealing with them. The notes are confined to parallel-flange simple girders, i.e., girders having flanges composed of a pair of angles with or without cover plates. Girders of other types present additional difficulties that cannot be discussed within the limits of the present article; moreover, simple flanges are to be preferred, where practicable.

Methods of Designing Plate Girders—Values for the resisting moments of various girders, according to five methods of calculation, are given in Table I. As the load that a girder can carry varies as its resisting moment, and as f is constant, the reader can easily make comparisons from the figures in parentheses.

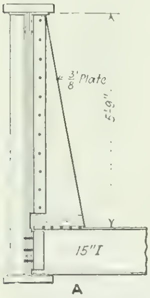
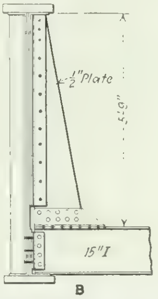
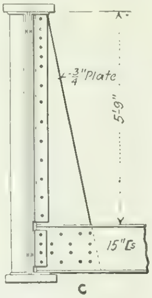




FIG. 1—WEAK KNEEBRACE CONNECTION AND TWO PREFERABLE DETAILS

There is little or no practical objection to using the moment of inertia of the gross section, M_1 in the table, even if it is not theoretically correct. As usually designed both flanges have the same section, and under ordinary conditions the ratio of the strengths of the flanges is such that the liability of failure of the top flange by buckling is greater than that of the bottom flange by rupture through the net section. This relative strength of the flanges, if of the same section, exists and is not altered by assumptions made in design.

The requirement in many specifications that the net section be used in determining the moment of inertia, M_2 in the table, seems needlessly severe.

Using the gross area of the top flange and the net area of the bottom flange, M_3, is nearer exact than any other method of the table. For flanges of the same section the neutral axis can quite accurately be assumed at the center of the girder section. The net section of the bottom flange exists only over a small proportion of its length, and it is not likely that the neutral axis of the girder will turn sharply up and down; it will probably remain very near the neutral axis of the preponderating section. However, even considering a section through rivet holes of the tension flange the location of the neutral axis is but slightly changed from the center line of the girder. For girder 1 of the table it is raised 0.4 in., changing the coefficient of M_3 from 193 to 185; for girder 4 it is raised 0.3 in., changing 406 to 391; for girder 14 it is raised 0.5 in., changing 1,745 to 1,651; and for girder 15 it is raised 0.67 in., changing 645 to 604.

Because of its simplicity, the writer prefers for ordinary girders the chord-stress method $M_4 = fd(A_2 + \frac{1}{8} d_1t)$. The limitations of this method should be well understood. Girders of unusual section, and shallow girders with several cover plates piled on the flange angles, should be proportioned by the moment-of-inertia method, as the chord-stress method may give too small flange areas. When designing plate girders in competition with rolled beams of the larger sizes it is often an advantage to use the moment-of-inertia method.

Some engineers in using the chord-stress method assume that the web resists no moment. The values of M_4 would thus be less than those shown in the table—about 13 per cent in girder 1, 12 per cent in girder 14, 6 per cent in girder 15.

For preliminary designs and estimates the equation $M_5 = fd_1A_2$ is especially convenient. It gives flange areas that are too large but not enough so to make it useless for approximate estimates.

Compression Flanges—The strength of plate girders with compression flanges unsupported laterally is an unsettled point. The formulas that have been presented for proportioning such flanges are many and varied. The writer has recommended (*Engineering News-Record*, Feb. 24, 1921, p. 336) the formula $S = 19{,}000 - 250\ l/b$ for plate girders without cover plates, and $S = 19{,}000 - 225\ l/b$ for plate girders with cover plates, in which S is the allowable stress, lb. per sq.in., with a maximum of 16,000; l is the unsupported length of flange, inches; and b is the width of flange, inches. If stiffeners are placed not farther apart than the depth of the girder, and their outstanding legs extend to the edge of the flange angles, these equations could safely be changed to $S = 19{,}000 - 225\ l/b$ and $S = 19{,}000 - 200\ l/b$.

A fault in many through plate-girder bridges with shallow floorbeams is the weakness of lateral support of the top flanges of the main girders. Fig. 1, sketch A shows a detail of a bridge on a leading railroad. (It is surprising that the detail "got by" the bridge engineer of this road.) If the detail of sketch B had been used the strength to resist lateral thrust at the top flange would be increased 50 per cent; with that of sketch C the strength would be three times as great.

Cover Plates—The maximum width of cover plates is fixed in most specifications by the requirement that the projection beyond the outer line of rivets shall not exceed 6 in. nor be greater than 8 times the thickness of the thinnest plate. What values shall be given to plates where these limits are exceeded? The writer suggests the following paragraph for specifications:

> Cover plates to have their full sectional area included in flange section shall not project beyond the outer line of rivets more than 6 in. or more than 8 times the thickness of the thinnest plate. Cover plates exceeding these limits not more than 50 per cent may have one-half the excess section included in flange section. No part of a projection beyond the outer line of rivets more than 9 in. or more than 12 times the thickness of the thinnest plate shall be considered as part of the flange section.

Web Plates—Notwithstanding the complicated nature of web stresses it has been found perfectly safe to design a web plate by making it thick enough to resist the maximum shearing stress assumed to be uniformly distributed over the cross-sectional area, and also thick enough to enable the flange-stress increments to be taken into the flanges by permissible rivet spacing. A limiting minimum thickness should be used, say ¼ in. for building, $\frac{5}{16}$ in. for highway and railway work of E40 or less loading, and ⅜ in. for railway work of more than E40 loading.

Specifications differ as to whether the unit shearing stress for proportioning web plates should be applied to net section or to gross section. The specifications (1923) of the American Society of Civil Engineers call for 12,000 lb. per sq.in. on the net section, while the specifications of the American Railway Engineering Association (1906, 1910, 1920) call for 10,000 lb. per sq.in. on the gross section. All these specifications use 16,000 lb. per sq.in. for axial tension on net section. To equate the values of 10,000 gross and 12,000 net the net area of web must equal five-sixths of the gross area. This is seldom the case through the vertical rows of rivets connecting end stiffeners. If ⅞-in. rivets spaced 4 in. apart were used the ratio of net to gross would be ¾, equivalent to a value of 13,330 lb. per sq.in. on the net section for 10,000 on the gross section.

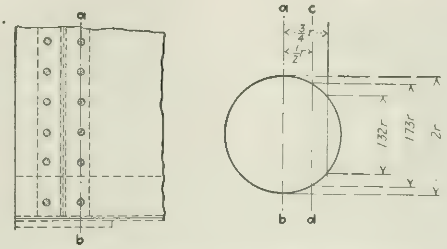


FIG. 2—SHEAR SECTION AT END STIFFENER

Theoretically, the gross section can safely be used. In Fig. 2 let *ab* be a partial section through the end stiffeners, where shear is greatest. The rivets relieve the shear in the web plate by an amount equal to one-half their bearing value, thus reducing the shear in the net section by this amount. (The section through rivet on line *c—d* is ½ of 1.73 of that on line *a—b*, but the shear is reduced by only one-fourth the bearing value of the rivet.) It is well, however, to restrict the punching of the web, and as the designer does not always control details he may better use a larger unit stress and proportion the web for an equivalent net section. The writer would not hesitate to change the 10,000 lb. per sq.in. on net section of his specifications to three-

TABLE I—RESISTING MOMENTS OF PLATE GIRDERS

No.	Girder Section	Flange Area Gross A_1	Flange Area Net A_2	$M_1 = fS_1$ Gross Section	$M_2 = fS_2$ Net Section	$M_3 = fS$ Top Flange Gross Bott. Flange Net	$M_4 = fd\left(A_2 + \frac{d_1 t}{8}\right)$	$M_5 = fd_1A_2$
1	Web 30x¼ in. 4-Angles 5x3½x⅜ in.	6.10	5.44	f(203)	f(183)	f(193)	f(183)	f(163)
2	Web 30x $\frac{5}{16}$ in 4-Angles 5x3½x½ in.	8.00	7.12	f(263)	f(236)	f(250)	f(238)	f(214)
3	Web 30x $\frac{5}{16}$ in 4-Angles 6x4x¾ in.	13.88	12.56	f(414)	f(380)	f(396)	f(389)	f(377)
4	Web 30x⅜ in. 4-Angles 6x4x¾ in.	13.88	12.56	f(423)	f(388)	f(406)	f(398)	f(377)
5	Web 30x⅜ in. 4-Angles 6x4x¾ in. 2-Plates 14x¾ in.	24.38	20.42	f(724)	f(614)	f(669)	f(646)	f(613)
6	Web 36x⅜ in. 4-Angles 6x4x¾ in.	13.88	12.56	f(530)	f(485)	f(508)	f(489)	f(453)
7	Web 36x½ in 4-Angles 6x4x¾ in.	13.88	12.56	f(557)	f(509)	f(533)	f(508)	f(453)
8	Web 36x⅜ in. 4-Angles 6x6x⅞ in. 4-Plates 14x½ in	33.46	28.62	f(1,140)	f(990)	f(1,065)	f(1,055)	f(1,030)
9	Web 36x½ in. 4-Angles 6x6x⅞ in. 4-Plates 14x½ in.	33.46	28.62	f(1,165)	f(1,013)	f(1,089)	f(1,075)	f(1,030)
10	Web 48x½ in. 4-Angles 6x6x¾ in.	16.88	15.36	f(898)	f(828)	f(862)	f(834)	f(747)
11	Web 48x½ in 4-Angles 6x6x¾ in. 2-Plates 16x⅞ in	30.88	26.72	[illegible]	f(1,344)	[illegible]	f(1,397)	f(1,282)
12	Web 48x½ in. 4-Angles 6x6x¾ in. 4-Plates 16x¾ in	40.88	34.56	[illegible]	f(1,726)	[illegible]	f(1,820)	[illegible]
13	Web 48x½ in. 4-Angles 6x6x⅝ in. 4-Plates 14x½ in	28.22	23.70	[illegible]	f(1,226)	[illegible]	[illegible]	f(1,139)
14	Web 60x½ in. 4-Angles 6x6x⅝ in. 4-Plates 14x½ in	28.22	23.70	[illegible]	f(1,610)	[illegible]	f(1,625)	f(1,422)
15	Web 26x½ in. 4-Angles 6x6x⅝ in. 4-Plates 14x½ in.	28.22	23.70	[illegible]	f(594)	[illegible]	[illegible]	[illegible]
16	Cunard Girder	144.00	120.65	[illegible]	[illegible]	f(16,720)	[illegible]	[illegible]

Notation:

M_1, M_2, M_3, M_4, M_5 = Resisting moment of girder section [illegible]

S_1, S_2, S_3 = Section modulus. In determining [illegible] modulus the [illegible] and the [illegible] angles to be one-half inch greater than the depth [illegible]

f = Extreme fiber stress for M_1, M_2 and M_3 [illegible]

d = Distance center gravity of flanges or effective [illegible]

d_1 = Depth of web plate, inches

t = Thickness of web plate, inches

A = Area of each flange (A_1 = gross area, A_2 = [illegible] fourths of the stress used in axial tension; that is, 12,000 where 16,000 is used and 13,500 where 18,000 is used. Unless known to be otherwise the net area would be assumed to be three-fourths of the gross area; this is equivalent to taking 9,000 and 10,125 on gross area.

Rivet Pitch—In determining rivet pitch for connecting flange angles to web plates, if there is no load on the top flange and the flanges are designed to take all the bending moment, the equation $p = rd/V$ is commonly used, in which p is the pitch of rivets, r is the resistance of one rivet (usually the bearing value on the web plate), V is the vertical shear at the section considered, and d is the girder depth. The value of d to be taken varies according to the authority followed. A large number think that it should be taken as the effective depth of the girder, that is, the depth used in designing; another group of writers teach that d should be taken as the perpendicular distance between rivet lines, while a third group takes it as the depth of the web plate. If one-eighth the web is considered part of the flange area the equation becomes,

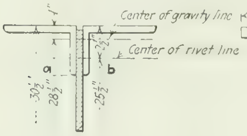


FIG. 3

FIG. 3—RIVET PITCH CALCULATION

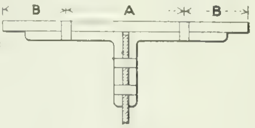


FIG. 4

FIG. 4—COVER-PLATE LIMITS

$$p = \frac{rd}{V}\left(\frac{F + \frac{1}{8}A}{F}\right)$$

in which F is the area of one flange and A is the area of the web. By the moment-of-inertia method the longitudinal shear per lineal inch between the flange and the web at any section is $h = Vm/I$, in which m is the statical moment about the neutral axis of that part of the flange outside of the section on which the horizontal shear is desired (ab in Fig. 3); then $p = r/h$. The maximum pitch by all methods should be limited to 6 in.

The variations in the pitch obtained by the four methods can best be shown by an example or two. Let the girder section partially shown in Fig. 3 be of four angles 6 x 4 x ½ in. and a web plate 30 x ⅜ in. Assume ¾-in. rivets to be used, with a bearing value of 24,000 lb. per sq.in. or 6,750 lb. for a single rivet. For a vertical shear of 50,000 lb., and no part of the web considered as flange area, the values of rivet pitch p from the foregoing assumed values of d are 3.84, 3.44 and 4.05. If one-eighth of the web is considered part of each flange area, the values of p are 4.41, 3.95 and 4.65. By the moment of inertia method $p = 4.72$.

Again, suppose the girder section to be of 30 x ½-in. web plate, each flange of two angles 6 x 4 x ½ in. and two cover plates 14 x ½ in., the rivets ⅞ in., and the vertical shear 100,000 lb. at the section considered. The values of p from the different values of d, with no portion of the web considered as resisting moment, are 3.08, 2.68 and 3.15. With one-eighth the web considered as part of each flange, p is equal to 3.32, 2.89 and 3.40. By the moment-of-inertia method, $p = 3.51$.

Without being dogmatic or entering into any discussion the writer expresses preference for the first method mentioned, that is, using the effective depth of the girder in determining the pitch of rivets connecting flange angles to web plates.

Attention is here called to the effect of a change of flange section on the rivet spacing. Where a new cover plate begins there is a redistribution of stresses because the ratio of plate sectional area to entire flange sectional area is changed. Additional rivets are needed around the point where the cover plate begins, in both the vertical and the outstanding legs of the flange angles.

Stiffeners—A goodly portion of the literature of plate-girder design is devoted to web stiffeners. The chief functions of stiffeners are stated by Hudson ("Plate Girder Design," 1911) to be: (a) to keep the web from buckling due to the compressive stresses in it; (b) to keep the compression flange from lateral failure as a whole and from failure in detail in any direction; (c) to relieve the rivets connecting the loaded flange to the web, by transferring the load directly to the web; (d) to reduce to a proper amount the vertical stresses, on horizontal planes, in the web brought by local concentrated loads; and (e) to help hold the web true to shape during manufacture and erection.

Goodman ("Mechanics Applied to Engineering") thinks that the primary function of web stiffeners is to give torsional rigidity to the girder to prevent side twisting. He regrets that he does not see any way of calculating the pitch of stiffeners to secure the necessary stiffness.

Broadly speaking, stiffeners may be divided into two classes, those that act as columns and those that act as beams. Of the first class are those at bearings and those under concentrated loads. Most specifications require that stiffeners in such cases be designed as columns, using in the reduction formula a length equal to one-half the depth of the girder (the column receives or discharges its load in increments). "A rational method would be, first, to assume the full concentration carried by the angles only, using the unreduced stress in compression, and, second, to consider the fillers and the strip of the web plate covered by these as part of the stiffener and dimension the latter as a column against buckling, the larger required section of the angle to be used" (Kunz, "Design of Steel Bridges," 1915). As it is impracticable to secure an accurate bearing of stiffener angles against the fillets of flange angles, the bearing area is restricted to a portion of the outstanding legs. The bearing value may be assumed at 24,000 lb. per sq.in., excluding the chamfered portion over fillets of flange angles. This often necessitates that outstanding legs be as wide as the flange angles will allow. A filler under the stiffener angle equal in thickness to the fillet of the flange angle would allow the whole area to be considered in bearing, in which case the bearing value should be assumed as 16,000 instead of 24,000.

Intermediate Stiffeners—The design of intermediate stiffeners is largely a matter of judgment based upon experience. The persistence with which girders with few or no stiffeners have carried heavy loads upsets all theories. It is accounted for in part by the low stresses used in some of the earlier specifications. The "General Specifications for Iron Bridges" issued in 1879 by the New York, Lake Erie & Western R.R., O. Chanute chief engineer, allowed but 4,000 lb. per sq.in. shearing stress (net or gross section not stated) in web plates. With such a value it was consistent to specify "when the least thickness of the web is less than one-eightieth of the depth of a girder, the web shall be stiffened at intervals not over twice the depth of the girder."

Until the effect of the tensile stresses acting at right angles to the compressive stresses is known the buckling stresses can not be calculated. Yet the case is by no means hopeless. If stiffeners are spaced according to the methods given in almost any textbook the web is secure against buckling so long as it is thick enough to resist the shear. A simple and common requirement and one based on good reasoning is that intermediate stiffeners shall be placed at points where the thickness of the web is less than one-sixtieth of the unsupported distance between flange angles, generally not farther apart than the depth of the web plate, with a maximum limit of 6 ft. Moore ("Design of Plate Girders," 1913) suggests, since this rule gives a constant spacing regardless of the intensity of shearing stress, that the factor of $\frac{1}{60}$ be multiplied by S_a/S_s, in which S_a is the allowable intensity of shearing stress in the web as determined by the specifications used, and S_s is the actual intensity of shearing stress as determined by dividing the shear at any section where the stiffening spacing is desired by the web area. While theoretically sound, the suggestion would be troublesome to follow in making details. Besides, stiffeners may be needed to keep the web true to shape, if the girder is subject to rough handling.

Since intermediate stiffeners act as beams the greatest strength is secured by having the outstanding legs extend to, or near to, the edge of the flange angles. This also secures the most efficient resistance to lateral deflection of the top flange.

Economic Depth and Weight—Many formulas have been presented for the economic depth and for the weight of plate girders, some of which in taking account of the many variables are quite complicated. While all of them are fairly accurate for girders built under conditions considered, none of them are accurate for plate girders in general. Textbooks usually give from $\frac{1}{8}$ to $\frac{1}{12}$ the span as the economic depth. Definite requirements to be met, however, often fix the depth regardless of the results of mathematical calculations. This is especially true in building work.

The minimum depth is often given as $\frac{1}{15}$ the span, though for girders subject to shock and vibration such as crane girders and deck plate-girder bridges the depth should be not less than $\frac{1}{12}$ the span. Bird, an English writer, in "The Practical Design of Plate Girders," 1920, deprecates the existence of many plate girders on English roads with depths of but $\frac{1}{30}$ to $\frac{1}{20}$ the span.

An approximate weight of a plate girder can easily be obtained (after determining the web plate and flange area at center) by multiplying the area of the center cross-section by four times the length of the girder in feet. The weight of the girder usually adds comparatively little to flange stresses. The weight of girder 1 of Table I on a span of 30 ft. adds 1.7 per cent to the center flange stresses; in girder 14 for a length of 50 ft. the addition is 5 per cent.

It has often been stated that in a well-designed girder the weight of flanges should equal one-half the entire weight, but there are so many exceptions to this rule that it is not a safe guide.

Stray Points—Many minor points connected with plate-girder design or details need to be kept in mind. For a number of these points (and for Figs. 1, 5 and 6) the writer is indebted to F. L. Castleman, plant engineer of the American Bridge Co. at Pencoyd, Pa.

1. Care should be taken that plate girders are so designed that the flange-stress increments can be taken from the web plate into the flanges by the rivets. This may seem to the reader so elementary that a caution is out of place. Yet until the current year a leading steel manufacturer's handbook, under the caption "Riveted Plate Girders: Safe Loads in Thousands of Pounds Uniformly Distributed," tabulated loads of 200,000 to 300,000 lb. for girders with 28 and 30x⅜-in. web plates and with flanges composed of cover plates on 6x4-in. angles with the 4-in. leg riveted to the web plate; to transmit the flange-stress increments near the ends into these flange angles by a single row of rivets would require bearing on the web plate beyond the permissible value. Thicker web plates should be used, or else 6x6-in. flange angles, giving a double row of rivets in the vertical leg.

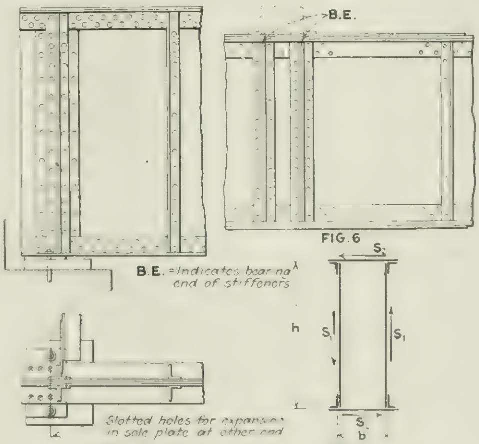

>B.E.
B.E. = Indicates bearing end of stiffeners
h
S_1
S_1
S_2
S
b
Slotted holes for expansion in sole plate at other end

FIG. 6

FIG. 5

FIG. 7

FIGS. 5-7—SOME DETAILS OF PRACTICE

Fig. 5—Good arrangement of end stiffeners. Fig. 6—Marking the bearing ends. Fig. 7—Torsional shear in box girder.

2. If the center of gravity of flanges with several cover plates falls outside the angles, the effective depth should be taken back to back of angles.

3. The ends of all girders should be secured against overturning.

4. It is sometimes cheaper to increase the thickness of web plates and either omit the intermediate stiffeners or decrease their number.

5. Although most specifications forbid it, there seems to be no good reason why the thinnest instead of the thickest cover plate should not go next the flange angles, especially when one cover plate extends full length. Material will be saved thereby, and if the lower plate is in two lengths it will be spliced by a plate of greater thickness.

6. Striving after ornamentation or architectural effects is expensive. The design drawing may present a better appearance thereby but the designer should look beyond the mere appearance of his drawing and consider the location of the finished structure. Girders encased in concrete or for a bridge in some wilderness need not be

artistically beautiful. In this connection it may be said that curved ends add to the cost of fabrication, and judgment should be used in requiring them. If they are necessary the radius of curvature should be not less than three (preferably more) times the vertical leg of the angle curved.

7. Lessening the weight of a girder does not necessarily decrease its cost; it may increase it. Curving the top flange to secure uniform stress will save weight in web plates, but the increase in cost of fabrication will more than offset the cost of plates saved. Crimping the intermediate stiffeners will do away with fillers, but unless the girder is deep or the flange angles thick or there is considerable duplication there will be no saving in cost.

8. Having the web plate in one or at most two pieces is desirable from an engineering point of view. But if very long the plates may cost enough more per pound to make it cheaper to use shorter plates with splices.

9. Theoretically, the web plates need not be of uniform thickness throughout. The 110-ft. center girders of the New York Central R.R. bridge near Lyons, N. Y., built in 1901, have web plates 134 in. deep and ⅜, ⅝ and 1 in. thick. However, for ordinary girders the cost of excess material in a uniform thickness of web plate is usually offset by the saving effected in the cost of fabrication.

10. The work of the detailer is often undervalued. He can easily lessen the efficiency and increase the cost of plate-girder work by poor details. More rivets than needed may be used in some places and too few in others. The strength may be materially reduced by a spacing of rivets that unnecessarily reduces the net section. In the girders of complicated structures, as locomotive and swing-bridge turntables, considerable engineering knowledge is often required to avoid excess of rivets and yet develop the required strength.

11. The detailer will facilitate shop work if he can, without excessive riveting, (a) use the same spacing of rivets in top and bottom flanges, (b) have the spacing symmetrical about the center line of girder, (c) have as few changes in pitch as practicable, and (d) make all lateral plates similar. In any case he should space rivets adjacent to stiffeners far enough away to allow them to be easily driven.

12. The detailer should especially bear in mind the erector. Entering connections should be avoided unless the member can be entered vertically by means of its own weight. Ample clearances should be allowed. Care should be taken that all field rivets can be entered and driven. It should be possible to erect floorbeams in place without moving girders from their permanent position. Anchor-bolt holes in shoe plates of bridge girders should be ⅜ in. larger than the bolts, and should be so located that holes can be drilled in the masonry with the drill held vertically. A washer can be used to cover the hole and provide bearing for the nut.

13. A question that often arises in detailing girders with flange angles of 8- and 6-in. outstanding legs is whether to use two or four lines of rivets in cover plates. On girders encased in concrete two lines are considered sufficient provided the stress increments are taken up and the following ratios are maintained: in Fig. 4 the distance *A* not to be greater than 32 times the thickness of thinnest plate and distance *B* (except as allowed in specifications for cover plates, *ante*) not greater than 8 times the thickness of thinnest plate plus 1 in. For 8-in. outstanding legs, 4 lines of rivets are commonly used; for 6-in. legs 2 lines are usually sufficient.

14. The detailing of splices is important, and its underlying principles should be well understood. If web plates are designed to take a portion of the bending moment, web splices should be detailed to take the same portion. The Lackawanna R.R. specifications, which allow no portion of the web plate to be considered as a part of flange section, nevertheless require the web to be spliced for both shear and moment. The additional factor of strength gained by neglecting the bending value of the web would be lost if the web were not spliced for moment.

15. It is not the best engineering, though more or less common in practice, to have the end reaction taken by a pair of stiffeners at each end of a bearing plate, as the pair at the inner edge will take considerably more than half. It is much better to bring the outstanding legs together over the center of bearing and proportion the bearing plate for concentrated loading. Fig. 5 shows such a detail.

16. It often happens that the shop in endeavoring to secure an exact bearing at both ends of a stiffener fails at both ends. If bearing ends were marked on shop drawings (letters *B. E.* may be used, see Fig. 6) the shop would know which end should have an exact bearing and could work accordingly.

17. Laterals should preferably be connected to gusset plates, and should stop short of flange angles. If diagonals are connected to the flange angles, the unequal deflections at their ends will cause the rivets to work loose owing to the stiffness of the angle. The flexibility of the gusset plate avoids this. Details are also simpler.

18. Intermediate stiffeners for girders that are encased in concrete may without harm be cut at the edge of the fillet of the flange angle. Chamfering the stiffeners is thus avoided. Beveled cuts and refinements made for the sake of appearance, if not exposed to view in the structure after erection, should be avoided.

19. Fillers under stiffening angles and web splice plates on work not encased in concrete or not exposed to the weather need not fit tight against flanges. A clearance of ¼ in. may be allowed.

20. It is expensive and useless to camber plate girders.

Box Girders—When two web plates are used with a space between, the girder is called a box girder. Heller ("Stresses in Structures," 3d. Ed. 1916) defines a plate girder as a girder having a single-plate web, and a box girder as a girder having two or more webs. A more useful nomenclature would be single-webbed and double-webbed plate girders, but it is not likely that this change from present custom will find adoption.

Bridge girders of electric traveling cranes are usually of the box type. In addition to the moment from vertical loads an overturning moment is introduced from walkways on the sides of the girders. When the walkway consists of two or three planks supported by light brackets the overturning moment is small and except in very light cranes can safely be neglected. But when the walkway is entirely of steel and the motor and shaft are placed on the walk several feet from the center of the girder the overturning moment must be taken into account. Crane makers have no standard practice for making provision for this moment. The problem of determining torsion stresses in a box girder—a hollow rectangular prism with re-entrant angles—has not yet been solved.

The following, developed by the Chicago engineering office of the American Bridge Co., is recommended for adoption in specifications:

> The torsional moment in box girders shall be assumed to produce vertical shears in the web plates and horizontal shears in the cover plates. These shears are assumed to produce no bending in the members in which they act and are to be regarded as pure shears. The torsional moment shall be divided equally between the web plates and the covers, that is (Fig. 7), $S_1 b = S_2 h$, where S_1 and S_2 are the total shears in web plates and cover plates, respectively.
>
> Full-length diaphragms shall be placed at all points of applied eccentric loads to distribute the shears properly to the component parts of the girder. Sufficient diaphragms shall be used throughout to maintain the true form of the girder.
>
> The unit stress in the connection between the web plates and the covers, produced by the torsional moment alone, shall be taken as equal to $S_1/h = S_2/b$. This stress acts in a direction parallel to the axis of the girder.

It is better to avoid torsion than to make provision for it. This may be accomplished by means of a light lattice stiffening girder attached to the main girder by horizontal bracing. This outer girder, besides being designed to carry its share of the walkway, can also be designed to serve as a railing. The main girder can then be of the single-web type with the carriage rail placed directly over the web plate.

Box girders are often used for short spans with heavy loads where the depth is limited and the shear excessive, as in foundations where columns are carried on cantilever girders, over assembly or ball rooms, in office buildings and hotels to carry the columns above, and over openings to carry walls.

Box girders are expensive to fabricate and clumsy to handle. Access cannot be had to their interiors for inspection or painting. Field connections to webs must be made by through bolts or by shorter bolts placed by way of handholes left in the web plates. Unless lateral stiffness is needed that can be provided in no other way there is nothing gained by their use. With 8-in. outstanding legs of angles, single-plate girders can be easily made 24 in. wide over cover plates. If this will not suffice, two single-plate girders tied together by diaphragms can be used.

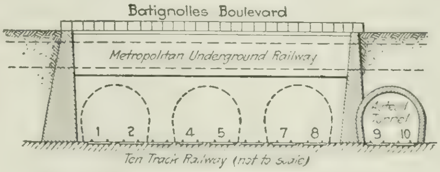
Harbor Works on the African Gold Coast

With a view to the better development of the Gold Coast Colony, important harbor construction work is being carried out at Takoradi, about five miles southwest of Secondee, on the Coomassie Railway, with which the new port is already linked up. On this coast, natural harbors of deep bays of any kind are very deficient, and hitherto steamers visiting the principal ports of Africa and Secondee have been compelled to lie some distance from the shore and make use of lighters and surf boats for trans-shipment to and from the land. The new port will obviate these unsatisfactory conditions by providing a large deep-water basin, sheltered by two breakwaters, together with quay space and storage accommodation, special arrangements being made for handling manganese ore, one of the most important exports of the country.

Open Cut to Replace Paris Tunnels

CONVERTING three of four parallel double-track tunnels into an eight-track open cut with masonry retaining walls is a difficult undertaking now being carried out at Paris to improve the approach to the St. Lazare terminal of the French State Railways.

A short distance from the station the twenty-seven platform tracks converge into an eight-track approach on which are the four parallel double-track Batignolles tunnels, about 1,000 ft. in length. Two tracks are for main-line trains, two for those of the Auteuil line and four for the trains of the extensive suburban system. Besides 430 suburban trains each way daily there are numerous light movements, since the locomotive facilities and coach yards are beyond the tunnels. The Auteuil tunnel is to be retained.


Batignolles Boulevard
Metropolitan Underground Railway
Auteuil Tunnel
1
2
4
5
7
8
9
10
Ten Track Railway (not to scale)

BATIGNOLLES CUT AT PARIS

For the removal of the tunnels a novel method has been adopted. Each tunnel will be given a heavy lining of reinforced concrete in sections of convenient length. This will enable practically all the earth above them to be excavated without fear of collapse. Then the old masonry will be removed and finally the sections of new lining will be picked up by powerful cranes or derricks.

Since these tunnels pass through a busy city district there were numerous difficult problems in providing for safe and uninterrupted operation of heavy railway traffic and for the protection of streets and buildings. On the surface, each side of the railway is paralleled by a street and in the length of the tunnels there are three transverse streets. Massive retaining walls along the sides of the cut and built-in trenches in advance of the main excavation will support the longitudinal streets. One of these walls will be directly over the side wall of the Auteuil tunnel and will be bonded to it by dowel rods. The finished cut will be 100 ft. wide.

Batignolles Boulevard, which crosses the railway, must be kept open to traffic and here the construction of a double-deck bridge is required since the open cut will intersect a rapid-transit subway of the Metropolitan Ry. crossing above the present tunnels. This bridge will have on the lower deck a double-track electric railway and a number of water and gas mains, electric conduits and cables and a large sewer. On the upper deck will be a broad central parkway, two roadways, a double-track electric railway of the conduit type, and two sidewalks on brackets. Two other bridges will be built later, the streets being closed temporarily.

Clearing the ground over the tunnels was commenced late in 1921, but the work will not be completed until 1925. The estimated cost is about $3,000,000. To still further increase the traffic capacity of the six future suburban tracks all suburban lines are to be electrified, involving about 60 miles of line. It is said that with 8-car trains at 2½-minute intervals the capacity will be 40,000 passengers per hour.

Taxing Gasoline for Highway Improvement

Tax Rates and Taxable Products—Methods and Cost of Collection—Exemptions and Refunds—Penalties and Recovery—Distribution of Fund

Editorial Review

FUELS for motor vehicles are taxed in 33 states to provide funds to be used wholly or in part for highway improvement. During the past winter, the taxation of gasoline was considered in 10 states besides the 16 which have enacted tax laws. In five states having laws prior to 1923 the rate of taxation has been increased. In only five states having no tax law was there no serious movement to enact any. No more conclusive evidence than these figures is needed to indicate that taxation of motor vehicle fuels is considered throughout the country sound procedure for creating funds for constructing and maintaining public roads.

> *Gasoline taxes are being more and more advocated as the proper and just method of allocating to those responsible the cost of road maintenance. An investigation has just been made by* Engineering News-Record *of the status of the gasoline tax in each state of the Union. The results as here presented for the first time bring together the facts about the gasoline tax.*

This extraordinary development of special tax legislation to finance public works invites consideration. In a number of states it gives evidence of having been hastily devised. Adequate advice appears not always to have been secured on the technical questions involved. In some states there seems to have been a deliberate attempt to divert authority from, and to deny the participation of, the state highway department. Lack of co-ordination with existing authority and road development policies is evident. In brief, gasoline tax legislation exhibits the usual idiosyncrasies of law-making by unadvised laymen on engineering administration questions. With a third of the 48 states yet to enact laws and with the certainty in mind that amendment will come up for action in many states, analysis, and a summation of the findings, of gasoline tax legislation is required.

Amount and Rate—It is estimated by the Bureau of Public Roads that a tax of 1c. a gallon on gasoline, as of present consumption, would produce about $40,000,000 annually. This is nearly two-thirds as much as the average annual Federal aid for 1923, 1924 and 1925. Observe that this income assumes no increase in the gasoline consumption of 1922. In 1922 the 17 states named in Table I, which imposed a gasoline tax, collected nearly $12,000,000. In these figures is had the reason for the favor which gasoline tax legislation has gained with legislators. There is no easier additional way of raising large yearly sums of money for road improvement without a general-tax increase and few lawmakers are flirting with the political hazards that this involves.

Tax rates, considering bills introduced and enacted, are 1c. in 19 states, 2c. in 18 states and over 2c. in 5 states. No state has in force or has proposed a rate exceeding 3c. The respective state' rates are given in Table II. Examining these rates in connection with the date of legislation, a clear indication is had of a tendency to increase rates. As previously pointed out, five states having laws prior to 1923 have amended them, or substituted new acts, increasing the rate. In a more general way, a count shows that the average rate in the laws of 1923 runs about one-third cent more than in laws of preceding years. A weighted average would show a greater increase. There is altogether convincing evidence that the gas tax rate is mounting. The average for all states is now more nearly 1½c. than the 1c. used by the Bureau of Public Roads in the estimate previously quoted. It is significant too that of all changes in gas tax laws all but one were changes in rates and always the rates were increased: Arkansas from 1c. to 3c.; New Mexico from 1c. to 2c.; North Carolina from 1c. to 3c.; Oregon from 2c. to 3c.; and Washington from 1c. to 3c. The conclusion is warranted that:

1. Rates will increase and not decrease as gasoline tax legislation is extended.

Taxable and Exempt Products—Precise definition of the products subject to taxation and also those exempt is generally lacking in gasoline tax laws. In the law introduced in Kansas exemption is made of all liquids having a flash point of 110 deg. or above. In Mississippi and New Mexico taxable fuels are all not less than "46 deg. Tagliabues Baumé Test." In some states the law names gasoline and no other substance. In general, as indicated in Table III, the law specifies as taxable all liquids used for developing power in internal-combustion engines or for propelling motor vehicles. It appears clear that the intent of legislation is to tax all fuels, with certain stated exceptions, capable of being used to operate motor vehicles of the internal-combustion-engine type. Not all laws state this clearly.

TABLE I—AMOUNTS OF GASOLINE TAXES COLLECTED IN 1922 IN 17 STATES HAVING LAWS OPERATIVE THROUGHOUT THE YEAR

State	Rate	Amount	Reported Cost
Arizona.....	1c.	$157,000	$1,800
Arkansas	1c.	208,000	Practically none
Colorado	1c.	687,363	Cost nominal
Connecticut	1c.	734,000	Not stated
Georgia	1c.	739,188	No extra cost
Kentucky	1c.	447,550	$1,068
Louisiana	1c.	484,269	Not stated
Maryland	1c.	1,200,000	Practically no cost
Mississippi	1c.	400,000	One extra clerk, $1,500
Montana	2c.	250,000	Negligible cost
New Mexico	1c.	130,000	Practically no cost
North Carolina	1c.	780,000	Practically no cost
Oregon	2c.	1,200,000	$5,000
Pennsylvania	1c.	2,389,211	$50,000 March 1, 1919 to Dec. 31, 1922
South Carolina	2c.	900,000	Not stated
South Dakota	2c.	330,000	Negligible cost
Washington	1c.	950,000	$5,000
		11,885,031	

Exemptions are stated in two ways: (1) Certain substances, as kerosene, are exempted by definition; (2) substances for certain uses, as farm tractors or fire engines, are excepted. Of the 29 states listed in Table III, 21 except from taxation certain fuels or fuels used for certain purposes. Kerosene oil alone is exempt in 14 states.

TABLE II—RATES, COLLECTION AND DISTRIBUTION OF GASOLINE TAXES IN FORCE AND PROPOSED

State	Date	Rate Cents	Payor	Payable	Distribution
Alabama....	E. 1923	2	Wholesaler	Monthly	G 50%, Co 50%
Arizona.....	E. 1921	1	Wholesaler	Monthly	St 100%
Arkansas....	E. 1923	3 (*a*)	Wholesaler	Monthly	St 25%, Co 75%
California...	I. 1923	2	Wholesaler	Quarterly	St 50%, Co 50%, (*b*)
Colorado....	E. 1919	1	Wholesaler	Monthly	St. 50%; Co. 50%
Connecticut.	E. 1921	1	Wholesaler	Monthly	St 100% (*c*)
Delaware....	E. 1923	2 (*d*)	Wholesaler	Monthly	St 100%
Florida	E. 1923	1	Wholesaler	Monthly	....
Georgia	E. 1921	1	Wholesaler	Quarterly	St. 100%
Idaho	E. 1923	2	Wholesaler	Monthly	St 100%
Illinois (*e*)...					
Indiana.....	E. 1923	2			
Iowa	I. 1923	2	Wholesaler	Monthly	St 50%, Co 50%
Kansas	I 1923	1	Wholesaler	Monthly	St 100%, (*i*)
Kentucky...	E. 1920	1	Wholesaler	Monthly	St 100%
Louisiana	E. 1921	1	Wholesaler	Monthly	St 100%
Maine	E. 1923	1	Wholesaler	Monthly	St 50%, Co 50% (*g*)
Maryland...	E. 1922	2	Wholesaler	Monthly	St 100%
Massachusetts...	I. 1923	2	Wholesaler	Monthly	G 100%
Michigan....	I. 1923	2	Wholesaler	Monthly	St 100%, (*h*)
Minnesota.. (*l*)					
Mississippi..	E. 1922	1	Wholesaler	Monthly	St 40%, Co 60%
Missouri (*f*)	I. 1923				
Montana	E. 1923	2	Wholesaler	Monthly	St 40%, Co 40%, G 20% (*k*)
Nebraska (*j*)					
Nevada	E. 1923	2	Wholesaler	Monthly	St $60,000, Co remainder
New Hampshire	I. 1923	1	Wholesaler	Monthly	G 100%
New Jersey..	I. 1923	1	Wholesaler	Monthly	St 20%, Co 80%
New Mexico	E. 1921	1 (*m*)	Wholesaler	Monthly	St 100%
New York (*n*)					
No. Carolina	E. 1921	3 (*o*)	Wholesaler	Monthly	St 100%
No. Dakota.	E. 1923	1	Wholesaler	Monthly	G 100%
Ohio	I 1923	2	Wholesaler	Monthly	(*p*)
Oklahoma	E. 1923	1	Wholesaler	Monthly	St 100%, (*q*)
Oregon	E. 1919	3 (*r*)	Wholesaler	Monthly	St 100%
Pennsylvania	E. 1921	1	Retailer	Monthly	St 50%, Co 5%
Rhode Island (*s*)					
So. Carolina.	E. 1921	2			St. 50%; Co. 50%
So. Dakota..	E 1923	2	Wholesaler	Monthly	G. 100%
Tennessee...	E. 1923	2	Wholesaler	Monthly	St. 100%
Texas...	E 1923	1	Wholesaler	Monthly	St. 75%; Schools 25%
Utah.......	E 1923	2½	Wholesaler	Monthly	St 100%, (*t*)
Vermont....	E. 1923	1	Wholesaler	Monthly	St 100%, (*u*)
Virginia.	E. 1923	3			
Washington	E 1921	2 (*v*)	Wholesaler	Monthly	St. 100%
West Virginia	E. 1923	2	Wholesaler	Monthly	St 100%
Wisconsin	I 1923	2	Wholesaler	Monthly	St 100%
Wyoming	E. 1923	1	Wholesaler	Monthly	St 100%

E., Enacted; I., Introduced; G., General state fund; St., State road fund; Co., County road fund.

Notes: (*a*) Original law of 1921 establishing 1c. tax repealed by present act. (*b*) State percentage for maintenance only. (*c*) Amendment in 1923 allotted tax specifically to road fund. (*d*) 1c. first year and 2c. thereafter. (*e*) No bill introduced and "no such bill contemplated." (*f*) Collected by county and credited to state-aid road fund. (*g*) State's percentage allotted to maintenance. (*h*) Pay interest on road bonds and remainder to road fund. (*i*) Constitutional amendment required. (*j*) Bill introduced but reported unfavorably by committee and allowed to die. (*k*) County percentage for maintenance only. (*l*) No tax bill introduced. (*m*) Amendment 1923 increased tax to 2c. (*n*) No bill introduced. (*o*) Amendment in 1923 raised rate from 1c. (*p*) The conflict on this provision prevented legislation. (*q*) To be distributed as state-aid [illegible]. (*r*) Act of 1919, still in force, calls for 1c. tax. Act of 1921, calling for 1c. tax amended in 1923 to call for 2c. Both acts give combined tax of 3c. (*s*) Little sentiment for and no bill introduced. (*t*) Allotted to interest on road bonds and to maintenance. (*u*) Allotted to laying dust and resurfacing roads. (*v*) Raised from 1c. by amendment in 1923.

Conclusions from the information assembled are:

1. Definition of taxable fuels requires study to determine some basis of scientific precision.

2. Distinction, in imposing taxes, between use for motor vehicles and for other purposes is common practice and sound legislative policy.

Tax Collection—Collection in most states is from the wholesale distributor. A number of laws require reports and collect from all dealers, wholesale and retail, with the proviso that the tax shall not be collected twice. A few states require the retail dealer to pay the tax. States with the longest experience favor collection from the wholesale dealer and generally the gasoline trade prefers to pay the tax through the larger distributors. In some states where collection is from either wholesale or retail dealer, the wholesale dealers have voluntarily assumed payment and deliver to the retail dealer, or to consumers in quantity, tax-paid gasoline. There are asserted to be these advantages in collecting from the wholesaler: (1) There are fewer accounts to be

TABLE III—DEFINITION OF TAXABLE MOTOR CAR FUELS SUBJECT TO TAX AND EXEMPT FROM TAXATION

State	Taxable	Exempt
Alabama...	Gasoline, naphtha and other liquid motor fuels commonly used in internal combustion engines.	Kerosene oil, distillates, gas oil, fuel oil and crude oil.
Arkansas	Gasoline. Law names no other product and defines gasoline no further than by name.	No exemptions are mentioned; inference is, all fuels except "gasoline" are exempt.
California	Motor vehicle fuel; any volatile liquid which may be used in operating motor vehicles.	Kerosene specifically excepted from other "motor vehicle fuels."
Colorado	Any product of, or containing, petroleum used for power to propel motor vehicles.	Distillate, crude petroleum, residium, gas or smudge oil.
Connecticut	Gasoline, benzol or other products for propelling motor vehicles over highways	Road rollers, fire apparatus, ambulances, agricultural tractors and vehicles running only on rails.
Delaware	Motor vehicle fuels; all volatile liquids used for propelling motor vehicles.	Kerosene oil specifically exempted.
Georgia	Gasoline, benzol, naphtha and other fuels commonly used in internal combustion engines.	Kerosene oil.
Idaho	Any product containing petroleum used for power to propel motor vehicles.	Kerosene, crude petroleum, residium, gas or smudge oil.
Kansas	Gasoline and volatile liquid fuels commonly used for operating internal combustion engines.	Kerosene, distillate and other liquid fuels having a flash point of 110 deg. F. or above.
Kentucky	Gasoline (no other fuel named)	No exemptions named; by inference other than "gasoline"
Maine	Gasoline, benzine and other motor vehicle fuels	Motor boats, agricultural tractors, vehicles running on rails and federal or state owned
Maryland	Motor vehicle fuels; all volatile and inflammable liquids for propelling motor cars	Kerosene oil
Massachusetts	Gasoline and other products in propelling motor vehicles	None indicated
Michigan.	Gasoline, distillate, benzine and other liquids for generating power and heat	Kerosene oil
Mississippi	Gasoline any volatile substance of not less than 46° Tagliabue's Baume Test	None indicated
Montana	Gasoline and distillate	None indicated
Nevada	Gasoline and other volatile and inflammable liquids for propelling motor vehicles	Kerosene oil
New Hampshire.	Gasoline, benzol or other products to be used in combustion type engines	Kerosene oil
New Jersey	Gasoline used for motor vehicles on public roads.	Gasoline for agricultural or manufacturing purposes
New Mexico	Gasoline; volatile substances not less than 46 deg. Tagliabue Baume Test	None indicated
North Carolina .	Gasoline, benzine, naphtha, liberty oil and all others for operating motor vehicles	Kerosene oil
North Dakota	Gasoline	None indicated
Ohio	Gasoline and all other motor vehicle fuels	Kerosene oil
Oregon	Gasoline and all other motor fuels, as distillate, benzine, naphtha and liberty oil	Kerosene oil
Pennsylvania...	[illegible]	None indicated
Rhode Island	[illegible]	None indicated
[illegible]	[illegible]	[illegible]
Washington	[illegible]	[illegible]
Wisconsin	[illegible]	[illegible]

posted and kept balanced; (2) the credit and stability of the wholesale dealer is more certain; (3) the existence of the tax is not made so evident as when the retail dealer adds it to the individual bills of the consumers and, so, there are fewer complaints to handle and less opposition to counteract.

Cost of collection is an uncertain item. The tax is payable monthly in most states and quarterly in a few. Each payment period the dealer reports his sales, generally on blanks furnished by the state collector, and then, or within a stipulated time thereafter, sends his check for the amount of the tax. Generally the state treasurer, comptroller, auditor, tax commissioner or other official authorized to receive the tax requires, to handle the returns, no additional collection machinery other than another clerk or two. It is this fact which accounts for the reports in Table I of "nominal" or "negligible" cost. Obviously there is always some extra cost but it is easy to see how it may be very small. Even in Pennsylvania, where there is a special state bureau for collecting the tax from retail dealers, the cost is only a fraction of one per cent of the amount collected.

From a review of the 43 laws proposed or enacted the conclusions are as follows:

1. Practice and experience favor the collection of gasoline taxes from the wholesale distributors and not from retail dealers.
2. Monthly reports of sales and payment of taxes are required in all but two of the 43 states reporting.
3. Practice favors the collection of the tax by existing state officials, in which event experience shows that the cost of collection is an insignificant percentage of the amount collected.

Tax Distribution—The general idea of a gasoline tax is to provide funds for road improvement. Of the 39 states in which the plan of distribution is known, the tax money goes wholly into the general fund in four states, and partly into this fund in two others. In 21 states all of the money is credited to the state road fund. In 12 states a part of the money goes to the counties for road improvement in the proportions shown by Table II. Use of funds by county or state is stipulated in a few states, notably in the following: California and Maine state percentage, and Montana county percentage, for maintenance; Utah for interest on road bonds and for maintenance, and Vermont for "laying dust and resurfacing."

1. Generally speaking tax distribution follows the distribution of authority over road improvement between county and state.
2. Commonly the use of the money for specific kinds of improvement, as maintenance, is not stipulated but the inclination toward this practice is shown more in recent legislation.

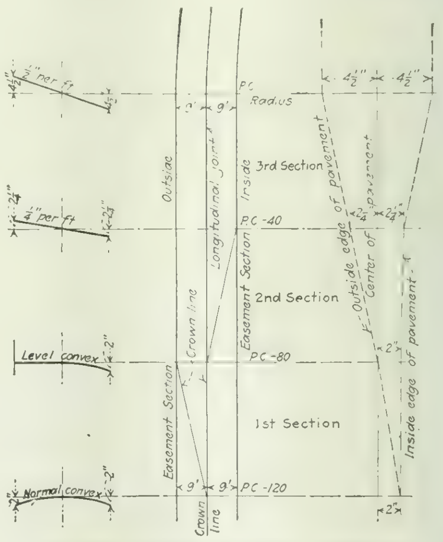
Opposition to Gasoline Tax—Active opposition to taxation of gasoline for improving public roads has been confined to the automobile associations and to the motor truck operators' organizations. Opposition from farmers, motor-boat users and manufacturers, where it has shown any great strength, has been eliminated by exemptions. In the case of the automobile and truck operators' associations, however, little disposition has been shown to concede anything. In a few cases perhaps these associations have this past winter prevented legislation from being enacted or approved.

Simple Method of Banking Curves on Concrete Roads

Transition from Convex Cross-Surface to One-Way Slope at P.C. Made in Three Sections—Extra Forms, Double Screeding Used

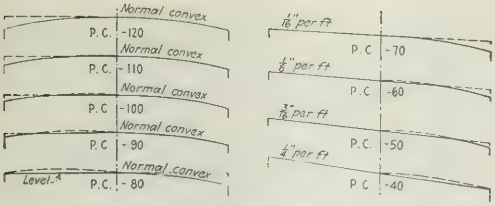
By Arthur H. Gardiner
Assistant Office Engineer,
Rhode Island State Board of Public Roads, Providence, R. I.

Curve superelevation on a concrete road, which on its tangents is designed for the ordinary convex cross-surface, is complicated by the necessity of providing a practicable method of effecting the transition from the convex surface to the one-way slope. Any method, to have real merit, must involve little hindrance to the progress of construction; must require as little as possible addition to the standard equipment, and must achieve a result that is graceful, symmetrical and correct from the standpoint of traction. From descriptions of various methods of constructing the type of a banked curve discussed, the writer is of the opinion that each of them fails to meet some or all of these requirements. They are either dependent upon a cumbersome system of false forms, troublesome to set and to maintain; they involve intricate calculation, or they result in too sudden changes of surface. From a study of these methods and of the requirements, the following plan is suggested as expedient.



CONVEX SURFACE CHANGES TO ONE-WAY SLOPE ON APPROACH

The suggested plan in general provides for the use of temporary auxiliary guides, or forms, superimposed upon the standard forms and employed, on alternate sides, through two successive sections 40 ft. in length. Regardless of rate of cross-fall of the pavement at the curve and regardless of the details of the standard section employed upon tangents, but conditional only upon a uniform rate of approach to the curves, a single set of auxiliary forms, 40 ft. in length, will provide all of the special equipment necessary to do the work for any number, or slope, of curves. The method is designed



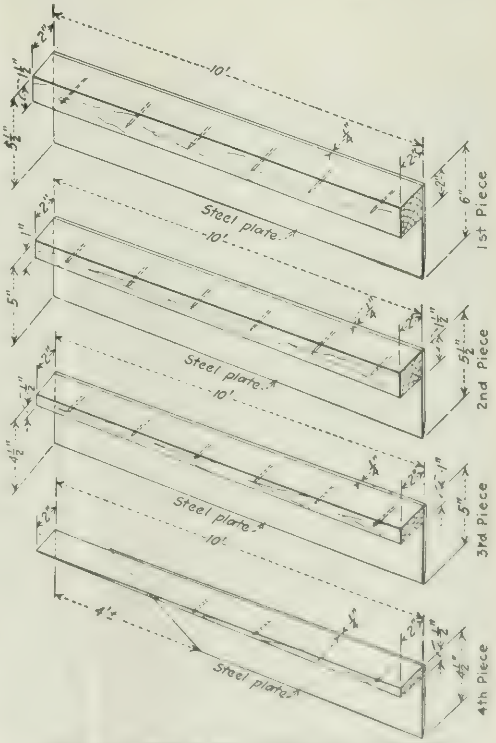
APPROACH SECTIONS AND PROFILES

especially for half-width construction, but it may be employed for full-width construction by inserting a temporary plate longitudinally in the center of the pavement.

In order to demonstrate, let us assume, Fig. 1, that we have to apply this method to the securing of a one-way slope of ½ in. per foot of width from P.C. to P.T. of a road 18 ft. wide, which, on its tangents, has a standard cross-section that is a convex parabolic curve whose crown is 2 in. higher than its sides. The approach to the curve only will be considered, the departure from the curve being, of course, inversely the same. It is assumed that in the development of the transition from the standard cross-section to the one-way slope desired, the *rate* of cross-fall, or pitch, shall not change more rapidly than ¼ in. per foot in a distance of less than 40 ft. in length. It is further assumed that the entire transition from convex to one-way slope shall take place before the curve is reached. Hence, in passing from a cross-fall of 2 in. on the standard cross-section to a one-way slope of ½ in. per foot at the P.C., this method assumes that three sections, each 40 ft. long, will be advisable, the first section extending between points 120 ft. and 80 ft. back of the P.C., the second section extending between points 80 ft. and 40 ft. back of the P.C. and the third section extending from a point 40 ft. back of the P.C. to the P.C. If, however, the curve were to be banked to a ¾ in. per ft. slope, it would be advisable to begin the process 40 ft. further back or at a point 160 ft. back of the P.C.

In the first section the road will be eased on the *outside* half, Fig. 2, from the convex curve to a level plane, the inside half remaining standard and convex. In the second section the outside half will tilt up gradually from the level plane to an upward slope of ¼ in. per ft. and the *inside* half will be eased from its convex to a downward slope of ¼ in. per ft., thus bringing the full width of the road to a continuous one-way slope at the end of that section. In the third section the entire road, now in one plane, will rotate on the center from the ¼ in. per ft. slope to a ½ in. per ft. slope at the P.C. Hence it appears that the two side forms should be set to grades which, at the beginning of the first section (P.C.—120) will be 2 in. below the center on both outside and inside, at the beginning of the second section (P.C.—90) will be level with the center on the outside and 2 in. below the center on the inside, at the beginning of the third section (P.C.—40) will be 2¼ in. above the center on the outside and 2¼ in. below the center on the inside and at the P.C. will be 4½ in. above the center on the outside and 4½ in. below the center on the inside, these figures being of course based on the 18-ft. width assumed.

The transition from convex to plane is effected in the following manner: The outside half of the first section is first screeded in the usual manner. Immediately afterward there is placed on top of the standard outside form, a temporary auxiliary form or guide, Fig. 3, of wood or steel or both, tapering from 2 in. above the standard form at its beginning, to nothing at the end of the section nearest the P.C. It will be noted from the preceding data and the accompanying sketches that the auxiliary form is laid to a grade level with the center form for the entire length of the section. After the auxiliary form has been secured to the standard form, by clamps or other fastenings, the section is screeded a second time, this time with a straight-edge resting on the center form and the auxiliary side form, after which the auxiliary form is removed. This double screeding, first with the convex template resting upon the standard forms, and then with a straight-edge, resting on the auxiliary form, functions to give the pavement a cross-section on the outside half with a level crown, always tangent to the convex surface of the inside half, and gradually widening from the center towards the outside until it has merged into a level plane for one-half of the width of the pavement at the end of the section.



AUXILIARY FORMS FOR SCREEDING APPROACH

On the inside half of the second section the process is repeated exactly as before, using the same temporary auxiliary form. The result here is gradually to extend the plane, already attained on the outside, across the inside half of the pavement until it has reached the full width at the end of this section. The transition is then complete. This method, while explained with reference to an 18-ft. road and a slope of ½ in. per ft. at the P.C., will be found adaptable to any desired width or slope.

Second Water Purification Plant for Dallas, Texas

Aerator Adjunct to 15 M.G.D. Filter Plant for Removal of Tastes and Odors From White Rock Reservoir Supply

A 700-FT. mixer channel, an 8-step cascade aerator, a perforated-pipe underdrain system and an accessible pipe gallery are features of the new White Rock water purification plant for Dallas, Texas, put into operation in March.

The city has three sources of supply, artesian wells (see *Engineering News-Record*, Jan. 31, 1918, p. 210), the Elm Fork of the Trinity River, which is filtered, and the White Rock reservoir water, which from now on will pass through the new plant. The White Rock impounding reservoir stores 5,700,000,000 gal. of water from a watershed of 114 sq.mi. back of a dam on White Rock Creek at a point about 6 mi. from the city. For several years after the construction of the dam, eleven years ago, fishing, boating and bathing were prohibited and the watershed was protected by policing. But in 1916 an ordinance was passed permitting hunting, fishing and boating but prohibited bathing. In 1920 David Morey, Jr., after making a preliminary investigation and report on the purification of the reservoir water, recommended aeration, sedimentation and filtration through rapid sand filters and chlorination of the effluent. White Rock water is usually low in turbidity or suspended solids, has some color and could be classified as a moderately soft water although provisions have been made in the plant for softening.

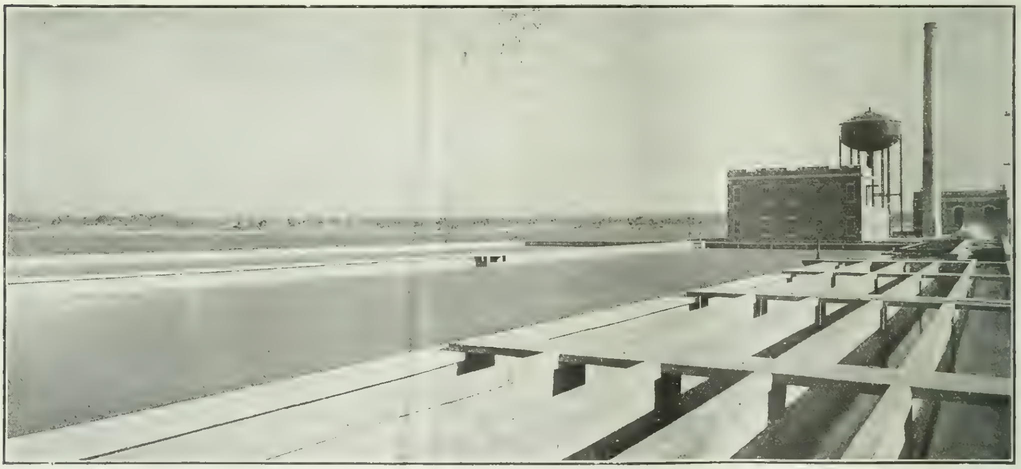


FIG. 1—GENERAL VIEW OF WHITE ROCK WATER PURIFICATION PLANT, DALLAS, TEX.

Five-compartment mixing channels giving 700 ft. travel. At left are settling basins. The filter house is in front of shallow wash-water tank. Chimney and pumping station behind it were built in 1911.

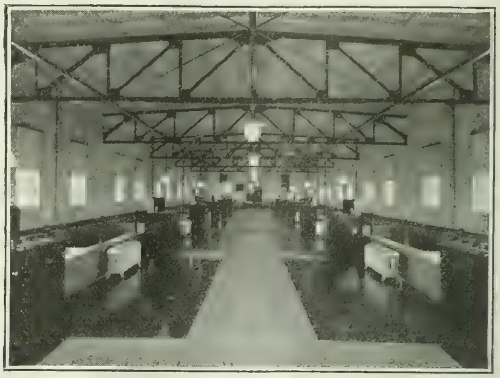


FIG. 2—FILTER OPERATING ROOM WITH PLASTERED WALLS AND GYPSUM ROOF

Owing to the fact that White Rock under certain conditions might be called upon to supply the entire city, it was deemed advisable to construct a plant with a capacity of 15 m.g.d. which at a later date could be extended to 20 m.g.d. at a small additional expense. In brief, the plant comprises a low-lift pumping station, an aerator, a mixing channel, two sedimentation basins, one secondary coagulant basin, twelve rapid filters, a filtered-water reservoir and a wash-water tank. The plant complete cost $420,000. Water is pumped from the lake by two turbine-driven centrifugal pumps with water-works type condensers, one having a capacity of 10 m.g.d. and the other having a capacity of 6 m.g.d. From the low-lift pumps the water goes first to the aerator through a 30-in. line in which is installed a Venturi meter tube connected to a registering-indicating-recording instrument located in the pump station.

Aeration—The aerator is a reinforced-concrete structure 90-ft. long, 14 ft. wide and 7 ft. deep, into which the water is discharged through thirty-five 6-in. pipes from which the water falls over eight steps, 86 ft. long. These steps are so arranged that when the water falls over them a cascade is produced. The function of the aerator is to remove the taste and odor. At times the growth of algae is such that it may be necessary to treat a portion of the water in the lake with copper sulphate. From the aerator the water flows through a channel where the first dose of chemicals is applied. Lime and iron are added through dry-feed machines located in the head house.

The Mixing Channel—The water is next received in the mixing channel, which is a reinforced-concrete structure, 141 ft. long and 21 ft. wide, divided into five compartments. This mixing channel is of the around-the-end type, so arranged that the velocity can be increased or decreased by lowering or raising the depth of water in the channel or by placing stop planks at different points. The depth of water can be regulated by a 42 x 42-in. sluice gate at the outlet of the channel. This gate also regulates the length of time in the mixing channel. The total travel through the mixing channel is 700 feet.

Sedimentation—The two sedimentation basins are each 300 ft. long by 75 ft. wide and under normal operation the depth of water in each basin will be approximately 16 ft. This depth will give an operating capacity of 2,700,000 gal. for each basin. There are no baffles in the basins, but the water in entering the basins is delivered over a weir, in front of which is a curtain wall, extending within 6 ft. of the bottom. The water is drawn off at the opposite end over a weir. It is estimated that practically all of the suspended solids, both from the softening process and from the use of coagulant, will settle out before the water leaves the basin. In consequence provisions have been made for a second dose of coagulant, if required, as the water leaves the basin. In each basin is an 18-in. drain pipe for removing the sludge that accumulates.

The Reaction or Secondary Coagulation Basin—This basin is 74½ ft. long by 24 ft. wide and when operated under normal conditions will contain about 13 ft. of water. Its function is to permit time for the second dose of coagulant, probably alum, to react. The water is then conveyed through a 42-in. lock-bar steel pipe to the filters.

Rapid Sand Filters—The twelve rapid sand filters are designed to operate at the rate of 2 gal. per square foot of filter area per minute. Each filter is a reinforced-concrete box, 17 ft. wide by 28 ft. long and 11 ft. deep, having an effective sand area of 442 sq.ft. Thus when operating at a normal rate each filter will produce approximately 1.25 m.g.d. or a total of 15 m.g.d. for the entire plant. In view of the water to be handled, it is believed that the plant will stand a 20 per cent overload without greatly decreasing the efficiency. The filter material consists of 18 in. of gravel overlaid by 2½ ft. of sand.

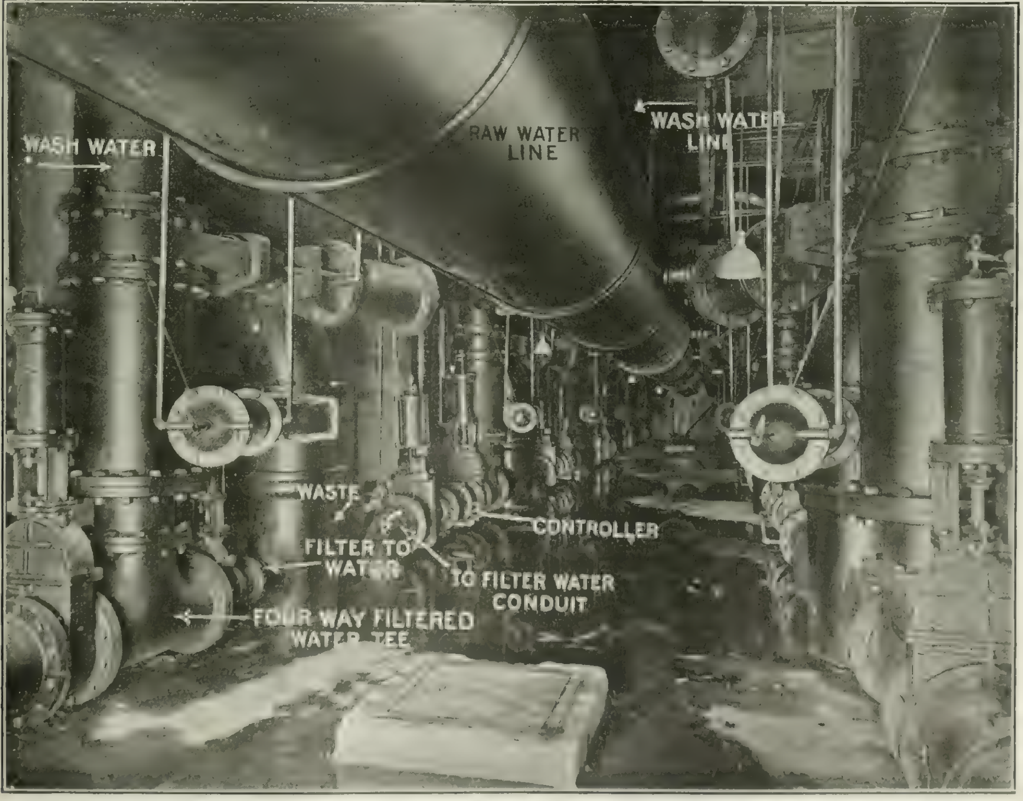


FIG. 3—ACCESSIBLE PIPE GALLERY WITH 6½-FT. HEAD ROOM

Above the 42-in. steel raw-water line [illegible] wash-water pipe. In the wash-water line [illegible] Venturi meter tube. Below the floor is a 24-in. sewer and [illegible] filtered water conduit.

The Underdrain System—This consists of an 18-in. cast-iron pipe manifold, into the top of which are tapped

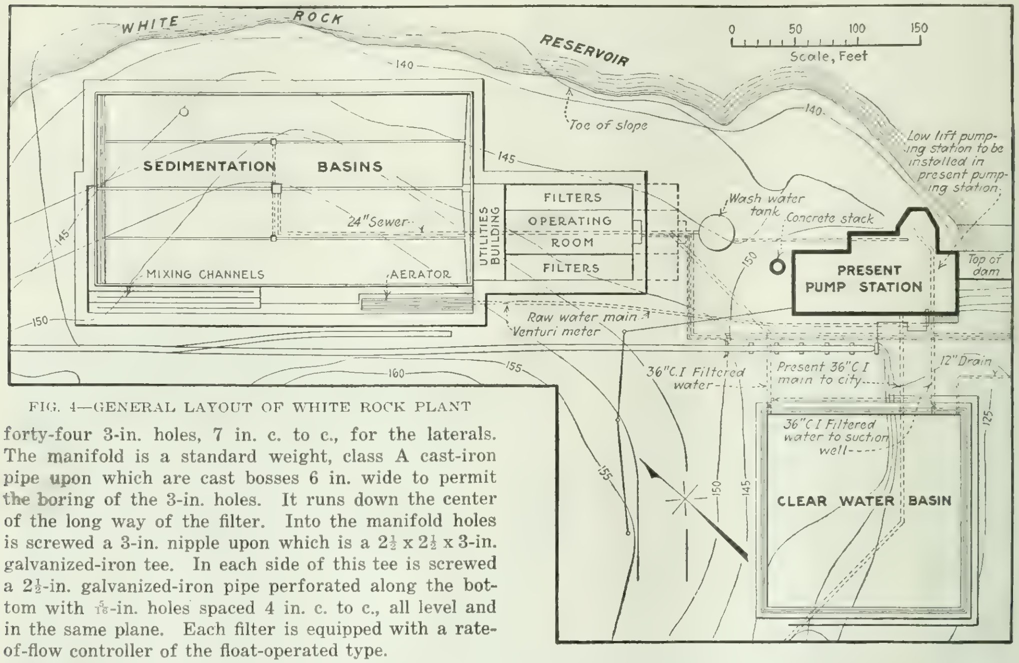


FIG. 4—GENERAL LAYOUT OF WHITE ROCK PLANT

forty-four 3-in. holes, 7 in. c. to c., for the laterals. The manifold is a standard weight, class A cast-iron pipe upon which are cast bosses 6 in. wide to permit the boring of the 3-in. holes. It runs down the center of the long way of the filter. Into the manifold holes is screwed a 3-in. nipple upon which is a $2\frac{1}{2}$ x $2\frac{1}{2}$ x 3-in. galvanized-iron tee. In each side of this tee is screwed a $2\frac{1}{2}$-in. galvanized-iron pipe perforated along the bottom with $\frac{5}{16}$-in. holes spaced 4 in. c. to c., all level and in the same plane. Each filter is equipped with a rate-of-flow controller of the float-operated type.

Pipe Gallery—In the pipe gallery the 24-in. wash-water line is above the 42-in. raw-water line and below the pipe-gallery floor is a 24-in. sewer and a reinforced-concrete filtered-water 4 x $2\frac{1}{2}$-ft. conduit. All pipes and valves in the gallery are arranged so that they are easily accessible and give a headroom of $6\frac{1}{2}$ ft. down the center. In the wash-water line is a 24 x 10-in. Venturi meter tube, the instrument for which is installed in the operating room. In addition to the regular indicating-recording instrument a special indicator dial 30 in. in diameter, graduated in gallons per minute, is visible from all parts of the operating room. The object of this dial is to let the operator know at all times the amount of water he is using in washing.

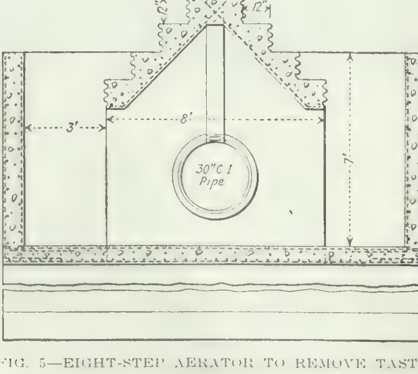


FIG. 5—EIGHT-STEP AERATOR TO REMOVE TASTES AND ODOR

The Utility Building—Over the reaction basin is a two-story structure, the first floor of which contains an office, refrigerating plant, a laboratory for chemical and bacteriological examination of water, a locker room, a store room and the chemical feed machines. Located on the second floor are the chemical store room, shower baths and toilet room.

A steel wash-water tank, 60 ft. from the base of the tower to the bottom of the tank, is 8 ft. deep and has a capacity of 80,000 gal. A tank of this shallow depth was chosen in order to get the least range in head.

Filtered water is stored in a reinforced-concrete basin, 158 ft. wide, 160 ft. long and 16 ft. deep, providing storage for 3,000,000 gal. of water. In addition to the high-duty pumping equipment at White Rock, which consists of a triple-expansion 15-m.g.d. pump installed in 1911, a turbine-driven centrifugal pump with water-works type condenser has recently been installed. It has a capacity of 2,900 gal. a minute against a head of 160 feet.

Four separate contractors installed the new plant. The Hughes-O'Rourke Construction Co., Dallas, was the general contractor; John M. Didinger, Philadelphia, installed the filter piping and equipment; A. M. Lockett & Co., New Orleans, the pumping equipment; and the Pittsburgh-Des Moines Steel Co., Dallas, the wash-water tank. The plant was designed by David Morey, Jr., assisted by Lewis H. Johnson, E. F. Morey and R. B. Pearce. The designs were approved by Nicholas S. Hill, Jr., consulting engineer, of New York.

Wabash Ry. to Lease 70 Miles of M.-K.-T. Ry.

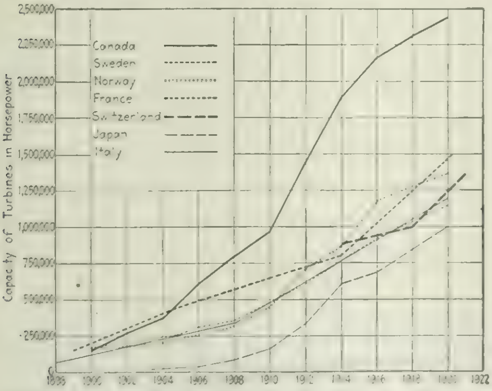
The Wabash Ry. Co. has applied to the Interstate Commerce Commission for authority to lease, with option to purchase, a portion of the Missouri-Kansas-Texas Ry. between Moberly and Hannibal, Mo., 70 miles long.

Twenty Years' Increase in the Use of Water Power

Rapid Increase in Turbine Installations Indicates a Total of Forty Million Horsepower by 1930

By Benjamin E. Jones
Hydraulic Engineer, United States Geological Survey, Washington, D. C.

The United States was a pioneer in the use of water power. In 1900 the capacity of turbines and waterwheels installed in power plants in this country amounted to more than 3,000,000 hp., while the combined capacity of water power plants in Italy, France, Switzerland, Norway, and Sweden was less than 1,000,000 hp. The capacity of the plants in Canada was then 150,000 hp. and in Japan practically no water power was used. These eight countries comprise all in which the capacity of water power plants in 1920 amounted to 1,000,000 hp. or more, except Germany, and Germany is in such a disorganized condition that accurate estimates for recent years are not available. In 1906 the capacity of water power plants in the United States amounted to 50 per cent of the capacity in 1920. Not until 1911 did Canada and the European countries named above reach 50 per cent of their capacity in 1920, and Japan not until 1913.

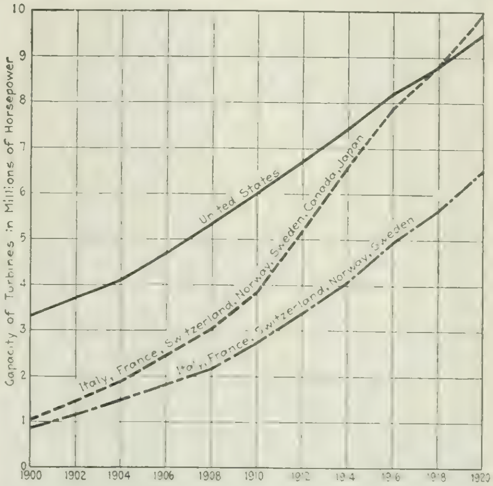


TURBINE CAPACITIES IN SEVEN COUNTRIES OUTSIDE OF THE UNITED STATES

During the 10-year period from 1900 to 1910 the capacity of new turbines and waterwheels installed in the United States amounted to 270,000 hp. a year—in other words, the increase in ten years was more than 80 per cent. In the five European countries named the rate of increase in turbine capacity during the same period amounted to 185,000 hp. a year, and the rate of increase for the seven countries, including these five with Japan and Canada, was 280,000 hp. a year.

The rate of growth in the United States in the next 10-year period, from 1910 to 1920, increased to 350,000 hp. a year, but, in the five European countries the rate increased more rapidly, reaching 380,000 hp. a year, or more than double the rate in the preceding decade. In Japan, Canada, and the five European countries the rate of growth from 1910 to 1920 was 610,000 hp. a year, an increase of 118 per cent over the 1900-1910 rate.

In the ten years from 1920 to 1930 the rate of growth in the United States will probably increase somewhat, owing to the operation of the federal water power act, which permits the use, under favorable conditions, of the water power resources on public lands and navigable streams. If the increase amounts to 100,000 hp. a year, the rate of growth will be 450,000 hp. a year, and in 1930 the United States will possess water power plants having a total turbine capacity of 14,000,000 hp.



TURBINE CAPACITIES IN THE UNITED STATES COMPARED WITH SEVEN OTHER COUNTRIES

In Europe, Canada, and Japan plants are being built even more rapidly than during 1910-1920, and as war conditions are gradually left behind the rate of growth will probably increase, as it already has in Canada, where plants with a capacity of 500,000 hp. were added in 1921 and 1922. If the rate of growth in each of the seven foreign countries here considered increases only 90,000 hp. a year, it will amount to 700,000 hp. a year, and in 1930 those countries will possess water power plants with a total turbine capacity of 17,000,000 hp.

In 1920 the eight countries here named possessed 78 per cent of the developed water power in the world. The capacities of plants in these countries in 1930, if the rate of increase is that estimated above, will be 31,000,000 hp., and if the rate of increase in other countries of the world is as great in proportion as in these eight, the total capacity of water power plants in the world in 1930 will be 40,000,000 hp.

The estimates of developed water power in Canada given in this article were supplied by the Dominion Water Power Branch, J. B. Challies, Director. Those for the United States and the other six countries were taken mostly from the World Atlas of Commercial Geology, Part II, Water Powers of the World, published by the United States Geological Survey, Department of the Interior.

Washington Adopts New Type Concrete Bridge

The Washington State Highway Commission has adopted a new type of concrete bridge, the "through" or "bowstring" bridge, in which the supporting arch is above the bridge floor, this type of bridge being particularly adapted to streams of small clearance between high water level and the highway grade, where it is impossible for the arch to be carried below the bridge floor.

Coal Mine Subsidence Damages Concrete Girder Bridge

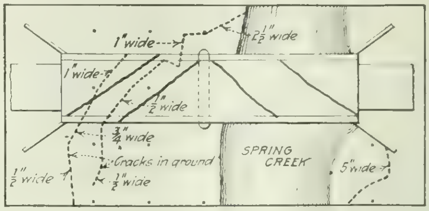
Collapse of Mine Roof 130 Ft. Below Causes Sinking of Pier and Abutment—Bridge Jacked Up to Grade

By G. F. Burch
Bridge Engineer, State Division of Highways, Springfield, Ill.

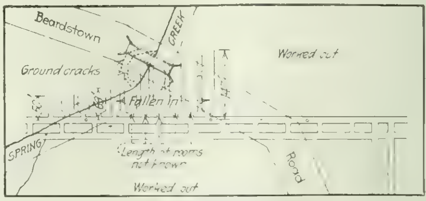
An unusual case of damage resulting from coal mine subsidence was observed recently in the partial failure of the Spring Creek bridge on the Beardstown road near Springfield, Ill. The bridge is a concrete through-girder structure consisting of two spans of 50 ft. each, with a clear roadway width of 20 ft. The pier and both abutments were founded on solid rock and the bridge was completed early in 1921.

Some time during the night of Jan. 11, 1923, the pier and east abutment sank some distance below grade. Elevations taken on Jan. 13 showed settlement as follows: Pier, north end, 8 in., south end, 16 in.; East abutment, north end, 9 in., south end, 15 in. Two diagonal cracks developed in the floor of each span. The cracks in the west span were the more pronounced and extended through the girders, due to the fact that the settlement of the pier was not uniform and the west abutment, apparently, did not undergo any settlement. The settlements of the pier and east abutment were nearly the same, producing only a very small warping effect, and consequently in the east span the diagonal cracks developed only in the floor slab and not in the girders. The east abutment was badly cracked at each corner but it continued to support the superstructure.

The banks of the stream adjacent to the bridge were examined closely and a number of large cracks in the ground were discovered. This led to the belief that the subsidence was caused by coal mining operations. A few days later an inspection was made of the coal mine operating in that vicinity and it was found that the roof in seven rooms, directly below the bridge, had collapsed on the night the bridge failure occurred. The mine at that point is about 130 ft. below the surface and the vein of coal is approximately 5 ft. thick. This is conclusive evidence that the bridge failure resulted from mining operations.



Cracks in Bridge and Ground Surface



Fall in Mine under Bridge

FIG. 1—SPRING CREEK BRIDGE AND MINE BELOW

Steps were taken immediately to prevent further damage and to raise the bridge to grade. By means of jacks applied to the underside of the superstructure, a cluster of piles was forced down to rock under the

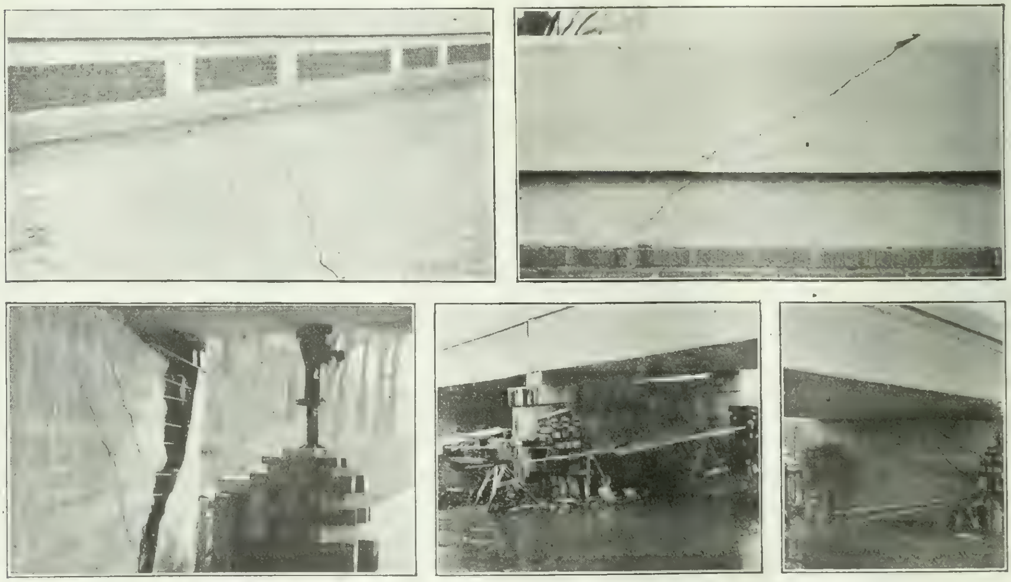


FIG. 2—DAMAGE TO BRIDGE AND RESTORATION BY JACKING

Upper Views: Crack in floor slab and south girder of west span, and near view of crack in coping. Lower Views: Rupture of east abutment, and jacking operations at pier and east abutment completed.

end of each girder. The piles were sawed off level and chained together, and a grillage of timbers was built upon each cluster of piles, to the proper elevation to receive the jacks. The jacks were applied and the superstructures were raised up to grade. This was a slow operation as each span weighs approximately 220 tons, and it was necessary to raise both spans at once to avoid interruption of traffic. After the spans were raised up to grade pillars of brick masonry were built upon the pier and east abutment to support the girders, and the jacks were released.

The bridge is being allowed to stand in this condition until such time as it appears that the settlement has ceased. At the present time further settlement is practically negligible and can hardly be detected with ordinary surveying instruments. When it appears safe to assume that there will be no further subsidence, more permanent repairs will be made on the east abutment, probably encasing it with concrete. The girders on the west span also will probably be repaired by replacing those portions of the coping (the main compressive area) damaged by the cracks.

Purification Plant for Oysters from Polluted Water

Oysters Cleanse Themselves in Basins of Sea Water Disinfected by Electrolytically-Produced Sodium Hypochlorite

THE successful establishment on a commercial basis of the process by which shellfish which may have been raised in polluted waters are rendered sanitary has been announced by the Conservation Commission of New York, working in co-operationg with the U. S. Bureau of Chemistry and the U. S. Public Health Service. This process has been developed by W. F. Wells, biologist and sanitarian of the commission, from experiments carried out in 1914-15 while with the Public Health Service. The plant has been built at Inwood (L. I.) N. Y., by Sprague & Doughty, the design and construction being supervised by Charles R. Bettes, chief engineer of the Queens County Water Company.

The general features of the plant are as follows: Two concrete basins, each 22 x 25 ft. in plan by 1½ ft. deep, with a capacity of 6,000 gal. each, are capable of handling 400 bushels of oysters in 24 hr. Salt water is obtained from a gravel-filled trench near the basin which removes all suspended organic matter. An electric-driven pump of 125 g.p.m. capacity delivers this water sterilized into the basins. Sterilization is effected by hypochlorite of sodium produced electrolytically from the sea water. A portion of the pumped water passes through an electrolytic cell (Electro Chemical Co.) and thence returns to the pump suction where it becomes mixed with the inflowing water. The strength of the sterilizing solution is controlled by regulating the amount of current entering the cell. An eleven-point switch on the rectifier makes this operation simple.

The details of the process are stated more specifically in the following extract from "Problems in Oyster Culture," printed in the 1922 report of the Conservation Commission's Bureau of Prevention of Stream Pollution:

> *Process.* The object of the process is to sterilize the outside of the oyster and to allow it, by natural processes, to free itself of such infected materials as may be in its shell or body cavities. These voided materials are then removed or sterilized. The edible portion of the oyster is not exposed to the action of any chemicals; the animal is merely allowed, in a perfectly natural manner, to wash itself clean in sterile water. The process is as follows:
>
> (1) Oysters of suitable cleanliness are placed in a clean empty basin. One bushel of oysters requires 25 gal. of tank capacity. Oysters must not be in layers over 8 in. in depth and must be so arranged that the water can freely circulate about them.
>
> (2) The basin is filled with water showing, by orthotolidin test, an excess of free chlorine. Amount of chlorine regulated by experience to meet the following requirement.
>
> (3) Sterilizing interval, during which there must be more than 0.2 p.p.m. of free chlorine in the water. Starting when basin is completely full, lasts for thirty minutes, or such longer period as may be necessary to reduce the free chlorine to less than 0.5 parts per million.

OYSTER PURIFICATION PLANT AT INWOOD, LONG ISLAND
Right-hand basin filled with oysters and sea water. Oysters in place in left-hand basin and sea water from settling basin being pumped in through hose. Pump and electrolytic cell in house at left.

> (4) Drinking interval starts at end of previous interval and lasts for at least six hours. During this interval the oysters are expected to be open and active.
>
> (5) Basin is drained.
>
> (6) Basin refilled with chlorinated water as in (2).
>
> (7) Sterilizing interval same as (3).
>
> (8) Drinking interval of not less than twelve hours.
>
> (9) Oysters removed, basin drained and cleaned.

The process is not difficult to carry out and the cost is so low as to make it commercially practicable. The current consumed in sterilization is a negligible factor.

Weather Forecasting at Sea Believed Practicable

After a study of forecasting weather at sea, made on the French training ship, *Jacques Cartier*, E. H. Bowie, chief forecaster of the Weather Bureau states that he is convinced that such forecasts are entirely practicable. Forecasting at sea is simpler than forecasting on land areas, because diversified topography does not have to be taken into consideration and cyclones and anticyclones move with more regularity on the sea. During the voyage to and from France, the *Jacques Cartier* received broadcasts of meteorological observations twice a day from Europe and America, and many vessels within range forwarded by radio their observations of the barometric pressure, temperature, wind, weather, and state of the ocean. From these observations weather charts were constructed twice each day and forecasts of wind, weather, and storms broadcasted.

Federal Valuation of Railroads and Its Results

An Outline of What Has Been Accomplished to Date And What Use Will Be Made of the Valuation Figures

By W. A. Van Hook
Consulting Engineer, Chicago

THE ENDEAVOR of the Federal government to inventory and to fix value upon all railroad property used in interstate commerce has reached the stage where within a year presumably the engineering, land and accounting reports will have been completed for all carriers. Final value has been determined in but one case, and this where the carrier made no protest. Hearings are being held at frequent intervals in cases upon value of other carriers. With the initial stage of field inventory completed, the second step of reports showing prices applied to quantities nearing completion, and the work passing from the stage where engineering activity predominated to one where legal activity is to the fore, it is time to look back over the engineering accomplishments and to look forward to the eventual outcome, both as to results in the sense of value of railroad property, and as to effects on railroad finance, rates, accounting, management and public relationship.

In considering the accomplishment to date and the future accomplishment of this engineering activity which has engaged the time of a large number of engineers for nearly a decade, it must be remembered that the dates of valuation of the individual railroads range from June 30, 1914, to June 30, 1919; that the prices applied to units of material and equipment and to structures are intended to be normal as of June 30, 1914, irrespective of the date of valuation; and that each carrier is required to prepare currently in uniform manner a record of additions and betterments to and retirements of physical property subsequent to its date of valuation.

Present Major Results—If no larger accomplishment has been made by this work, there have been certain results of undebatable value, due either directly or indirectly to the valuation activity. Briefly summarized, the major results are:

1. Map and profile records of railroad property as it exists have been created.
2. Up-to-date records of quantities of materials, of structures and of units of equipment have been compiled.
3. Engineering-accounting methods in recording costs and other facts pertaining to physical property have been installed.
4. An impetus has been given to cost analysis in construction and maintenance.
5. The tendency has become established to estimate prior to construction (and to record during construction) complete rather than incomplete costs.
6. A comprehensive knowledge of wear upon and life of property in railroad service has been developed.
7. Basic data necessary to determination and analysis of certain elements of operating expense are now available.
8. Property rights as between owners in complex situations have been defined.
9. There has been established a datum line as to quantities of materials, which may be modified at any time to give facts as of that time.
10. A corresponding datum line as to prices has been drawn, which may be modified readily to state prices of another time.

The Valuation Act of 1913 is responsible for the results so far attained. The Transportation Act of 1920 states how the results of the previous act shall be used, and in so doing brings new duties upon the engineer in railroad service. The act of 1920 requires the Interstate Commerce Commission to "determine and make public what percentage of such aggregate property value constitutes a fair return thereon"; and also requires that "in the exercise of its power to prescribe just and reasonable rates the Commission shall initiate, modify, establish or adjust such rates that carriers . . . will under honest, efficient and economical management and reasonable expenditures for maintenance of way, structures and equipment, earn an aggregate annual net railway operating income, equal as nearly as may be, to a fair return upon the aggregate value of the railway property of such carriers. . . . " In addition the 1920 act provided that for the two years beginning March 1, 1920, a return of 5½ per cent would be fair, with discretion given the Commission to increase this not over ½ per cent for certain specified purposes.

Future Use of Valuation—With the government's valuation machinery in operation for nearly ten years, and the purposes of the valuation defined, it is full time that the legal questions of valuation, the fairness of values as fixed at pre-war prices, the question of what prices and what values are now fair, and the question what constitutes a fair rate of return, be quickly determined.

The future use of railroad valuation has been clearly fixed by law. During the two years now gone by, fair return also was fixed by law, but that two-year period coincided with the time in which occurred the crucial part of business deflation following the war. The fixation of fair return at 5½ per cent for those two years may or may not be a legislative reflection of the very general desire that business, whether manufacturing, merchandising, transportation or what not, get down to earth again. Whatever the reason, and whether that figure be a fair return or not, there was little chance that carriers as a whole would earn any fair rate of return during that time.

The law requires the Commission to do certain things: to determine fair value and a fair return thereon, and to consider efficiency of railroad management in determination of rates which will produce fair return. Indirectly it imposes upon railroad managements the necessity to determine whether waste and inefficiency exist and to correct whatever of such faults are found. Maintenance-of-way and structures cost over one billion dollars in the year 1920. The engineer of maintenance must be prepared to make economical expenditures for maintenance, and to defend the value received for each dollar spent.

The Interstate Commerce Commission must fix fair value and fair return. The law is specific. If the values now being fixed as of given dates are not fair values as of that date, nor fair values as of the present time, there has not so far been recourse to our highest court. If the return is not fair, there will be full evidence of this when our country, once more fully prosperous, fails to invest in railroads upon the basis of the return as fixed.

We are not done with valuation; it has not reached the point of acid test. That point may not be reached until actual use of the value of an individual carrier's property is made. There are still some "Minnesota rate cases" to come, and such cases may be the best means of testing the contentions of carriers and Commission as to fairness. When such cases arise, there will be because of valuation more definite knowledge of facts and more conclusive determination, with rates established in a better way. This country will prosper; it must have better avenues of transportation. Fair wages, fair value of property used and fair return on value are a necessity.

Benefits From the Valuation—The full question of the benefit we will receive from railroad valuation is in the future. Fair value, fair return and greater efficiency in railroad management will come. Valuation will have had no small part in effecting those results. The members of the Interstate Commerce Commission are human; they are affected by political and business eddies and currents just as all of us are. In the end they must give adequate treatment to the questions of value and return, so that there may be more and better railroads for the 150,000,000 population of this country in 1950.

Further Problems—Valuation is the forerunner of other railroad problems which must be met. Rate structures must be established on more scientific lines; accounting methods must be bettered; cost of operation must be more definitely ascertained; division of revenue from through shipments over lines of more than one carrier must be based on analyzed costs to each carrier.

There must be once more an even flow of capital into railroad facilities, and this can only be when there is an incentive to thus invest. Railroad managements, moreover, must acquire an incentive to function at their greatest efficiency.

Sewage Effluent as Boiler Feed Water

Shortage of water supply from a well at a railway water station in a "bad-water" district of the Western States led to the suggestion of the use of effluent from a city septic-tank plant as feed-water for the locomotive boilers. It has been pointed out, however, by a railway water service engineer, that great caution would have to be exercised in the use of such water, since resulting damage to boilers might far exceed any saving in cost of water. It is found that many septic-tank effluents still contain organic matter, and boilers soon leak when decomposing organic matter is in the feed water. If the septic tank has done its work completely, the water would probably be safe for boiler use without further treatment, if the water is reasonably soft. But if the effluent consists of hard water, the process of softening with lime and soda ash should remove organic matter thoroughly. It was considered that such effluent might possibly be used as a last resort for boiler feed water, if always safeguarded by treatment with lime and soda ash. But if a town has water enough for a sewerage system, there will probably be enough for the railroad, and the cost of a well would be small as compared with the continual cost of boiler repairs and interrupted service due to the use of unsuitable feed water.

Railroad Consolidation—Supreme Court and I.C.C. in Conflict

A NEW phase of the railroad consolidation question developed at the hearing by U. S. Circuit Court Judges at St. Paul on May 31, of arguments in the case of the United States against the Southern Pacific R.R. In this case the Supreme Court issued its mandate to the circuit judges to enter a final decree requiring the Southern Pacific to divest itself of any control, either by lease or stock ownership, of the Central Pacific R.R. Co.

After the Supreme Court's decision the Southern Pacific filed a petition with the Interstate Commerce Commission, under the provisions of the Transportation Act, asking the Commission to authorize it to retain its present control of the Central Pacific by a new lease, and by continued stock ownership. This petition was granted by the commission, and now the Southern Pacific has filed a petition asking the circuit judges to enter a decree under the mandate of the Supreme Court to carry into effect this order of the Interstate Commerce Commission. The arguments involve the effect of the Esch-Cummins Transportation Act upon the Sherman Anti-Trust Law.

The solicitor-general, in discussing this effect, said:

> It is this feature that gives to this case its unusual character and exceptional interest. The present proceeding concerns not merely the integrity of the judgment of the Supreme Court in one of the most important transportation cases ever submitted to that court for its authoritative decision, but, in its last analysis, affects the integrity of the Sherman Anti-Trust Law. If, in the enforcement of this famous rule of public policy, the action of the courts is subject to the revision of the Interstate Commerce Commission, then the Sherman Anti-Trust Law, so far as the regulation of interstate transportation is concerned, has largely lost its efficacy, and there would seem to be little use in the future of any effort by the government to enforce its provisions in the judicial department of the government when under the interpretation now sought to be given to the Transportation Act the real court of last resort is an administrative commission.
>
> It may be that Congress intended such a radical departure in a policy to which it has now tenaciously adhered for nearly thirty-three years, and it may also possibly be an act of wisdom to transfer the whole question of permissible monopolies or restraints of trade in interstate transportation from the rigid enforcement of the Sherman Anti-Trust Law to the more elastic discretion of an administrative tribunal.

In conclusion the solicitor-general said:

> It may well be that the settlement proposed by the commission, which has, at least for the time being, harmonized the long-standing differences of great transcontinental carriers, will better subserve the public interests than the absolute divorce which the Supreme Court, enforcing the Sherman law, has decreed.
>
> Nevertheless, the question remains whether, after the Supreme Court had adjudged that the control of the Central Pacific by the Southern Pacific was unlawful as destructive of competition, the commission could disregard such finding and declare otherwise.

After the hearing was concluded Judge Sanborn said that the Circuit Court of Appeals did not believe that the Supreme Court had considered the Transportation Act in rendering its decision; that the Circuit Court had concluded to enter a decree to the effect that the Interstate Commerce Commission had power to authorize and approve the control by lease and stock ownership of the Central Pacific by the Southern Pacific Co.

Developments in Co-operative Engineering Courses

A Review of the Various Alternate Industry and Class-Room Courses Given in Different American Colleges

By R. L. Sackett
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A paper delivered before the Fourth Industrial Conference, Pennsylvania State College, May 26, 1923.

By co-operative education we mean that method by which a student spends a certain period in the pursuit of classwork which is then followed by a period spent in an industry, to be followed again by the return to the class-room and thus alternating between the class-room and the industry. The earliest organization of work of this character on a scale of any importance was at the University of Cincinnati where, in 1906, students were placed in the shop for a period of two weeks and then returned to the university for a corresponding period and thus alternating through the year. If the class consisted normally of thirty students, there would be two groups of thirty, one of which would be in the class-room while the other was learning in the machine shop; and when the group in the machine shop returned to the university, those who had been studying for two weeks took their places in the shop. This period of two weeks has been open to considerable discussion by different institutions which employed different periods in the class-room but all of them spend an equal period in the industry and in study.

The University of Cincinnati Plan—The co-operative plan at the University of Cincinnati has grown so that it includes a wide variety of lines, such as civil, electrical and mechanical engineering. The number of students has correspondingly grown also, and while an alternative was offered until 1920 and students might devote their entire time to the class-room there were fewer each year who did so. The majority preferred the co-operative scheme. Students are employed in the industries not only of Cincinnati but of Dayton, Springfield, Columbus, Cleveland, Detroit, Pittsburgh and a few are in even more remote places. So long as the distance between the industry and the university is not more than a night's ride, the distance is not considered as an important factor in the plan or an objection to it. The period of study and of practice was recently changed to one month.

At the University of Pittsburgh, the period chosen for study is four weeks and this is followed by four weeks of work in the industry. The University of Pittsburgh confines its co-operative work to the industries in the Pittsburgh district because of the greater ease of supervision and because most of the students at the University of Pittsburgh in co-operative courses live in that district.

When the co-operative plan was adopted, the course at the University of Cincinnati was increased from four years of about nine months each to six years of nine months each. The plan has recently been changed to include five years of eleven months each—a net increase of about nineteen months or two college years.

At the University of Pittsburgh, the co-operative instruction is confined to the second and third years. The academic year is divided into three terms and the summer period is also utilized making a four-quarter plan in effect. The co-operative course includes a total of four college years and three summer periods or fifteen terms. Eleven terms are spent in the institution or only one less than the usual number in a four-year course of three terms to each year. The total time of fifteen terms is three more or nine months longer than the usual four-year course.

The Massachusetts Institute of Technology Plan—The Massachusetts Institute of Technology has still another form of co-operative technical education instituted at the Lynn Works of the General Electric Co. In this instance, the normal period of employment in the industry is three months followed by a corresponding period in the institute. However students do not begin the co-operative plan until two years after entering the institution, so that the scheme is carried out only for the last two years of the course. The academic year is divided into three terms of about three months each and the summer period is about the same in length. The total length of the course is five academic years and four summer periods or about fifty-seven months' gross time except that vacation periods between terms reduce the net time about a month per year.

The Harvard University Plan—At Harvard University, students in civil, electrical, sanitary, municipal and mechanical engineering may spend three periods of one-half semester each in practical work off the campus. About one-half the students in these courses do so. The co-operative plan mentioned is required of those taking the five-year course in engineering and business administration.

The New York University Plan—At New York University, a more radical plan has been adopted. Under the plan adopted at the universities previously mentioned, it is necessary to repeat each subject every four weeks if that is the period which the student spends in the class-room. The consecutive time given to study of a particular subject is reduced, and the instructor changes his group and turns back to where this group left off. This involves no greater teaching cost providing that there are enough to make two classes in each subject. If the number of students is fewer than twice the normal number in a class, then the teaching cost is greater as a result of the co-operative plan.

At New York University it is proposed to alternate the work of the junior and senior years in order to avoid teaching each subject twice. While this may economize in cost of instruction, it introduces an even more serious problem. In engineering courses there are well defined sequences of subjects and of prerequisites for the profitable pursuit of advanced subjects. This plan of New York University would sacrifice some of the prerequisites and the logical order of subjects. The period of alternation is four months—the longest so far proposed. Juniors and seniors would not be in college at the same time. The course will occupy four consecutive calendar years and two semesters (about eight months) except for a vacation period of four months at the end of the freshman year.

The Antioch College Plan—Antioch College, reorganized under its new President, Arthur E. Morgan, offers administrative curricula with considerable latitude in the selection of courses. The college has one shop building and proposes to erect standard factory buildings for production work on a profitable basis. It is planned to make the shop work self sustaining and a financial aid to the students. At present the college is sending students to outside plants for their practical work. About 160 students are working or studying under the co-operative plan. It is reported that several thousand have applied for next year.

Worcester Polytechnic Institute has maintained a pattern shop, foundry and machine shop for commercial production since its founding in 1869. Students work here much as apprentices or helpers would alongside the journeymen who do most of the work. Students receive no pay. Juniors spend a year and three months in practical employment on pay with one of several co-operating corporations.

We see how education has changed from the old classical course which was study, reading and recitation to recitation, laboratory instruction, drafting room and shop work, as a result of our industrial development. The co-operative plans abandon or modify the use of college shops and substitute the shops and organization of industrial plants for a part of the practical instruction. The same plan is being adopted in common school education of which the continuation school is one phase.

Advantages of Plan—The advantages of the plan are:

The college is relieved of the capital cost of shops and of their cost of operation in part.

Actual production standards and labor conditions are substituted for the more or less artificial ones of college life. Speed is emphasized and the college adopts to a degree the standards of industry as its standards.

Industrial experience co-ordinates practice and theory more closely.

There is a closer co-operation and better understanding between industries and the college, including the college graduate.

A student may be helped in finding himself and the kind of work which he should do.

Students who are not practical are eliminated early from production lines and seek a place in some other activity.

The students get a taste of plant discipline, meet the shop men and appreciate the value of the practical man in industry.

The corporation has an opportunity to study students, get the judgment of foremen and in a measure to select desirable men for employment after they graduate.

Disadvantages of Plan—The disadvantages are:

Time from entrance to graduation is prolonged, which is not a serious matter if the student has made progress commensurate with the added time.

While the cost of college shops and of their operation may be decreased, there is an added cost for supervision either to the college or to industry or to each if the purpose of education is really served.

The short periods of alternation cause more commotion and more lost motion in starting and stopping than the longer periods of a term or semester.

The co-operative student is prevented from taking part in athletics, in class activities, in college editorial, debating and musical activities, at least to the same extent as students in the usual four-year course.

The co-operative student cannot get the same college spirit that the regular resident student gets.

The most serious objection is to the materialistic view of life being early impressed on the student. Many of the ideals of a cultural education are in jeopardy if they have not already been sacrificed. To put an immature freshman into a shop, the ideal of which is production, is to emphasize materialism so much earlier. The sacrifice will be made no doubt but should college cultural life be sacrificed so early to industry? The ideals of the executive staff may be the very highest but the youthful student in the average shop does not meet them. He gets the workman's philosophy and the company policy as to production. Industrial ideals do not shine through with clearness if at all.

At Pennsylvania State College the industrial shops are a part of the equipment for teaching industrial engineering and for the instruction of students in other courses. Our industrial engineering course teaches the methods of production, planning, routing, the selection of machine tools, factory planning, organization, welfare, wages and personnel. Our teachers are men of experience. What then is the difference between students learning here and in a Philadelphia plant? We do not teach the methods of one plant but the best practice selected from many plants. We are not so much concerned with making money as in helping students to get good information, the best principles and some preparation for the business of engineering, the business of life.

After graduation from the usual four-year course the student begins at the same place in the same shop perhaps but he is more mature; he has received all that the college has to give or all that he chose to get. Normally he is not put through the stages of shopwork which the co-operative plan requires. He may go into design or sales or testing work and not do shopwork after he leaves the campus.

If we assume that the college shop is practical, that the variety of work presented is well selected; if the industrial standards of discipline are good; if the purpose is to teach good production standards, machine tool selection, jig and tool design, shop planning, safety, welfare and organization, then what is the compensating virtue of co-operative education? (See article by Prof. Roe, in *Management Engineering*, Feb. 1, 1923.)

We are firm in the belief that it is not our province to give trade training and that we are responsible for a broad cultural course with a professional outlook; that we are responsible for thorough instruction in the fundamentals and for planting such standards of life in the minds of students that they will be able to serve society according to their capacities, to enjoy their work and to use their leisure to advantage.

Is co-operative education a more efficient means of bringing the student to find himself and his life work? Is it an expedient or a real educational process? On this question we want your thoughtful judgment and shall appreciate all the evidence which you can present.

Importance of Water Service Pipe Construction Records

By John P. Wentworth

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In several states the utility commissioners compel the water companies and other public utilities to pay for the laying of the services from the street mains to the curb or property lines. For the first few years after such regulations are made the cost of services is small compared with the cost of the entire plant but eventually their cost becomes a considerable percentage. Thus, in two large water company plants recently valued, the cost of installing new services and relaying old services from the street mains to the curb lines, for a period of four years, averaged 12 per cent of the cost of the entire construction work for the same period.

In valuations for purchases, condemnation, and rate cases the value of the services from street mains to curbs, if installed at the expense of the company, should of course be included. It is the object of this article to call attention to the fact that careful records of construction of services should be kept, so that inventories can be accurately and quickly prepared and so that reliable data can be obtained for determining costs. The construction slips should show the kind, size and length of pipe, the size of fittings and cocks, and a detailed estimate of the cost, separated as far as possible between the section from the street main to the curb line and the section from curb to building.

Most companies keep such records, although some do not distinguish between new services and renewals. There is one item, however, which is seldom kept as a part of the records, and that is the length and kind of pavement cut. Although the cost of cutting pavements is relatively small, the work of preparing an inventory without past records may be difficult and costly. The amount of ledge and difficult excavation in service trenches may be estimated from the quantities encountered in the laying of the street mains but the amount of pavement cannot be so estimated. The street mains may have been laid many years before the services were laid and when there was no pavement present. The services in any one street may have been laid in many different years and the street may have been repaved several times, which would add to the difficulty of preparing an inventory. Many services are renewed just before a permanent pavement is laid and in such cases the records should state the number of feet and kind of pavement removed.

The above comments on pavements apply chiefly to cases where the court or commission rules that the company is entitled only to the value of the pavements actually cut, instead of to cases where the company is allowed the reproduction cost of cutting and replacing all pavements.

It will take a negligible amount of a foreman's time to add the pavement data to his construction slip. This information will save time and money.

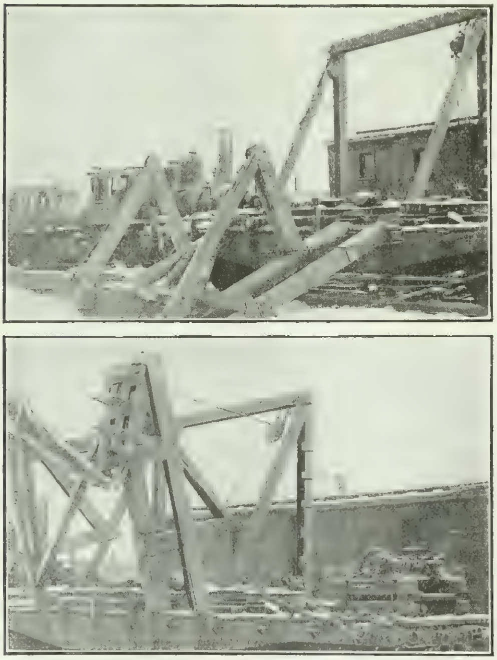
From Job and Office

Hints That Cut Cost and Time *For the Contractor and the Engineer*

Home-Made Railway Ditching Car

A HOME-MADE railway ditching machine on the Toledo division of the Pennsylvania R. R. is found economical in constructing and shaping ditches on level ground and through shallow cuts and also for shaping or dressing the roadbed and ballast shoulders for both cuts and fills. This machine is shown in the accompanying views.

On one side of a steel flat car is erected a timber frame carrying the topping lifts attached to the head of a frame hinged at the opposite side of the car. To this latter frame is attached a large steel mold-board or plow fitted with a templet for forming standard sections for ballast, roadway and ditches. The cables pass over struts on the hinged frame so as to give a more effective pull in raising the plow and frame. They are operated by a hand hoist anchored to the floor of the car. In this way the frame and plow are raised slightly to clear such obstacles as bridges, rail rests and mile posts. For transportation, the frame rests on the floor of the car and all parts are then within clearance lines.



DITCHING CAR ON PENNSYLVANIA R.R.

Above: plow and frame in operating position. Below: plow raised for transportation.

In service, the hinged frame is lowered to the desired position and as the car is pushed forward by a locomotive the nose of the plow cuts the material for roadway shoulder and ditch, while the inclined mold-board carries this material beyond the ditch line. The machine works best in cuts not more than 2 ft. deep to top of rail, two or three runs being required to form the completed ditch under such conditions. Although it cannot be used in shaping the shoulder of stone ballast it will form the sub-ballast, roadbed and ditch outside of the stone ballast. The work is cheaper and gives a more uniform section than can be obtained by hand work or by teams with scrapers.

An example of the work is the cutting of 11,060 ft. of ditch in a working time of 2 hours 44 minutes, the surface of the ground being from one to two feet above rail level. Average daily cost, at labor rates of July, 1921, is about as follows: 8 hours for foreman at 55½c., $4.44; 40 hours of five trackmen at 40c., $16; work train service, $100; total, $120.44. This gives a cost of 1.1c. per foot of ditch. This cost would be materially lower if the machine could have longer working time, but as it has to be kept clear of traffic this time is restricted.

The machine was designed by Paul Jones and R. C. Miller, formerly division superintendent and division engineer, respectively, of the Toledo division. Information as to its operation and work has been furnished by W. R. Hillary, the present division engineer, Toledo, Ohio.

Slide Rule for Solving Manning's Formula

By H. B. Muckleston

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THERE have been published in this journal several descriptions of special slide rules designed to solve Manning's formula for the velocity of water in channels. This formula is so easily handled by the ordinary slide rule that the construction of a special rule hardly seems to be a paying proposition. However, for those incurably addicted to the habit, a special rule is a convenience and to them the following may be of interest.

Manning's formula may be written as two identical ratios,

$$\frac{V}{r^{\frac{2}{3}}}=\frac{1.486s^{\frac{1}{2}}}{n};$$

and, given any three of the quantities concerned, the fourth is readily found. If the four scales A, B, C and D of the ordinary Mannheim slide rule be graduated for the four quantities, A for V, B for $r^{\frac{2}{3}}$, C for n and D for $1.486s^{\frac{1}{2}}$, then, no matter how the slide containing the B and C scales may be set, any two opposite readings on the A and B scales and any two opposite readings on the D and C scales will satisfy the equation as given. In any statement of the problem three of the four quantities are known and two of these three must be either on A and B, or on C and D; therefore if the slide be set to bring the values of the known pair opposite each other the unknown fourth quantity must be opposite the known third on the other pair of scales.

The rule is very easily constructed if a suitable foundation be available. A student's rule, price $1.50, is a very good foundation but one is easily made. The graduating can be done without calculation if a scale of logs (the A scale of the ordinary rule) is available. Starting with an ordinary rule the A scale is left undisturbed, but it should be figured from 0.1 to 10 instead of 1 to 100 as usual.

For the B scale, giving $r^{\frac{2}{3}}$, we require a scale of logs ⅔ as long with the index (log 1.0) in the middle. Using a pair of proportional dividers both ways from the center, set off ⅔ log r and figure r from 0.1 to 10.

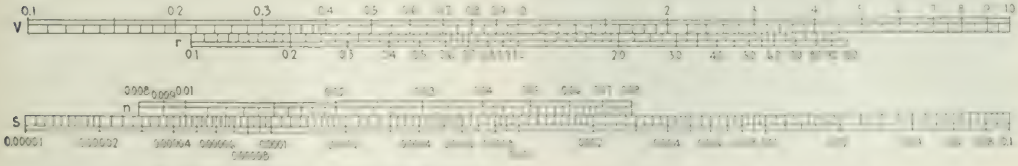
Both n and s are usually small fractions, hence their logs will be negative, or have negative characteristics; n ranges from 0.008 to 0.1; s ranges from 0.000,01 to 0.1 and $s^{\frac{1}{2}}$ from 0.003 to 0.3. To keep these graduations on the rule it is necessary to shift the index (log 1.0) to the right, the exact shift is not important but must be the same for both C and D scales.

The D scale must represent $1.486 s^{\frac{1}{2}}$. We will therefore call the index of this scale 0.001 and we will set it opposite the index of the A scale (log 1.0). From this point, using the proportional dividers as before, set off log s to half the scale of the logs on the A scale both ways and figure the graduations from 0.000,01 to 0.1. There will be four units.

The C scale must represent n, which will be to the same scale as the graduations on A. However, we must shift the index to agree with the D scale. From graduation 0.0001 on the D scale set off to the left log 1.486 as measured by the A scale and figure this point 0.01 on the C scale. From this point set off the logs to the same scale as on A and figure from 0.008 to 0.08, which will be sufficient.

The figure herewith is a sketch of the rule as it would appear if set as graduated, i.e., $V = 1$, $r = 1$, $s = 0.0001$, $n = 0.01486$.

If conditions of the problem make it necessary to consider values of V greater than 10.0 or of s greater than 0.1, the indices of V and s may be supposed shifted one whole unit to the left, or in other words the values figured on the V scale may be multiplied by 10 and those on the s scale by 100.



SLIDE RULE FOR MANNING'S FORMULA FOR VELOCITY OF WATER IN CHANNELS

For example: With the slide set as shown in the illustration the following problem might be solved:

$s = 0.0002$, $n = 0.021$, $r = 3.0$, hence $V = 2.08$

or by assuming the indices shifted one unit, we would have for the same graduations:

$s = .02$, $n = .021$, $r = 3.0$ and $V = 20.8$

The finer graduations have been omitted from the figure.

Nine-Room House Moved to New Site by Motor Truck

A NINE-ROOM house estimated to weigh 75 tons was recently towed four city blocks along the streets of Los Angeles by a 5-ton truck carrying 8 tons of pig iron ballast to give traction. Occasional stops were necessary to raise wires or to cut the limbs of trees, but where there were no obstructions progress was rapid. One continuous pull of 400 ft. was made at a speed of about 2 miles per hour. This rapid rate of travel was made possible by the fact that no block and tackle was used, the truck pulling directly on the timbers carrying the weight of the house.

The house was first jacked up from its original location with 10-ton jacks and supported on 12 x 12-in. beams extending for its full length and width. The two lowest beams were transverse, that is at right angles to the direction in which the house was to be moved.

TRUCK TOWING A 75-TON, NINE-ROOM DWELLING
Speed of 2 miles per hour was attained. No block and tackle was used, the load being moved by direct pull. Truck carried 8-ton ballast load.

A single four-wheel dolley was put under the center of the forward transverse beam and two dolleys were placed under the rear beam, one near either end. This arrangement gave sufficient stability and afforded the necessary flexibility in "steering." The dolley wheels were about 14 in. in diameter and had 14-in. tires.

The direct pull from the truck was transmitted to the house by a 1-in. steel drilling cable. The midpoint of the cable was passed through a pintle hook on the truck and at either end the cable terminated in chains that were passed under the forward transverse timber and thence around the forward ends of the longitudinal timbers.

The moving job was completed without any serious damage to plastering or plumbing, the actual moving

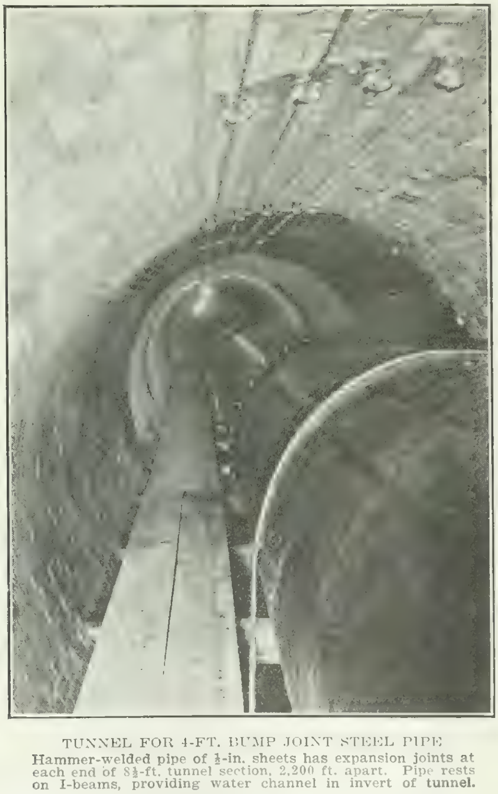
From Job and Office

Hints that Cut Cost and Time

time being about two hours. One hour of this time, during the afternoon, brought the house to the point beyond which the permit did not allow it to move in the day time. After 8 p.m. the moving was completed in another hour.

Tunnel for Water Mains Under Cemeteries

An 8½-ft. circular 4-ring brick tunnel (necessitated by the inability to resort to open-trench excavation) 2,200 ft. long, carries a 48-in. hammer-welded steel main under two cemeteries in Detroit, Mich. The depth is 43 ft. at one end and 57 ft. at the other. The 10½-ft. 4-ring brick shafts were sunk by building up a section of masonry work and mucking out the dirt inside. No cutting shields were used. The mucking in the tunnel was carried out by hand with the aid of a tunneling knife pulled by an electric motor. With 28 men the contractor, Booth & Flinn, Ltd., Pittsburgh, averaged 12 ft. per day. Pipe was delivered in 20-ft. sections and all brought in from one end. It was laid on steel I-beams spaced on 5-ft. centers, with an expansion joint at each end.



TUNNEL FOR 4-FT. BUMP JOINT STEEL PIPE
Hammer-welded pipe of ½-in. sheets has expansion joints at each end of 8½-ft. tunnel section, 2,200 ft. apart. Pipe rests on I-beams, providing water channel in invert of tunnel.

An automatic electrically-driven pump located in the sump in the deeper shaft kept the tunnel dry. When the water in the sump raised the float to a predetermined elevation, the pump started to operate and continued until the sump was dry. If this float did not work, or if there was a leak in the pipe line which exceeded the capacity of the pump, the water raised a second float which rang an alarm bell in the central storage yard. A blow-off, to be used for draining the line, was installed in the deeper shaft.

Special cast-steel base-elbows were used at the bottoms of the shafts, while standard elbows were used at the tops. The pipe was anchored in concrete outside each shaft and also in the middle of the tunnel.

Manholes were placed at 700-ft. intervals. Single bump riveted joints were used on the circular seams. The type of joint used greatly facilitated the laying of the pipe according to the latest annual report of George H. Fenkell, superintendent and general manager. At first an open fire forge was used but the smoke and fumes were so dense that an electric rivet heater was substituted with excellent results. All joints were calked and the completed line, tested under 100-lb. head, showed no leaks or sweats at the beams. Of the 6,900 rivets driven only seven showed a slight sweating and were immediately calked.

Coal Consumption Recorder Used at Philadelphia Water-Works

By H. R. Cady

Mechanical Engineer, Bureau of Water, Philadelphia, Pa.

Fuel being the largest item of operating expense in the boiler room careful and economical operation requires a frequent and reasonably careful check of the quantity consumed. With fuel oil the problem is of course extremely simple since we have a liquid in a regular shaped container and need only an elevation gage and calibration curve or table for the tank. In small hand-fired plants the coal consumed can usually be conveniently checked by means of scales over which the coal passes in push-cars or wheel-barrows.

Large modern plants, however, where economy requires the use of mechanical stokers and mechanical coal-handling equipment, present a more difficult problem. Weigh lorries are used in many cases but they preclude the use of direct down-spouts, which are so desirable on account of the small amount of labor and freedom from mechanical complication and troubles. A coal meter for measuring flow through down-spouts has been in use for some time, but it is a rather expensive piece of apparatus and can not be expected to have a long life under the severe conditions encountered in boiler rooms.

The method of checking coal consumption which has been used in the Philadelphia Bureau of Water for some years, in connection with traveling grate stokers, consists of a counter attached to the driving shaft of each stoker, the counter readings being multiplied by a factor to take into account travel of grate per revolution of shaft, width of stoker, weight of coal per cubic foot and fire thickness. All factors except the last two are constant for any particular stoker and the factor of weight per cubic foot varies only with the general character of the fuel. The constant may be determined experimentally by weighing the coal fed to the stoker hopper and reading the counter and fire depth; or the constant may be made up by calculating the volume of

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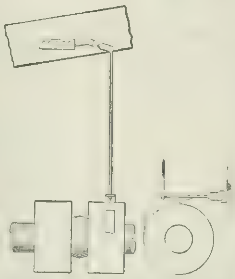
coal passing into the furnace per turn of driving shaft, the only experimental data needed being a determination of the weight of coal per cubic foot.



COAL CONSUMPTION COUNTER ATTACHED TO STOKER

The illustration shows a convenient, durable and inexpensive method of attaching counters. Counters of rectangular shape, rugged construction and fair size should be used since the cost is small, in any case, and those of too light construction and small size are not sufficiently durable for satisfactory service.

Steel Transmission Towers Raised While the Line Was "Hot"

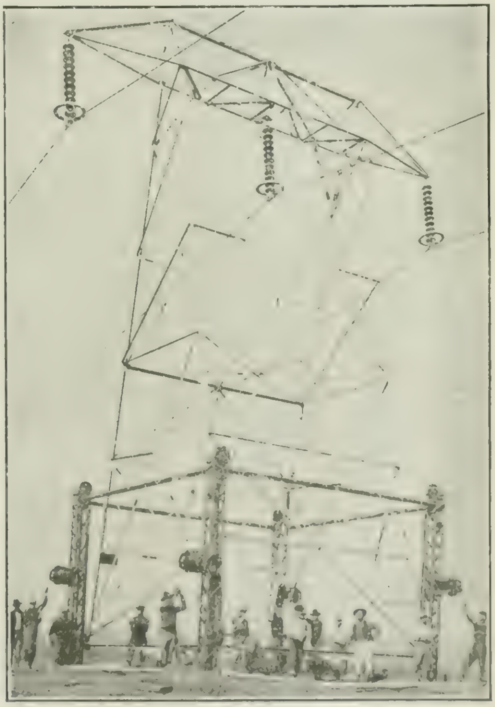
AS A PART of the program for increasing the voltage on a 240-mile transmission line from 150,000 volts to 220,000 volts, the Southern California Edison Co. found it necessary to increase the height of most of the steel towers over the entire length of the line in order to secure the desired minimum clearance of 30 ft. above ground for the cables carrying the current. Because of the importance of power transmitted over this line it was not feasible to keep it out of service while the process of raising the towers was under way; hence methods were devised for doing most of the work while the conductors were in service. The line was only "killed" for handling special cases, such as dead ends, sharp alignment changes, etc. Calculations showed that it would be safe to use vertical extensions of the tower legs and consequently the footing stubs already anchored in place. Although in some cases raises of as much as 20 ft. were made, the average raise was 10 ft.

The process of raising the towers consisted of lifting them bodily and holding them suspended while a structural steel extension of the desired height, which had been erected in advance, was placed and bolted. The device used for lifting the towers, shown in the accompanying illustration, consisted of four structural-steel latticed posts joined at the top by pipe struts which fitted into sockets and were held in place by king-pins. The ground was leveled off and wooden sills were placed to prevent any settling of these posts under load. A plate connection was bolted to each post and the adjacent footing. Steel cable guys with turnbuckles for tightening were used, extending from the top of each post to the bottom of the two adjacent posts, thus making diagonal bracing for the elevator. Each post carried a three-ton differential hoist for lifting. This was similar to a chain block, except that it had a drum instead of a load chain, and was mounted on a frame which was bolted to the post. The hoisting cable passed over a sheave in the top of the post to a plate clevis bolted onto the tower leg at the point where the connection was broken from the footing. A shoe bolted to the tower leg followed a vertical guide on the post.

Great care was used in keeping the towers plumb in raising so as to avoid any undue strains due to tilting. One tower leg and its elevator post were carefully grounded to the footings by heavy copper cables and broad terminals to avoid any possibility of accident due to the tower becoming energized.

The crew for this work was made up of four first-class towermen, four second-class towermen, four groundmen, truck driver and one foreman. The best record made was seven towers raised and bolted in ten hours, the elevators being left in place for the night on the last tower.

Before any raising was done, the ground wire was slacked off at its dead end points and the clamps at intervening points were loosened to permit slack to run through in order that there might be no abnormal strains set up in case a tower did not remain vertical while being raised. In the main power cables, however, there was sufficient slack so that the towers could be raised without changes. At points where ground-wire loads were unbalanced, such as at angle points, or where any particular conditions made the hazard more than normal, the line was de-energized before raising the tower.



TOWER IN PROCESS OF BEING RAISED

As shown in this view the weight of the tower is being carried by the elevator framework. At the post on the left the separation of the tower leg from its footing is seen

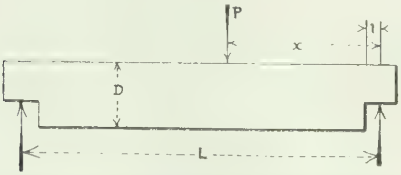
For about two-thirds of its length the transmission line is accessible by motor trucks, the remaining distance in mountainous country had to be reached by wagons or pack animals and in some cases materials and equipment had to be transported to the site on men's backs.

Determining Longitudinal Shear in Wooden Beams

By George A. Merrill
Engineer with Desmond & Lord, Architects, Boston

In building construction, the engineer or architect sometimes has cases wherein a wooden joist rests upon a wooden beam or some other support, and desires to notch the beam over the support that he may gain in the depth of floor, or may substitute deeper beams for shallower ones in order to gain strength; or it may be desired to cut out the joists in the under side to give room for a pipe. In determining the depth of shoulder, or the depth and distance out for the hole for the pipe, the strength of the joist in longitudinal shear must be considered in the one case, and the tensile strength in the other.

In general, such notching and cutting is not to be recommended; either a piece bolted to the side of the supporting girder or a shelf angle on a steel beam is to be preferred. The shoulder on the joist is an element of weakness. If, during construction, a heavy load falls close to the notch, the joist may split. Some builders in case of notched joists, nail a piece of ⅞-in. stuff underneath to add strength to the construction. However, it may be necessary at times to notch the piece or conceal a pipe above the ceiling by cutting in.



ELEMENTS INVOLVED IN SHEAR DETERMINATION

In determining the various factors involved in such design the following formulas have been developed:

Let D = depth of beam, in. (see diagram)
d = depth of shoulder, in.
L = span of beam, ft.
l = distance out from support of notch, ft.
W = total uniform load on beam
f = allowable transverse bending stress, lb. per sq.in.
f_1 = allowable stress in longitudinal shear, lb. per sq.in.
i = width of beam, in.

S = unit end shear $\frac{W}{2}$ for uniform load

Then $BM = \frac{fD^2}{6} = \frac{WL12}{8}$

$$W = \frac{fD^2}{9L} \text{ and } S = \frac{fD^2}{18L}$$

$f_1 = \frac{SQ}{I}$, when Q = statical moment above its center of beam d deep; and I moment of inertia of the same.

$$\text{Then } f_1 = \frac{\frac{fD^2}{18L} \times \frac{d^2}{8}}{\frac{d}{12}} = \frac{fD}{12dL}$$

$$d = \frac{fD^2}{12Lf_1}$$

From Job and Office

Hints that Cut Cost and Time

Following the Boston building law for yellow pine, $f = 1{,}600$ and $f_1 = 150$; for spruce, $f = 1{,}000$ and $f_1 = 100$.

Substituting these values,

$$\text{for } Y.P.\ d = \frac{1{,}600\, D^2}{12\, L\, 150} = \frac{8D^2}{9L}$$

$$\text{for spruce } = \frac{1{,}000\, D^2}{12\, L\, 100} = \frac{5D^2}{6L}$$

Longitudinal shear decreases as the support is left, while the bending moment increases. Therefore, the width of shoulder toward the center figured from the center of support, and the depth of any notching at points between the support and center of beam, depend upon the bending strength of the beam.

Then, the bending moment M, at a point l feet out from the support $\left(l < \frac{L}{2}\right)$ is, d being the depth of beam at this point,

$$M_1 = \frac{Wl}{2} - \frac{2l}{L}\frac{W}{2}\frac{l}{2} = \frac{Wl}{2}\left(1 - \frac{l}{L}\right).$$

where M_1 is in ft.-lb.

but $W = \frac{fD^2}{9L}$

and $M_1 = \frac{fD^2l}{18L}\left(1 - \frac{l}{L}\right)$

$$\frac{12M_1}{f} = \frac{d^2}{6};\ d^2 = \frac{72M_1}{f}$$

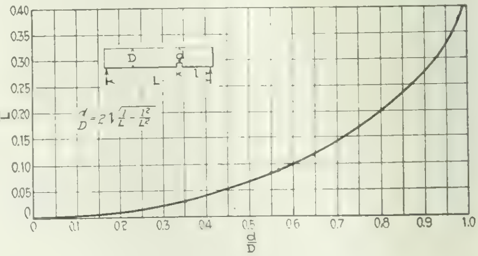
Substituting the value of M_1

$$d^2 = \frac{4D^2l}{L}\left(1 - \frac{l}{L}\right)$$

$$\frac{d^2}{D^2} = \frac{4l}{L}\left(1 - \frac{l}{L}\right)$$

$$\frac{d}{D} = 2\sqrt{\frac{l}{L} - \frac{l^2}{L^2}}$$

The diagrams show the minimum depth of shoulder d for beams of D depth at center for various spans when subjected to the allowable bending stress; also the relation between $\frac{d}{D}$ and $\frac{l}{L}$.



NOTCH DEPTH AT VARYING DISTANCES FROM SUPPORT

For example a 12-in. spruce beam 16 ft. long, fully loaded, must not be notched more than 12 in. — 7½ in. or 4½ in.; $\frac{d}{D} = \frac{7\frac{1}{2}}{12} = 0.63$; and $\frac{l}{L} = 0.11$, 16 × .11 =

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1.76 ft. or the shoulder, if 7½ in. deep, must not extend farther than 21 in. from the support.

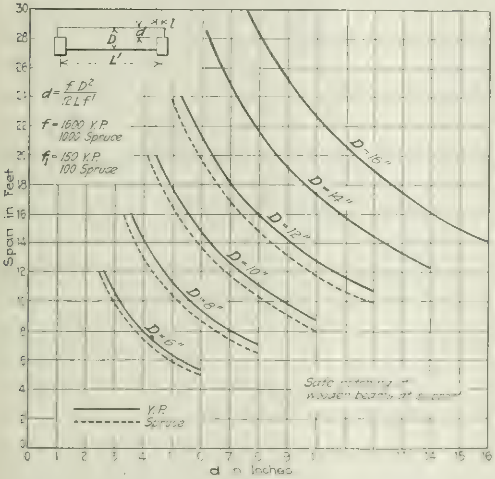
Suppose a notch is to be made in the beam 3 ft. out from the support:

Then

$$\frac{l}{L} = \frac{3}{16} = 0.19 \text{ and } \frac{d}{D} \text{ (by diagram) } = 0.78.$$

7.8 × 12 = 9.36, or the notch should be not over 2.64 in. deep.

The equations and diagrams are for uniform loading; for concentrated loadings, each case must be worked out individually.



SAFE NOTCH DEPTH AT SUPPORT FOR VARYING BEAMS

In the figure herewith let beam L be loaded with load P x feet out $x < (L - x)$, then the maximum end reaction $= \frac{P(L - x)}{L}$.

Reaction per inch of width $= \frac{P(L - x)}{tL} = S$, where t = thickness of beam in inches

$$f_1 = \frac{SQ}{I} = \frac{P(L - x)}{tL} \times \frac{3}{2d} = \frac{3P(L - x)}{2tdL}$$

$$d = \frac{3PL - 3Px}{2f_1tL}$$

for spruce $f_1 = 100$, and $d = \frac{3PL - 3Px}{200tL}$

If $P = 1{,}000$ lb., $x = 4$ ft., $L = 16$ ft.

$$d = \frac{36{,}000}{3{,}200t} = \frac{11.25}{t}$$

$$\frac{M}{f} = \frac{750 \times 4 \times 12}{1{,}000} = 36 = \frac{1}{6}tD^2, \; tD^2 = 216$$

if $D = 10$ in., $t = 2.16$ in.

$$d = \frac{11.25}{2.16} = 5.21 = \text{min. depth of shoulder in inches}$$

$$M_1 = 750l = \frac{2.16(5.21)^2}{6} 1{,}000 = 9{,}770$$

$$l = 13.06 \text{ in.}$$

In practice 3-in. x 10-in. spruce, or 2-in. x 12-in., would be used, and the cut could be made slightly deeper for the same distance out, or farther out for the same depth or cut.

Settling Tanks Clear Foundation Water

TO REMOVE the mud and sand from water pumped from foundation shafts and thus prevent clogging of the sewer into which this water was discharged, settling tanks were used recently in the construction of the Canal St. viaduct between Taylor and Harrison Sts., Chicago. In connection with the approaches to the new Union Station, part of Canal St. will be a reinforced-concrete viaduct with its columns supported by foundation piers built in open wells or so-called caissons sunk to rock. An unusual amount of water and water-bearing sand was encountered in some of the wells and this condition led to the use of the tanks.

The water was delivered from the pumps into a galvanized iron tank about 3x15 ft. and 3 ft. deep, fitted with wood baffles so arranged that the water rose from under the last baffle and overflowed into a similar but smaller tank. This latter was 4x6 ft., and 3 ft. deep, also fitted with baffles. The final overflow was led by the street gutters or by chutes to a convenient sewer inlet. Two pair of tanks were placed side by side, so that one pair could be cleaned while the other was in use. Each pair of tanks had to be cleaned several times daily. The contractor for this work is the Blome-Sinek Co., Chicago.

Dynamite Used to Excavate Soft Muck

TESTS were recently carried out in the Sugar Bowl Drainage District, near Pine Level, De Soto County, Fla., to determine the feasibility and costs of using dynamite for work through very soft muck. The tests were continued for two days. On the first day a 200-ft. strip was blasted, and on the second day two shots were fired, one covering a distance of 800 ft. and the other about 200 ft. In the first operation it was necessary to obtain a 5-ft. depth at the outlet of a dredged ditch, the work being complicated by the fact that for a distance of 50 ft. it was necessary to cut diagonally across the spoil bank of the dredged ditch. The spoil bank was 4 ft. high.

To get the 5-ft. depth for the entire distance four cartridges of 50 per cent straight dynamite were used in holes spaced 24 in. apart. In going through the spoil bank six cartridges were used to each hole and the load was gradually decreased to three cartridges as the depth of the ditch tapered to 3 ft. at the outlet.

The 800-ft. shot on the second day was a propagated shot; the 800 ft. of muck lifted in the air, split well and spread out widely on both sides of the ditch, leaving a clear ditch 3 to 4 ft. deep according to the grade that had been established and the depth of the holes, and 12 ft. wide at the top. This 800-ft. length was loaded with three cartridges of 50 per cent straight dynamite to the hole, with the exception of the last 100 ft., in which two cartridges were used with one row of holes spaced 22 in. apart.

The total cost of the ditch, including labor, was less than 20c. per cubic yard. The work was done under the supervision of Otho O'B. Strayer, of the Du Pont Co.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Economy in Structural Steel

Sir—An editorial in your issue of April 12, p. 653, refers to the subject of steel economy. It is unquestionably true that economy in the use of materials is a necessary factor in engineering progress, and that the present high prices of all constructional materials make the question urgent. In the writer's opinion, higher stresses than 16,000 lb. per square inch are permissible in steel used in statically determined members of steel and reinforced-concrete structures. A stress of 18,000 lb. would not be too high.

European engineers are using stresses up to 21,000 lb. and higher in steel bridges, and in reinforcement of reinforced-concrete structures they are using stresses exceeding 17,000 lb., except that in bridges the reinforcement stresses are generally limited to 11,000 to 14,000 lb. However, it is important to bear in mind the fact that high working stresses are safe only when good material is used and the design calculations are precise and complete. The designer must take account of all contingencies and calculate the maximum stresses occurring in his structure.

Los Angeles, April 24. Z. GILLEWICZ.

Cemented Beds for Granite Blocks

Sir—In your issue of April 26, 1923, p. 760, a correspondent gives a clause proposed for his specifications for granite block paving.

A dry mortar bed has been used for wood and asphalt blocks for many years, but for granite blocks for only about ten years and then only in heavy traffic streets. In Manhattan it has been used as a standard since 1914, and this was probably its first use under granite blocks. The purpose was largely to prevent the washing away of the sand bed and the consequent settling of the pavement. The proper method is to mix the sand and cement to a uniform color and then spread the mixture, using it just as a sand bed would be used, and attention should be paid to obtaining a true surface on the concrete parallel to the finished surface of pavement.

The method of striking the bed is proper for a manufactured block such as wood or asphalt, but will not suit for granite, as it does not take into account the irregular depth of granite blocks, which necessarily vary at least ½ in. in depth.

R. A. MACGREGOR,
Assistant Engineer, Dept. of Public Works,
Borough of Manhattan.

New York, May 15, 1923.

Some Facts on Everglades Survey

Sir—In *Engineering News-Record*, April 19, p. 720, there appeared a letter by C. B. Burnside which, I fear, may be construed as a criticism of the operations of the Florida East Coast Ry. Inasmuch as I was connected with some similar work in the Everglades, I think my own experience may be of interest.

In 1915-17 I surveyed several townships, subdividing them into sections, of 640 acres each, a mile square, making 72 miles to the township and 60 miles of this was interior lines; each township consists of 36 sections, making a township six miles square. The work that I did was done under very favorable conditions. I employed a tractor such as was used by the railway in its surveying, and I used ten to twelve men. Mr. Burnside was a chainman on one of the surveys. I used five chain tapes, of a total of 350 ft. in length, and with a 4-ft. lath as a marker, we only had to stop for chaining each 350 ft. making only four stops in a quarter mile. In the open Everglades we averaged around ten to twelve miles per day—we have done as high as fifteen miles—but this was accomplished with three separate chaining crews. We had no hubs to set, no levels, no stakes to mark—except our quarter, half and three-quarter stakes and the section corner. This was all done in camp. The quarter, half and three-quarter stakes were 1x3-in. cypress, 5 ft. in length, which made them very light and handy to carry. The corner stakes were 1¼-in. galvanized pipe of 5 to 10 ft.

At the time of this survey, there was very little water on the surface of the ground in places and at times it was perfectly dry. I maneuvered my machine in such a way as to keep it in very close touch with my work and as to walking 20 miles, I don't know of any time that any of my men were ever required to do so in one day. We did walk, however, ten to twelve miles in doing some of this work, but we did not have from a foot to three feet of water to travel through, as the railroad engineers had on their trip from the North New River Canal to the Miami Canal the latter part of last summer.

In my chaining crews I employed three to four men. There was very little clearing, in fact nothing except an occasional high bunch of saw grass or weeds. Where there was any cutting to do, and where the above mentioned progress was made, the saw grass generally was from knee high to waist high, making progress generally good, as the head chainman had nothing to do except to walk ahead and keep on a line. There were spots encountered on and near Lake Okeechobee banks where we did not make more than one mile a day at times.

This work that I refer to was only a surveying contract and, of course, was conducted entirely different from that of a railroad engineering nature. I have been on both kinds of surveys and I am sure that the railway party made very excellent progress on the survey referred to in the article in *Engineering News-Record.*

OTIS A. HARDIN,
President, H. P. & W.
Construction Co., Inc.

West Palm Beach, Fla.
May 24, 1923.

Bridge Members Lengthened by Welding?

Sir—I have been interested in reading in recent numbers of the *Engineering News-Record* the accounts of the repair of an old highway bridge by heating and upsetting certain structure members, and the controversy that has been started by them. I wonder if any of your readers have definite knowledge of an engineering feat that was performed in my home neighborhood, near Hudson, N. Y., years ago?

During the building of what was originally known as the Kinderhook & Hudson R.R., which I imagine to have been in the early '90s, it was common talk in the country side that the lower horizontal members of the iron bridge over Stockport Creek, at the first crossing north of Stottville, had been originally designed too short, or that the piers were built too far apart, and that the engineer in charge of the work had recruited a gang of local blacksmiths and welded into those members extensions to enable them to be used. Whether this story was true or not I cannot say, but I remember as a boy going swimming under that bridge and looking up at what were certainly rough and lumpy places on some of the structural members in question. The bridge was still there when I was last home, five years ago, although the old K & H has long since given way to a very up-to-date electric line that runs through to Albany. It might be interesting to either prove or disprove this story so long after its origin.

A. C. STOTT,
Commander, U. S. Navy.

Washington, May 12.

Joint Short Railway Authorized by I.C.C.

The Interstate Commerce Commission has authorized the construction of a joint line by the New York Central, the New York, Chicago and St. Louis, the Pennsylvania, and the Wabash. The new line which will be located in Allen County, Ind., will be only 8,000 ft. long and will be known as the Fort Wayne Union Ry.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Building permits issued in St. Louis in May, 1923, exceeded all previous figures, with a total valuation of $4,166,386 as compared with $2,396,880 for May, 1922.

Request that the Name of Harding Dam be given to the big reservoir project to be built on the Snake River near American Falls, Idaho, has been made by the residents of Pocatello, Idaho. The work on the project is under way.

Net Income for 1922 of $32,339,723 or $12.75 a share on its outstanding common stock is reported by the Union Pacific. In 1921 its income amounted to $11.73 a share. The company has written off as a complete loss the $15,259,531 which it invested in the securities of the Chicago & Alton R.R.

Competition of Motor With Rail traffic between Spokane and Seattle has come to a head in the filing of a joint suit by the Great Northern and the Chicago, Milwaukee & St. Paul to prevent the department of public works from issuing a certificate of necessity for the operation of an auto stage line between those cities. The auto stage line is now in operation between Spokane and Almira.

Contract for the Installation of automatic train control on 165 miles of double track between Blue Island and Rock Island, Ill., has been let by the Chicago, Rock Island & Pacific to the Regan Safety Device Co. of New York. This territory includes 216 automatic block signals, 4 mechanical and 2 power interlocking plants. There will be 240 ramps installed. 100 locomotives will be equipped for operation over this section of track.

Training For Prospective City Managers and other public administrative officials is being offered by the National Institute of Public Administration of New York (261 Broadway) in the form of special courses for engineers and other technically trained men who wish to go into the details of public-works, health, police and fire department administration, purchasing, various aspects of municipal finance, and personnel management.

Presentation of the Charles A. Coffin Foundation gold medal was made June 7 to the Southern California Edison Co., Los Angeles. This medal was offered for the first time last year to the electric public utility company of the United States which made the most notable contribution during the year to the development of electric light and power service, and this is the first award to be made by the Foundation, which was created by the General Electric Co.

Fire Destroys Broad St. Station Trainshed

Philadelphia Terminal of Pennsylvania R.R. Scene of Conflagration Which Wrecks Large Arch and Menaces Station

Special Correspondence

Fire starting at about 1 a.m. June 11 and continuing well over 12 hours practically destroyed the trainshed of the Broad St. Station of the Pennsylvania R.R. at Philadelphia, together with rolling stock and parts of the station itself. The total damage is estimated at between $1,000,000 and $1,500,000. For a time the station proper and the adjacent City Hall were menaced but they were saved from any but minor damage. Flying sparks, however, did jump Market St. to the south of the station and set fire to wooden formwork under concrete floors of a theater under construction at the corner of 16th and Market. These forms were destroyed from the sixth to the thirteenth floors. No lives were lost but many firemen were endangered by smoke and falling debris and several hundred occupants of sleeping cars under the shed were imperiled until the cars could be drawn out to safety.

The train level at the Broad St. station is on an elevated structure which crosses the streets by masonry arch spans. The 16 tracks are carried on plate girders, while the platforms between pairs of tracks are entirely of wood construction, being timber planking about 2 in. thick laid on what would appear to be 3 x 12-in. joists carried on steel over the girders. The trainshed is a single arch spanning all 16 tracks and resting on masonry walls on Filbert St. to the north and Market St. to the south. The shed was built in 1892 supplanting at that time a lower four-arch shed built in 1881.

The trainshed was described in *Engineering News*, June 1, 1893, p. 507. It is of wrought iron, with the exception of the lower chord bars which are of open-hearth steel. It consists of 10 main three-hinged arches each 300 ft. 8 in. c. to c. of end pins and with a rise of 108½ ft. Each arch is formed by a pair of parallel trusses, 9 ft. apart, the ribs themselves being spaced variously from 56 to 67 ft. apart. The whole shed is 598 ft. long. The roof was a combination of glass, sheet iron and wood.

ORIGIN OF FIRE

The fire apparently started in the timber floor construction beneath the tracks and above the service rooms used for mail, baggage, storage, etc., and due to the oil-soaked condition of the timber, helped out by an explosion of a gasoline tank near the tracks, soon spread to practically all parts of the structure and down into baggage room and storage rooms below.

The slowness of its eventual spread and the difficulty of extinguishing it were apparently due to the fact that the track girders separated the structure into many separate bays. The floor construction runs back toward the waiting room and main station building some 20 ft. beyond the train gates and this part of the floor up to the [illegible] was covered with [illegible] asphalt paving, which had to be ripped up by

Major Bell Succeeds Col. Keller in Washington Post

Major J. Franklin Bell has been appointed engineer commissioner for the District of Columbia to succeed Col. Charles Keller, who resigned to become associated with H. M. Byllesby & Co. in hydro-electric development on the coast. Major Bell at present is district engineer at Pittsburgh. He was appointed to the military academy from Pennsylvania, graduating in 1902. He is also a graduate of Washington and Jefferson College, receiving a B.S. degree in 1898 and his M.S. degree in 1907 from that institution. During the World War, Major Bell commanded the 24th Engineer Regiment, the depot at Angers and served with the first and second armies. After the armistice he assisted in the liquidation of surplus supplies and was chief engineer of the A.E.F. Nov. 10, 1919, to Jan. 8, 1920.

Heavy Rains Damage Kansas

Heavy rains in southern Kansas and northern Oklahoma, which swelled the Arkansas and tributary rivers to flood stage, have caused millions of dollars worth of property damage. Wichita has been particularly affected, the city being inundated, railway trackage in some places reported to have been covered to a depth of 10 ft. Railway service has been generally disrupted.

S. W. Stratton Inaugurated as President of M.I.T.

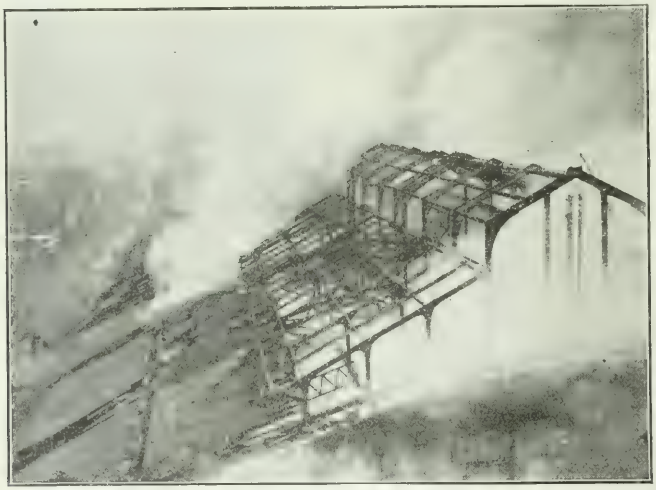
On June 11, Dr. S. W. Stratton, former director of the Bureau of Standards, was inaugurated as president of the Massachusetts Institute of Technology. The ceremonies were marked by an address of greeting from Governor Cox for the state and from Major-General George Owen Squier, for the federal government. Other speakers welcoming Dr. Stratton were Prof. Edward Furber Miller, representing the faculty; Dr. C. W. Eliot, representing the Founders of the Institute; Prof. C. E. A. Winslow, representing the alumni; and President John C. Merriam of the Carnegie Institution of Washington.

President Stratton based his inaugural address upon the part played by [illegible] in the [illegible] of industry, stressing the tremendous opportunities for industrial as well as social service open to those technically trained.

gangs of laborers in order to get at the smouldering fire beneath.

Such inspection as was possible up to the time this edition went to press showed that the steel roof structure was still standing intact, although individual arch and truss members had been considerably twisted by the heat. The wooden roofing has been almost entirely burned away leaving fragments of the sheet iron "protection" still hanging to the steelwork, and the glass which formed a large part of the roof covering has entirely gone. The track girders in the main held up the few cars and engines which had not been pulled out of the shed, although in one case they gave way and let their burden fall through.

The engineering department of the railroad is not yet ready to state the extent of damage but it is safe to say, however, that most of the steelwork of both floor and roof is now fit only for scrap owing to the intense heat treatment to which it has been subjected. The intensity of the heat during the early stages of the fire is shown by the warped surfaces of those of the steel cars which were in that part of the shed.



TRAINSHED OF BROAD ST. STATION, PHILADELPHIA
Photograph, by Underwood and Underwood, taken at 4 A. M., June 11

The estimated loss runs over a million dollars including the train shed, power plant and miscellaneous supplies and machinery, while the loss due to baggage destroyed may be even greater.

The running of trains was kept up surprisingly well, the train being made up as usual in the yards, not backing into the terminal, but being run empty to the West Philadelphia station where all passengers embarked. This small station was rapidly equipped with extra ticket offices, telephone booths, and so forth. Some detouring to avoid congestion was done, such as running all Atlantic City trains from Camden instead of starting some from Broad St., and having all trains from the West to New York run direct through North Philadelphia instead of pulling some in and out of the Broad St. station as formerly.

A.G.C. Chapters Dissatisfied With 3-Per Cent Alien Law

Reports received by the Associated General Contractors from member chapters on discussion of a national immigration policy, which was the topic suggested for consideration at all May meetings, indicate widespread dissatisfaction with the present 3-per cent quota law and a desire for a law based on selection, flexible as to numbers of aliens admitted. It will be some time before all reports are received.

It is the desire of officers of the Associated General Contractors to have the construction industry prepared to present definite views supported by concrete arguments to the committees of Congress which will consider permanent immigration legislation at the next session, as the existing law expires June 30, 1924. The discussion of this subject which all chapters were requested to assign for their May meetings is the first step toward defining a common policy for the industry.

Chapters meeting in June have been asked to discuss co-operation between the constructor and the designer, with emphasis on the responsibility each should assume toward the project.

New England Water-Works Annual Outing

The annual outing of the New England Water-Works Association will be held on June 20. The party will assemble at Washington Square, Worcester, Mass., at 9:45 a.m. and proceed by automobile to Pine Hill Reservoir, one of the nine reservoirs of the Worcester water-works system. Luncheon will be served at 1 p.m. at Sunset Hill Farm in Paxton, after which there will be an opportunity for baseball and other sports. All who can do so are requested to arrive at the assembly point in their own automobiles. The cost per person of the outing after arriving at the assembly point will be $2.50. The committee in charge of the outing is headed by George W. Batchelder.

Moffat Tunnel Bond-Issue Project Held Legal

Decision on the Moffat tunnel case, rendered by the U. S. Supreme Court last week, holds that the plan of paying for the work by a bond issue as proposed by Colorado is legal. The work is now expected to proceed without further delay. The litigation is referred to in Engineering News-Record, Nov. 23, 1922, p. 905, and a general outline of the project in the issue of Sept. 28, 1922, p. 532.

Runaway Car Does Great Damage to Brick Building

A street car on the Amsterdam Ave. hill in New York, on June 7, starting from near the top of the hill, ran backwards, for seven blocks to the foot of the hill, derailed at the turn into La Salle St. and collided with the building on the northwest corner of Amsterdam Ave. and La Salle St. The building was a five-story apartment house with a store on the ground floor. The store had show windows across the Amsterdam Ave. front and one window around the corner in La Salle St. The outer wall of the building above these windows was carried on steel I-beams supported at the corner on a cast-iron column. The car struck this column, knocking it from its footing, ran on past the front of the building and stopped on the sidewalk in front of the adjoining store. In the next instant the whole corner and front wall of the building up to the fourth floor collapsed and fell onto the sidewalk behind the car. The forward end of the floor of the second story front room was carried down with the wall. The floors of the other rooms remained in place. Two women who remained on the car and two other women who jumped from the car sustained minor injuries. The motorman also jumped but was uninjured. A child who had just come out of one of the stores was struck by the car and killed.

The motorman of the wrecked car states that the power gave out just as he reached the top of the hill, that he tried to apply the air brake but found that it would not work, nor could he work the hand brake. The car was one of the old one-man cars.

Suit Verdict Allows Completion of Pacific Highway

Construction of the last link in the Pacific Highway in Oregon which will allow continuous travel from Canada to Mexico is made possible in a recent court decision rendered by the Supreme Court of Oregon, upholding the opinion of the Marion County Court that the state highway commission and engineers are not bound to locate a highway on the exact line as called for in the highway act, in order that appropriations for such highway be made. The contention of the appellants in the case was that the line as located should pass through the cities of Dallas and Independence. The commission had selected that route as tentative and upon the original location was an appropriation for construction made.

New York Public Works Law Arousing Interest

Departmental Consolidation Experiment Will Depend for Success on Bureaus' Co-operation

Special Correspondence

The new Public Works Law of New York State, signed recently by Governor Smith, is an experiment in departmental consolidation. The success of the experiment will depend largely upon the spirit of co-operation expressed by various bureau heads. It was introduced as an administration measure and affects three principal departments, the highway, public buildings and public works, which are already Democratic as to their administration, so that the administration has taken nothing away from the Republican party in the consolidation. It has, however, created a vehicle whose functions will be subservient to and coterminous with the office of the Governor of the State. Thus a governor, representing a minority party, would have this consolidated department absolutely under control.

FUNCTIONS OF OFFICE

The superintendency of public works is a constitutional office. Section three of article five of the New York State Constitution provides:

"A Superintendent of Public Works shall be appointed by the Governor, by and with the advice and consent of the Senate, and hold his office until the end of the term of the Governor by whom he was nominated, and until his successor is appointed and qualified. He shall receive a compensation to be fixed by law . . . He may be suspended or removed from office by the Governor, whenever, in his judgment, the public interest shall so require; but in case of the removal of such Superintendent of Public Works from office, the Governor shall file with the secretary of state a statement of the cause of such removal, and shall report such removal and the cause thereof to the Legislature at its next session. . . ."

It would appear therefore, under the terms of the new Public Works Law, that the present superintendent of public works would automatically become the head of the consolidated department on July 1; that if the Governor were to remove him and reappoint him to succeed himself, then the appointment for the balance of his term would be subject to confirmation by the Senate at the next session of the Legislature in 1924, and if he refused to be removed, a serious question of the right of the Governor to bring about his removal on charges might be raised. Section five of the new law, opening sentence, reads: "The state department of public works as now existing is hereby continued with the powers and duties now vested in such department and the additional powers and duties vested in it by this chapter." Section 11 of the law makes specific transfer of powers and duties to the present superintendent of public works, so that under the terms of the new law, as it reads, the present superintendent of public works is the superintendent of public works and has power to appoint his subordinates.

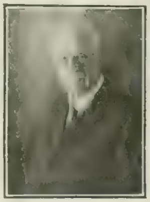
Whoever undertakes to effectuate the plan of consolidation will undertake a difficult task. If he wishes to effect real economy, he will be obliged to discharge a considerable number of recently appointed Democrats from positions; that is the only alternative, while the law itself creates a number of new positions. About the only feature consolidation which might be made is the merger of the three bureaus of bridges now in the state service.

It is also questionable if section nine of the law is not in conflict with the civil service provisions of the constitution and court decisions. It would seem to give arbitrary power for the appointment and removal of employees. Prior to 1894 the rule obtained that the civil service laws of the state did not and could not apply to appointments in the department of public works. That rule was abrogated, however, by the adoption in 1894 of section 9 of article 5 requiring that "appointments and promotions in the civil service of the state. . . . shall be made according to merit and fitness," and it is now well settled that departments in the department of public works are subject to the regulation of the general civil service laws of the state (Per O'Brien, J. in *People v. Roberts* (1896) 148 N. Y. 360, 42 N. E. 1082, 31, L. R. A. 399, affirming 91 *Hun* 101, 34 N. Y. S. 641, 36 N. Y. S. 677).

The successful application of the new law will prove an object lesson to determine the advisability of the consolidation of other departments; its failure to function will constitute an indictment of the entire reorganization plan. Past experience demonstrates that departmental reorganizations seldom give [illegible] of an administrative policy until after several months of functioning.

John D. Isaacs Retires

John D. Isaacs, consulting engineer of the Southern Pacific Ry. Co., retired from active service on June 1, 1923, after 48 years of engineering practice in the railway field. He was born at Richmond, Va., Oct. 6, 1848, was graduated from the University of Virginia, and on March 1, 1875, entered the service of the Southern Pacific as a draftsman. In 1890 he became acting superintendent of bridges and building and a year later assistant engineer, maintenance-of-way. In 1906 he was appointed consulting engineer for the Harriman lines, and in 1913 after the dissolution of the system he was retained as consulting engineer by the Southern Pacific. An appreciation of Mr. Isaacs was given in *Engineering News-Record*, April 15, 1920.



Highway Officials to Meet Dec. 3

The 1923 meeting of the American Association of State Highway officials will be held in New Orleans the week of December 3. A decision to that effect was reached last week by the executive committee which met in Washington. W. S. Keller, state highway commissioner for Alabama, was elected to succeed George P. Coleman, of Virginia, as chairman of the executive committee. Mr. Coleman had served for twelve years. J. D. Fauntleroy was elected a member of the executive committee.

Indianapolis Has Extensive Public Works Program

Sewers, Bridges and Viaducts, River Improvement, Street Work, Parks and City Planning Involved

The city of Indianapolis, Ind., has a large program of work to be done or started during 1923, under the direction of J. L. Elliott, city engineer. Among the projects are the following:

Sewers—On May 1 a contract was awarded for a sanitary sewer system for the north side, which will develop about six square miles of territory. Plans are being made for a new sewer system on the south side, to develop 20 square miles. Various sewer extensions will be made throughout the year as petitioned by property owners.

Bridges and Viaducts—On April 30 a contract was awarded to Todd & Reid for eight concrete arches over Pleasant Run and Pogues Run, under the jurisdiction of the Park Board, the total contract price being $141,000. Plans are being prepared for four concrete arch bridges across White River at Tenth St., Michigan St., Oliver Ave. and Kentucky Ave., in connection with the flood prevention program. These bridges will be from 600 to 900 ft. in length. Another bridge is being designed for Indiana Ave., over Fall Creek, which will be approximately 250 ft. long.

River Improvement—After the flood of 1913, the city constructed a levee on the west side of White River from 16th St. south to the Belt Railroad. War conditions prevented completion of the levee on the east side but plans have now been prepared for its construction.

Street Improvement—The 1923 session of the Legislature passed a law which permits the city to resurface existing streets, charging 75 per cent to owners of abutting property. This law carried with it a $300,000 bond issue for 1923. A total of $400,000 of work in accordance with this law is planned.

Parks—Bids have been invited for four ornamental comfort stations, built of brick and stucco. Bids have been called for on a $40,000 addition to the South Grove Golf House. Plans have been prepared for a wading pool in Military Park, an addition to the swimming pool in Willard Park, a new swimming pool in Rhodius Park and a natatorium in the southern district. A resolution has been adopted for the acquisition of 150 acres of wooded ground northeast of the city to form the nucleus of a new park. A resolution has also been adopted for the construction of another mile of the Pleasant Run Boulevard on the south side and a new boulevard in honor of the World War Soldiers on the north side, 10 to 15 miles in length. A contract has been awarded for paving five squares of Fall Creek Boulevard on the north side of the city with Kentucky rock asphalt and a resolution is now pending in council for the paving of eight squares of the same boulevard.

Track Elevation—Preliminary plans have been made for track elevation on the Union Belt R.R.

City Planning and Zoning—Under the zoning ordinance passed and made effective Dec. 15, 1922, the City Plan Commission is investigating traffic and main thoroughfares with a view to adopting a thoroughfare plan which will improve traffic conditions.

Random Lines

Some Suggested Openings in Rising to Discuss a Technical Paper—All Bearing the Approval of Long Usage.

——I do not know that I have anything to contribute to this discussion, but . . .

——The society is to be congratulated upon the opportunity of listening to so valuable a contribution . . .

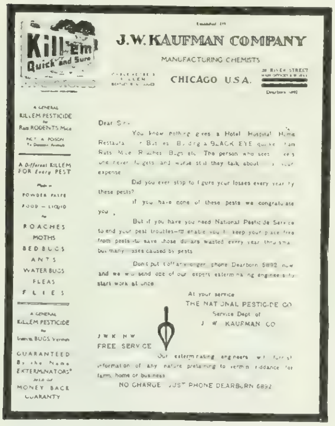
——I regret that I have not had the opportunity of reading the paper, but in glancing over it just now there appear to be one or two points . . .

——The subject this evening is one of the greatest interest particularly that part . . . (here torture some sentence or phrase out of its context and lead from it gracefully into the speaker's pet hobby).

* * *

More Free Engineering

Won't some one in Chicago tell the author of this funereal-looking letter



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Made in POWDER PASTE FOOD — LIQUID for ROACHES MOTHS BED BUGS ANTS WATER BUGS FLEAS FLIES

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Dear Sir:

You know nothing gives a Hotel, Hospital, Home, Restaurant or Business Building a BLACK EYE quicker than Rats, Mice, Roaches, Bugs, etc. The person who sees [illegible] one never forgets and worse still they talk about [illegible] your expense.

Did you ever stop to figure your losses every year by these pests?

If you have none of these pests we congratulate you.

But if you have you need National Pesticide Service to end your pest troubles—to enable you to keep your place free from pests—to save those dollars wasted every year thru small but many losses caused by pests.

Don't put it off any longer, phone Dearborn 5892 now and we will send one of our expert exterminating engineers to start work at once.

At your service

THE NATIONAL PESTICIDE CO.

Service Dept. of

J. W. KAUFMAN CO.

FREE SERVICE

Our exterminating engineers will furnish information of any nature pertaining to vermin riddance for farm, home or business.

NO CHARGE. JUST PHONE DEARBORN 6892

that free services are not being offered now by professional engineers?

* * *

A Dutch engineer reporting on a far-Eastern concrete bridge he had erected writes: "Cracks (shrinkage-cracks, as a consequence of hardening in the dry) have been stated only in the plaster layer up to now. The wildwooden centerings were namely of such a nature that plastering completely was necessary for the good aspect. In some places this plaster layer is even loose from the proper concrete, observed by means of knocking." Some of the friends of concrete sometimes feel that that is the way a lot of people observe concrete structures.

* * *

Higher Education

The new president of the Oklahoma Agricultural and Mechanical College has been escorted into office by state troops to protect him from the students, who don't like his politics or his personality. Why not introduce a pleasing innovation into the curriculum in the way of daily combat maneuvers between the President's bodyguard and the cadets of the Reserve Officers Training Corps.

Buffalo Gravel Firms Found Not Guilty

A jury in the New York Supreme Court has returned a verdict of not guilty in the cases of five firms and three individuals engaged in the sand and gravel business in and near Buffalo, indicted for alleged violation of the State Anti-Trust Laws. The indictments followed an investigation by the Lockwood committee here. The trial lasted eight days.

Over 300 Miles of N. Y. Railroad Affected by Electrification Bill

New York State Assembly Bill No. 1848, known as the Strauss-Kaufmann bill, calling for the electrification of all railroads within the limits of New York City, will affect about 311 miles of track. The law states that "No railroad corporation, operating a railroad within the limits of a city . . . having a population of one million or more, shall, on or after Jan. 1, 1926, use any motive power in the operation of such railroad or part thereof within the limits of such city, except electricity . . ."

To comply with this order it will be necessary for operating reasons, to electrify the whole of some divisions that are only partly within the city limits. On account of this fact the mileage affected is greater than the actual mileage of steam operated railroads within the city limits.

The mileage involved is as follows:

	Miles
Long Island R.R., main tracks and yards	123
New York Central:	
West Side, Manhattan Island main track and yards	88
Yonkers—main tracks and yards	6
Putnam Division tracks and yards	37
Port Morris Branch tracks and yards	12
Baltimore & Ohio yards	2
Staten Island Rapid Transit, main tracks and yards	23
New York, New Haven & Hartford	20
Total	311

Southern Pacific Builds $6,000,000 Line in Mexico

One hundred and three miles of new railway to give the Southern Pacific R.R. Co. access to Mexico City over the lines of the National Rys. of Mexico, are now under construction. The company is doing some of the lighter grading with its own forces and has recently let a $6,000,000 contract to the Utah Construction Co. for the other 90 miles. The location as now revised calls for a maximum curvature of a little over 9 deg. and a maximum grade of 1½ per cent. There will be thirty-three tunnels with a total length of approximately 26,000 ft. and requiring 4,000,000 cu.yd. of excavation. Fourteen viaducts will have an aggregate length of 5,000 ft. and will require 5,500 tons of steel. The contract calls for the completion of the railroad in three years. Track laying and ballasting will be done by the company's own forces.

The new line will provide access by rail to the rich mining area near Ixtlan, State of Jalisco, and will open up an agricultural country devoted to the growing of garbanso and sugar cane. It will also provide a southern outlet for the states of Sonora, Sinaloa and Jalisco.

Don Pedro Dam Completed

Don Pedro Dam, built on the Tuolumne River in California to store water for the Turlock and Modesto irrigation districts jointly, has just been completed and will be dedicated on June 25, the second anniversary of ground breaking.

The spillway which has a capacity of 100,000 sec.-ft. has been equipped with ten gates, each 58 ft. long and weighing 22 tons, which sink into the lip when not in use and which can be raised to increase the reservoir height by 9 ft. The power house built at the toe of the dam is being equipped for an initial capacity of 15,000 hp. The dam is 1,040 ft. long on top, contains 282,000 cu.yd. of concrete and is 280 ft. high. The reservoir capacity is 280,000 acre-ft.

Sacramento Asks Bids on 150-Ton Garbage Incinerator

Bids for a 150-ton garbage incinerator are to be received by the city of Sacramento, Calif., until June 21. The incinerator is to be of the high-temperature, mechanically-charged type, capable of reducing garbage, refuse, and general municipal waste to clinker, and of affording complete combustion and of discharging chimney gases free from dust and objectionable odors. Bidders are to submit their plans, specifications and guaranteed estimate of cost of operation, together with references to other municipalities where U. S. furnaces of their make are used.

Civil Service Examinations

UNITED STATES

For the U. S. Civil Service examinations listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Highway Bridge Engineer—Vacancy in the Bureau of Public Roads, Department of Agriculture, for duty in the field, at $2,400 to $3,600 a year; and vacancies in positions requiring similar qualifications. Applications must be filed with the Civil Service Commission, Washington, D. C., before June 26, 1923.

CALIFORNIA

For the California State Civil Service examination listed below, apply to the California State Civil Service Commission, Sacramento or Los Angeles, Calif.

Associate Highway Engineer, Grade 5, and Highway Engineer, Grade 6, for service in the field under a division engineer, salary $285 to $350 per month. Applications must be filed with the California State Civil Service Commission, Sacramento, on or before June 23, 1923.

NEW YORK STATE

For the New York State Civil Service Examination listed below, apply to the New York State Civil Service Commission, Albany, N. Y., or to any local office of this New York Civil Service Commission.

Assistant Sanitary Engineer — Vacancy in the Division of Sanitation of the New York State Department of Health, for duty in the field on investigation and reports, salary $2,500 to $3,000 a year. Application must be filed with the New York Civil Service Commission on or before June 16.

Engineering Societies

Calendar

Annual Meetings

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; Annual Convention, Ithaca, N. Y., June 20-23.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, Annual Convention, Chicago, July 11-13.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

The Pittsburgh, Pa., Section of the American Society of Civil Engineers at its annual meeting May 31 elected James L. deVou president, R. V. Porter, vice-president, and Nathan Schein secretary-treasurer. The retiring president, John N. Chester, gave an illustrated lecture on "Engineers Who Have Become Famous."

The Buffalo, N. Y., Engineering Society recently elected the following officers: Karr Parker, president; W. L. Spaulding, vice-president; N. L. Nussbaumer, secretary; and E. T. Mathewson, treasurer.

Personal Notes

MAJOR MAX C. TYLER, Corps of Engineers, U. S. Army, has been ordered to proceed to Florence, Ala., for duty as principal assistant to Lieut.-Col. George R. Spalding, in charge of the work on Muscle Shoals. It was the original intention to give Major Tyler charge of the Muscle Shoals work but because of ill health he asked to be relieved of the full responsibility which such an assignment would entail. Major Tyler will be succeeded as district engineer in Washington by Maj. James A. O'Connor.

The **WEEKS CONSTRUCTION CO.**, Dayton, Ohio, has been organized with a capital of $50,000 to do a general construction business.

NORMAN F. BROWN and **CHARLES M. REPPERT** announce their association as **BROWN & REPPERT, INC.**, engineers, with offices in the Commonwealth Bldg., Pittsburgh, Pa. Mr. Brown was formerly in charge of construction for the Pennsylvania R.R. in the Pittsburgh district, and after the war was director of public works in Pittsburgh and later vice-president of the Dravo Contracting Co. Mr. Reppert for a number of years was connected with the department of public works in Pittsburgh and was chief engineer of the Bureau of Engineering in 1921 and 1922; previous to which he was chief engineer and assistant manager of the Housing Division of the Emergency Fleet Corporation. Among the works undertaken in Pittsburgh under Mr. Brown as director of public works and Mr. Reppert as chief engineer were the construction of the Boulevard of the Allies, restoration of Bigelow Boulevard Slip, and improvements on other streets including Brownsville Ave., Broad St., and West Carson St.

EDWARD T. JONES, for the past four years chief engineer of the Stevens & Thompson Paper Co., has been appointed general manager of their mills at Middle Falls, N. Y. During the war, as lieutenant in France, Mr. Jones had charge of the Langres water supply.

THOMAS C. HIGGINS, formerly inspector with the Maine Highway Commission, has been appointed construction engineer of the Sanders Engineering Co. at Gorham, N. H.

CLAUDE V. TURNER has been appointed city manager of Bartow, Fla., to succeed J. W. Greer. Mr. Turner has been employed in Bartow on power plant projects in connection with the development of the phosphate industry in Polk County.

PETER C. HAMMELEF, formerly resident engineer with the Pennsylvania State Highway Department, has recently become associated with Connell, Laub and Bracht, road builders of Parkersburg, W. Va., as engineer.

FRED C. DUNLAP, for the past nine years chief of the Bureau of Surveys, Philadelphia, became chief of the Bureau of Water on June 1, succeeding Carleton E. Davis whose resignation was recently announced in these columns. Mr. Dunlap was formerly chief of the Bureau of Water, having entered the service of the Bureau in 1900 in a subordinate position. Subsequent to being chief of the Bureau of Water he held successively the positions of consulting mechanical engineer to the Bureau of Surveys; chief engineer, Department of City Transit; and chief, Bureau of Surveys. In view of the fact that Mr. Dunlap had previously held the office of Chief of the Bureau of Surveys, the Philadelphia Civil Service Commission, at the request of Frank Caven, director of public works, requested the Commission to waive examinations in the case of Mr. Dunlap as it had previously in the case of Mr. Davis. The alternative to waiving examination would have been what is known in Philadelphia as a "promotion examination" under which the only two persons eligible would have been Mr. Dunlap and Seth Van Loan, the latter having been for some time deputy chief of the Bureau of Water.

W. W. DALZELL was recently appointed city engineer of Iron Mountain, Mich. Mr. Dalzell was previously assistant engineer in the Bureau of Sewerage in the city of Akron, Ohio, in the design and investigation of intercepting sewers and sewage treatment.

R. D. SHORT has been made bridge engineer of the Kentucky Highway Department, having been previously employed in the same organization as a designer.

C. F. PRICE, formerly with the California State Highway Commission, has been appointed city manager of San Mateo, Calif.

HERBERT NUNN, former state highway engineer of Oregon, was appointed general manager and engineer of the Contractors Association of Northern California on June 4. As chief engineer of the Multnomah County (Ore.) system of highways and as state highway engineer of Oregon, Mr. Nunn has, during the past eight years, been in charge of the construction of the Oregon state highway system, including the Columbia River Highway. The membership of the contractors' association is composed principally of general contractors engaged in state, county and city highway and other heavy construction in Northern California. Its head office is in San Francisco.

JOHN R. FREEMAN of Providence, R. I., has been appointed consulting engineer for the city of San Diego, Calif., to investigate and advise the city council on the development of additional water supply in the San Diego river basin.

W. G. KNOX, city engineer of Santa Ana, Calif., has been appointed street superintendent in addition to his duties as city engineer.

C. C. CARLISLE, consulting engineer, Cheyenne, Wyo., has been appointed city engineer following the resignation of D. C. Showers.

JAMES R. POLLOCK, assistant city engineer at Lansing, Mich., has returned to Flint, Mich., to resume work in the city engineer's office of investigating the sewage disposal problem in the latter city.

STEVENS & KOON, consulting engineers, Portland, Ore., have been appointed valuation engineers for the Pacific Power & Light Co. of Portland, Ore.

JOSEPH JACOBS, of Powell & Jacobs, consulting engineers of Seattle, Wash., has been appointed to represent the city of North Yakima, Wash., to make an appraisal of the water-works of that city with a view to the city's taking over the water-works.

ADAM SCHWINN has been appointed assistant city engineer of Dayton, Ohio, to succeed W. C. Wangler, resigned. Mr. Schwinn had been employed many years in the Dayton office.

Obituary

WALTER J. HARRINGTON, a concrete construction engineer, died in Brooklyn, New York, June 6, of pneumonia, at the age of 36 years.

CHARLES SIRRINE, for thirty-five years in the construction business in New York City, died June 7 aged 52 years. Mr. Sirrine had been associated with the Alfred Boote and Frank L. Davis companies.

ARNOLD R. DOE, East Haddam, Conn., superintendent of bridges under the state highway department, died May 24 while submerged in a diving suit in the Connecticut River. In inspecting the piers of the East Haddam bridge, Mr. Doe in diving suit was first successfully submerged for five minutes at a depth of 25 feet and pulled up. He then asked to be submerged the full depth of 40 ft., and the men on the barge, not receiving a signal from Mr. Doe after fifteen minutes, brought him to the surface and on opening the suit, which however had no water in it, found him dead—physicians said from heart failure. The bridge was being inspected to show that there is no danger of collapse.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Practical Hints on Wood Pipe Construction

Manufacturer Suggests Details of Best Practice in Use of Continuous Stave and Wire-Wound Pipe

To INSURE the best service from wood pipe of both the continuous stave and wire-wound types, the Continental Pipe Manufacturing Co., Seattle, has incorporated in a newly published handbook and catalog a number of practical suggestions covering details of construction and maintenance. The following notes cover the main points:

While wood pipe can be laid by inexperienced workers if they follow the directions which come with the pipe it is usually best to employ experienced men, constantly doing work of this character, who are kept on the payroll of the manufacturing company to be sent out on work on a per diem basis. Pipe should be unloaded carefully from cars so that the tenon or mortise ends will not be broken or wires or surfaces of the pipe injured. The laying of wood pipe requires care and precision, and joints must be driven snugly home without abusing the pipe in the process.

Laying Pipe

Wood pipe for all purposes, when untreated, should be either completely buried in non-porous soil or left completely exposed resting on supports clear of the ground. Especially with the larger sizes of pipe wooden or concrete cradles should be employed. With an exposed pipe repairs can be quickly made and leaks readily detected. Where silt is encountered in lines blow-offs should be used, so that accumulations may be readily removed.

The pipes, if buried, should be well covered with material free from vegetable matter which rots and leaves the ditch porous to surface waters and the atmosphere. Too little attention is given to backfilling the pipe trench. Rocks should not be left under the pipe nor packed against it. A finer material should be used under and about the bottom of the pipe than at the sides and top and should be well compacted either by hand or by puddling with water.

Uncreosoted pipe should either be kept entirely above ground or placed well below the surface and backfilled. An alternate wet and dry condition is exceedingly detrimental and has been the cause of nearly all complaints regarding wood pipe lines. This condition cannot always be avoided and in such instances the pipe manufacturer recommends the use of creosoted staves.

Pipe Line on Curves

In the location of wood-stave pipe lines it is preferable to provide fairly sharp curves and long tangents, instead of easy curves and short tangents. The accompanying table indicates safe radii of curvature for different diameters of continuous stave pipe.

The practice is recommended of dropping the grade of the pipe as quickly as possible from the intake to a point 25 to 50 ft. below the hydraulic gradient, so that the pipe may always be kept full of water and the staves at the top as well as the bottom become saturated. In localities where the upper end of the pipe line cannot be maintained under pressure the upper end of the line may be made of creosoted material while the lower end may economically be laid with untreated pipe.

SAFE RADII IN FEET FOR CONTINUOUS STAVE PIPE

Diam. ft.	Thin Shell	Thick Shell
2	100	115
3	115	125
4	125	150
5	150	175
6	200	225
7	275	300
8	350	400
9	450	500
10	...	600
11	...	650
12	...	700
13	...	775
14	...	850

In placing air valves it should be kept in mind that the greatest accumulation of air is not necessarily at the extreme high point, as the velocity of water may carry the air beyond the summit a short distance, depending upon the grade of the pipe. An air vent should be placed at points where the pipe drops with increased gradient, so that in cases of heavy draft, a vacuum will not cause the collapse of the pipe.

In dredging or sluicing operations wood pipe, when worn on the bottom, may be turned one-quarter way and each pipe section used four times. For carrying heavy sluiced materials there is provided a special type of spoil pipe with a bottom made of removable wood blocks, which can be replaced when worn.

Sales Managers to Organize on National Scale

At a recent meeting held at the New York Advertising Club by a committee representing the New York Sales Managers' Club and the Sales Managers' Clubs of Philadelphia, Boston, St. Louis, Milwaukee, St. Paul and Columbus, it was decided to organize the National Association of Sales Managers, the first meeting to be held at Atlantic City, June 7, directly following the convention of the Associated Advertising Clubs of the World. Membership in the Association will be confined to sales managers, either as individuals or as a club membership.

The object of the association is, through co-operation, investigations and systematic interchange of ideas, to secure for members the benefits of the best and most economical methods in the sale, marketing and distribution of merchandise. Charles F. Abbott, 26 Madison Ave., Montclair, N. J., was elected chairman of the forthcoming meeting. Sales Managers throughout the country are cordially invited to attend the first conference and further information may be obtained by addressing the Chairman.

Railways and Shippers Organize Regional Advisory Boards

For the purpose of bringing about the fullest measure of co-operation between the shippers and the railroads of the country, to give the shipping public a direct voice in the activities of the Car Service Division on all matters of common interest, regional advisory boards, composed entirely of shippers and selected by the shipping public itself, are being organized in various parts of the country by the American Railway Association. These boards will work in conjunction with the district manager of the Car Service Division, together with representatives of the railroads in the various districts. Regional advisory boards have already been organized in five districts.

Trade Report on British and Dutch East Indies

The Department of Commerce has just released a new report (Special Agents Series 218) in its series of Commercial and Industrial Handbooks, entitled "Netherlands East Indies and British Malaya," by Trade Commissioner Fowler. The book, a work of 411 pages, the result of Mr. Fowler's three years residence as trade commissioner to the Netherlands East Indies and British Malaya, goes into detail on the mineral resources and the industrial and agricultural development of the territory under review. He presents a thorough study of the dominant industries, gives detailed statistics on imports and exports of primary products, reviews the import needs, gages the future prospects and offers suggestions to American business men who wish to launch their products in these fields.

Our direct trade with these sections of the Far East now averages more than $300,000,000 annually and Mr. Fowler is optimistic as to future expansion. The book costs $1 and may be obtained from the Superintendent of Documents, Government Printing office, Washington, D. C.

Study Effect of Immigration Cut on Industry

Immigration statistics for 1922 with relation to the 3 per cent restriction law, while showing that "unquestionably the law greatly reduced the volume of immigration," do not afford a certain basis for estimating the future effect of the act on the industrial labor situation, according to a recent report of the Civic Development Department of the Chamber of Commerce of the United States. The survey was the basis of the report of the Immigration Committee of the National Chamber, recently made public, and which recommended retention of the 3 per cent restrictions, coupled with an additional 2 per cent quota allowance in case of demonstrated need to be employed in making a practical test of selective restriction methods. Action by the National Chamber on the committee report is expected during the annual meeting of that body in New York this month. The survey showed that in 1922 (fiscal year), the first year in which the 3 per cent law was operative, excess of aliens admitted over aliens departed was 87,121 as compared to 552,132 in 1921 and 769,276 for the last comparable pre-war year, 1914.

Highest Court Holds Price Interchange Unlawful

American Linseed Oil Co. Enjoined From Exchanging Trade Data, Reversing Lower Tribunal

Washington Correspondence

Manufacturers in the same industry cannot exchange information as to sales and prices practically as a unit controlling the business of the industry without coming into conflict with the Sherman law, even though the information be cleared and distributed by an independent agency, the United States Supreme Court held June 4 in a decision reversing the action of the District Court for Northern Illinois in holding for the defendants in the government's suit against the American Linseed Oil Co. and eleven other crushers, and the Armstrong Bureau of Related Industries. The opinion, read by Associate Justice McReynolds, directed the District Court to grant the government the injunction it had sought.

The twelve linseed oil manufacturers were subscribers to the Armstrong Bureau. They are alleged to have controlled a large part of the business of their industry. They agreed to turn over to the Bureau full reports of sales, quotations, offerings and other information. They were to receive through the bureau data on the market, trade and manufacturing conditions in the industry, economies in manufacture and sale, information regarding credit of buyers, uniform cost accounting systems, fair freight rates, standardization of products and other information and help.

The District Court held that this agreement was not unlawful and denied the government's petition for an injunction against the practice as a violation of the Sherman act.

Business Notes

SURPLUS STEEL EXCHANGE, INC., New York, has been formed to dispose of excess stocks of steel. A commission will be charged only on sales made, as the organization does not propose to purchase material but acts solely in the capacity of agent. The officers of the new company are Robert D. McCarter, president; George E. Dix, vice-president; William L. Cooper, treasurer, and Edward Michaud, secretary and general manager.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO., East Pittsburgh, Pa., announces the acquisition of the plant of the Savage Arms Corp. at Sharon, Pa., which will be remodeled and equipped for the manufacture of transformers. At the new works, which will be in operation in the fall, C. H. Champlain, formerly assistant works manager at East Pittsburgh, has been appointed works manager and M. I. Fawcett has been made superintendent.

GEORGE W. CRAIG, for ten years city engineer of Calgary, Alta., has been appointed district engineer for the Portland Cement Association with offices in Chicago.

MINE & SMELTER SUPPLY CO., with branches in Denver, Salt Lake City, and El Paso, has taken over exclusive representation for Colorado, Utah, Nevada, Wyoming, New Mexico, and western Texas of the plastic arc welders and color-tipt welding metals manufactured by the Wilson Welder & Metals Co., New York.

HARRISBURG MANUFACTURING & BOILER CO., Harrisburg, Pa., recently opened a sales office in the Park Row Building, New York City. The company builds boilers, tanks, steel stacks, breechings and entire lines of machinery for companies not having their own shops.

HOWARD E. BOARDMAN, for the past seven years engineering assistant to the general valuation counsel of the New York Central Lines, located in New York, recently resigned to become president and treasurer of Foster, Merriam & Co., Meriden, Conn., manufacturers of brass and grey iron castings and cabinet hardware.

WEBSTER MANUFACTURING CO., Chicago, announces further expansion of its Canadian business. A new corporation, the Webster-Inglis, Ltd., 14 Strachan Ave., Toronto, has been formed. The new plant will design and manufacture elevating, conveying and power transmission machinery along the same lines as now manufactured by the Webster company.

Equipment and Materials

Spring Scraper Truck Attachment for Road Maintenance

For the maintenance of earth and gravel roads a spring scraper blade attachment, designed to be bolted to the chassis of a motor truck, is manufactured by the Root Spring Scraper Co., Kalamazoo, Mich. The device employs the same principle as has been used by the company in the manufacture of its snow scrapers for street cars. The scrapers are manufactured in several sizes to suit any make or capacity of motor truck. For a truck of 1 ton or less capacity a four-spring scraper, 9 ft. long, is supplied. For a 2-ton truck, the scraper length is increased 1 ft., and for trucks of over 2 tons capacity the 10 ft. length of blade is employed and the number of springs increased to five.

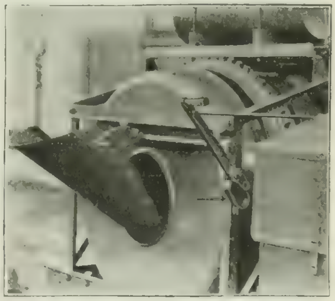
The blade is of high carbon spring steel 8 x ¾ in., with an extra strip, oil-tempered, 3 x ¾ in. on the lowest cutting edge. The strip is made so that when one edge is worn it can be turned over and the other edge used. The springs are 6 in. wide and ½ in. thick.

As shown in the accompanying photograph, the scraper is installed between the wheels of the truck at an angle of about 45 deg. across the body and is operated by a windlass double ratchet wheel and chain, running in a 12 in. sheave on the scraper shaft. The top of the hanger board is carried by brackets 21 in. above ground, which are in turn bolted to the truck frame When not in use the scraper can be released and turned up underneath the truck.

With the scraper on earth or gravel road maintenance a truck speed of from 6 to 8 miles per hour is recommended, while for snow removal speeds of 15 miles an hour or more may be attained.

New Chute Mechanism for Concrete Mixer

For operating the discharge chute of its 7-S concrete mixer the T. L. Smith Co., Milwaukee, has developed a new mechanism. The operating lever is pivoted to a short arm keyed to the shaft to which the chute is attached. When the operating lever is moved a small roller, attached to the end of the lever, follows the outline of a cam bolted to the mixer frame. Except for the rod which extends across the mixer to enable the chute to be operated from the other side, these few simple parts constitute the complete discharge operating mechanism.



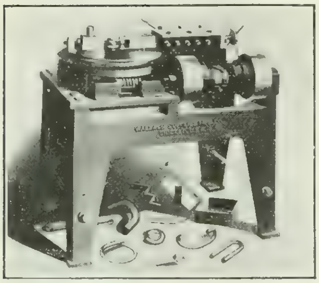
In the illustration the lever is shown in its extreme forward position. The chute is locked securely in the position for mixing and interferes in no way with the mixing action. Pushing the lever back moves the chute into the discharging position. In the full discharge position the chute is locked and does not have to be held. The peculiar shape of the cam provides the locking feature in each position, no other arrangement being necessary. Releasing the chute from either position is merely a part of the operation of moving the chute from one position to the other. The operator simply moves the handle forward or backward, according to the position of the chute.

New Large Revolving Shovel

To meet a demand for a large revolving shovel for coal stripping, iron and copper mining and large construction projects the Bucyrus Co., South Milwaukee, Wis., is now offering a new shovel, known as the 320-B, which has superseded its 225-B revolving shovel. This new machine follows in the main the general features of the 225-B. It carries the same size standard dipper, 7½ cu.yd. capacity, heaped measure, but is equipped with an 85 ft. boom. The shipping weight has been increased from [illegible] lb. in the case of the 225-B to 625,000 lb. in the new machine. This added metal has been distributed in vital parts of the machine where the greatest strains are imposed. A number of these machines have already been sold in various parts of this country.

Bar Bending Machine

For bending metal bars—rounds, squares, flats, tees, angles, and channels—the Wallace Supplies Manufacturing Co., Chicago, has placed upon the market a bending machine equipped with pulleys for belt drive. For cold bending the capacity of the machine is 1 in. diameter squares or rounds, ⅜ x 2-in. flats, and 2 x 2 x ¼-in. angles.



The bending machine occupies a floor space of 3 x 4 ft. and is 3 ft. high. It weighs 950 lb. and may be driven by a 3-hp. motor. The speed of the rotating table is 6 r.p.m. A fair average production estimate for ordinary cold bending to 180 deg., the manufacturer states, is 150 pieces per hour based on rounds, squares, and flats bent flatwise.

The machine is started by a hand lever and there is an adjustable mechanism which stops the rotating table at any predetermined point so that materials can be bent identically to any desired number of degrees.

Publications from the Construction Industry

Transportation for Road Building—GENERAL MOTORS TRUCK CO., Pontiac, Mich., in a 16-p. booklet entitled "Money-Saving Transportation for Road Construction and Maintenance," shows a wide variety of the uses of its motor trucks on highway construction contracts. Among the subjects discussed are: Batch charging with motor trucks, in which advantages are claimed for the multiple-batch-body instead of the light one-ton truck carrying a single batch; motor trucks versus industrial railways; body equipment; loading and turning trucks.

Steel Forms for Concrete Floors—BLAW-KNOX CO., Pittsburgh, in a 12-p. illustrated bulletin, explains the use of its removable pan system for ribbed slab floors. The pans are steel soffits of No. 14 gage, no lumber being used, except in the shoring. The saving in lumber is one of the big economies claimed for the system of steel forms. The bulletin contains a double-page reproduction of a blueprint illustrating in details the various steps in setting up and removing the forms. The pans are furnished in depths of 6, 8, 10, and 12 in., are 6 ft. or 8 ft. long, and provide for 25 in. center to center of joists.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Production and Material Stocks in Ten Cities

Record Iron Output—Steel, Lumber, Cement Increasing—Fewer Burned Brick—Rail Shipments Better

Iron and Steel—Pig-iron output during May averaged 124,764 gross tons per day as against 118,324, for the preceding month. This rate represents the heaviest on record in the history of the industry.

Steel ingot production, according to the Iron and Steel Institute, totaled 3,537,753 tons during May as against 3,321,278, for the month preceding. The following table shows output in gross tons during the first five months of the current year as compared with the corresponding period in 1922:

	1923	1922
January	3,251,694	1,593,482
February	2,919,017	1,745,022
March	3,402,007	2,370,751
April	3,321,278	2,444,513
May	3,537,753	2,711,141

Unfilled steel tonnage figures issued by the U. S. Steel Corporation, totaled 6,981,351 tons, May 31, against 7,288,509, April 30 and 7,403,332, March 31, 1923.

Lumber—The National Lumber Trade Barometer, June 8, shows production at 5 per cent above normal; shipments, 106 per cent and orders, 82½ per cent of normal production. In other words the present situation is one of increased production and shipments with a falling off in demand. One year ago production was nearly 5 per cent below normal with shipments 100 per cent and orders 97½ per cent of normal production. The following table shows lumber movements this month, compared with last:

	Four Weeks Ending	
	June 2, M. Ft.	May 5, M. Ft.
Cut	1,102,856	1,036,778
Shipments	1,035,352	1,018,967
Orders	857,074	949,078

Cement—Stocks on hand throughout the entire country May 1, totaled 11,450,000 bbl. as aganist 14,470,000, for the corresponding period in 1922, according to the Geological Survey. Production during the first four months of the current year amounted to 36,991,000 bbl., against 24,497,000, for the corresponding period in 1922 Shipments from January to April, 1923, inclusive, totaled 34,625,000 bbl., compared with 21,810,000, during the first four months of last year.

Brick—Burned brick on hand totaled 150,316,000 as of May 1, compared with 181,298,000 for the month preceding, according to the Common Brick Manufacturers' Association of America. Orders on books increased 852,000 in one month. Demand has been more pronounced during the last thirty days in every district of the country except New York and New England, the Middle Atlantic states and the agricultural belt just west of the Mississippi. In Illinois and in eastern Pennsylvania and New Jersey demand has grown in volume from 200 per cent to 400 per cent.

San Francisco—Large reserves of road oils, asphalt and reinforcing bars. Supply of structural rivets, somewhat low a month ago, has improved. Shortage of cement threatened. Stocks low on blue annealed steel sheets. Other construction materials stocks in fairly good condition.

Los Angeles—Slight shortage of sewer pipe. About half enough cement in dealers' warehouses. Hollow tile demand strong but no shortage of material. Heavy lumber reserves at harbor. Steel mill shipments take two to three months. Ample supplies of other materials.

Denver—About 500,000 brick on hand; supply dropped to one half of last month's reserve. Mill deliveries of materials moving easier since settlement of strike difficulties.

Minneapolis—Cement, lime, brick, tile, etc., reported readily obtainable, though no great amounts are on hand

Freight Loadings Near Record

A total of 1,014,029 cars were loaded with revenue freight during the week ended on May 26, according to the Car Service Division of the American Railway Association. This total is not only by far the largest loading ever reported for any one week at this season of the year, but has only been surpassed twice before for any week in any year in history, both of which were in the fall when traffic is always heaviest due to crop movement. Loading for the week of May 26 was only 4,510 cars below the total for the week of October 14, 1920, when 1,018,539 cars were loaded, the largest number for any week on record.

New York Bricklayers Still Refuse $11 a Day

According to an announcement made last week by Thomas B. Clarke, president of the old Building Trades Council, New York City, 38 of the 44 crafts included in that organization had accepted the $1 bonus offered by the Building Trades Employers' Association. Of the six crafts still negotiating for an increase the glaziers voted in favor of a strike.

Other developments of the week in the New York district included the refusal of the largest local of the bricklayers' union to accept terms of $1.37½ an hour or $11 a day for the next two years, as proposed by a group of the building industry headed by R. H. Shreve. It has been estimated that the striking bricklayers are holding up $200,000,000 worth of work in the metropolitan district.

Franklin D. Roosevelt, president of the American Construction Council, last week disclaimed any attempt on the part of that organization to bring about a 90-day suspension of construction throughout the country, as charged by certain brick manufacturers and lumber men.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Lumber, Minneapolis, 60,000,000 ft.), time required for delivery of carload lots to city job, example: (hollow tie Atlanta 4 @ 5 days), and stocks on hand in general terms, example: (brick, New York, scarcity.)

	San Francisco	Los Angeles	Denver	Minneapolis	Detroit	Chicago	Cincinnati	New Orleans	Atlanta	New York
Sewer pipe.....	Stocks in good condition	Slight shortage	Del. 24 hr., local plant	Shipments easier	Ample	Stocks in good condition	Plenty	Sufficient to meet all demands	Del. take 4 @ 5 days	Mill del. slow; 10 days to 2 weeks
Cement ...	Limited supply	Scarcity	Normal	Readily obtainable	Plenty available	Fairly well supplied	Well supplied	Ample	About 50 cars	Stocks in city small; mill shipments quick
Lime	Fairly well stocked	Plentiful	Sufficient	No great amounts in warehouses	Plenty	Del. in 24 hr.	Enough	Plenty	About 60 cars	Dealers' stocks small; mill del. prompt
Common brick.	Reserves in good condition	Supply ample	500,000	No heavy stocks in yards	Enough; no large surplus in yards	Shortage; del. take 2 @ 3 wks.	No scarcity	Enough for present construction	Plenty	Scarcity; strikes in yards
Hollow tile.....	Stocks in excellent shape	Demand strong; no shortage	Stocks normal	Shipments better	Enough for immediate needs	Del. take 7 @ 10 days	Sufficient	No shortage	Del. take 4 @ 5 days	Recent shipments from plants heaviest on record
Lumber........	Heavy shipments continue	Large stocks at harbor	Mill shipments easier	60,000,000 ft. in yards	Moderate stocks on hand	Stocks in good shape. Del. take 30 @ 60 days	Shortage	Pine stocks low	Plenty pine	Del. take 5 @ 6 wk. from mill
Asphalt.......	Heavy native stocks	Well supplied	About 10 cars	Plenty	Small stocks; quick shipments	Limited supply	.....	None in stock	About 50 cars	Heavy reserves in N. J.
Structural steel.	Structurals, fair; rivets, improving	Demand steady. Del. take 2 @ 3 months	Warehouse stocks sufficient	Mill shipments improved	No shortage	Mill shipments heavy	Del. from mill in 6 @ 8 wks.	Enough in warehouses	About 6 cars	Del. take 30 @ 60 days from mill

in warehouses or yards because of the ease in getting prompt shipments from sources. Lumber in Twin City yards normal for season, 60,000 to 75,000 M. ft., estimated. Noticeable showing up in building operations in last several weeks leaves yards well supplied.

Detroit — Construction materials available for all building needs. Dealers increasing stocks, previously depleted. Car shortage anticipated; materials being accumulated to forestall this condition.

Chicago—Little change in conditions of materials stocks during month. Shortage of brick continues; asphalt supply limited; plenty of other materials.

Cincinnati—Scarcity of lumber; other building materials plentiful.

New Orleans—Stocks of yellow pine low; other construction materials on hand ample to meet all demands.

Atlanta—Plenty of brick and lumber. Sewer pipe and hollow tile deliveries take from four to five days. Between forty and fifty cars of cement; fifty and sixty cars of lime; fifty cars of asphalt and from four to six cars of structural steel, on sidings.

New York—Dealers' stocks small because of limited space and usually quick mill deliveries by rail and water. Present scarcity of brick unprecedented. In former years some brick usually remained over from the preceding season, frequently lasting up until early summer. This year no 1922 brick are in sight and the new output has not yet entered the market to an appreciable degree. Sand, gravel and crushed stone situation improved.

Labor Unions Establish Bank in New York City

The Federation Bank, opened a few weeks ago in New York City, is a new type of labor bank. Single unions have organized banks within the past year of two, but so far as is known this is the first one which is a co-operative institution. In the beginning it had 142 unions, representing all the various trades and branches of industry in New York City and it was organized by the central labor body of the city on a co-operative basis. Its directors are not entirely trade unionists. About 60 per cent are of that class, the others being made up of financiers and business men who were individual subscribers in its formation.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 349 to 362, are the following large projects:

Library, Cleveland, O., to Lundoff-Bicknell Co., $4,000,000.

Coagulation basin, Cleveland, O., to Stange-Walsh Construction Co., $1,365,425.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 349 to 362, are the following:

Hotel, New Orleans, La., for the Grunewald Hotel Co., $3,000,000 to $4,000,000.

High school, Brooklyn, N. Y., for Board of Education, $2,000,000.

Canal, Wichita Falls, Tex., for Wichita Co. Irrigation Dist. No. 1, $1,500,000.

Office building, New York, N. Y., for Fifth Ave. and 46th St. Corporation, $1,000,000.

Decline in Lumber Movement Has Been Checked

Reports received June 7 by the National Lumber Manufacturers Association from the various regional lumber manufacturing associations, indicate that the decline in the lumber movement, which has continued for some time, has been checked. All the reporting mills give shipments as 96 per cent, and orders as 74 per cent of production. Southern pine mills by themselves show similar percentages of 102 and 64 respectively, and the West Coast mills 118 and 96. All but 32 of the mills represented in the compilation have established normal production figures for the week, and with respect to these their actual production was 106 per cent of normal, shipments 107 and orders 82 per cent of the same.

For the first 22 weeks of 1923 and the corresponding period of 1922, the lumber movement by association mills is as follows:

	Production	Shipments	Orders
1923	5,240,206,937	5,685,226,723	5,742,306,525
1922	4,296,022,595	4,405,941,852	4,831,310,012
1923 Increase	944,184,342	1,279,284,871	910,996,513

Business Conditions Surveyed

Production and trade continued in large volume during April, according to the monthly review of credit and business conditions by the Federal Reserve Bank, New York, but there was some slackening of business activity in the latter part of the month and during the early weeks of May, partly on account of seasonal influences. The Federal Reserve Board's index of production in basic industries declined about 1 per cent in April.

Production of lumber, anthracite and mill consumption of copper decreased, while there were increases in the output of pig iron and petroleum. There was a further increase in the value of building contracts awarded in April, but the value of building permits issued in 168 cities was 16 per cent less than the record figures of March. The decrease is said to be due chiefly to a curtailment of new projects in New York, as the aggregate value of permits at other reporting cities showed an increase of 20 per cent. Carloadings continued to be much larger than in the corresponding weeks of previous years, owing chiefly to heavy shipments of manufactured goods. In spite of present heavy traffic the shortage of freight cars has largely disappeared.

Employment at industrial establishments continued to increase during April, although plants in Eastern states reported some reductions in their forces and there was an increase in those states in the number of [illegible] working part time. Increases in wage rates were announced by many concerns and average weekly earnings of factory workers increased about 1 per cent.

The general index of wholesale prices

of the Bureau of Labor Statistics showed no change between March and April. Prices of building materials, metals, cloths and clothing were higher in April than in March.

In May, as in April, money rates continued to become slightly easier, in accord with the usual seasonal tendencies. Commercial paper sales were somewhat more generally at 5 per cent and in a few cases were 4¾ per cent compared with prevailing rates of 5 to 5¼ per cent a month ago.

Freight Car Shortage Reduced

Despite the fact that the number of freight cars loaded with revenue freight is now the largest for this time of year in the history of the railroads, shortage in freight cars has virtually disappeared, according to reports filed May 24 by the carriers with the Car Service Division, American Railway Association.

Shortage in freight cars for the country as a whole on May 14 totaled 23,761, which was a decrease of 4,555 since May 7. Compared with the car shortage on Jan. 1, 1923, this is a decrease of nearly 60,000 cars, with a decrease since April 1 of 45,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 3; the next, on June 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.64	$4.30	$4.50	$3.40	$3.55	$4.20	+$3.95	$4.10	+$4.25
Structural rivets, 100 lb	4.40	5.00	+4.95	3.75	4.25	+5.40	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb	3.54	4.25	3.70	3.32½	3.45	3.85	3.65	4.10	4.00
Steel pipe, black, 2½ to 6 in. lap, discount	+44%	—52%	45%	+47%	53-5%	36%	35.2@47.6%	40%	32.76
Cast-iron pipe, 6 in. and over, ton	62.50@63.50	+55.00	63.00	60.20	60.50	69.00	60.00	70.00	60.00
Concreting Material:									
Cement without bags, bbl	2.70@2.80	2.85	2.25	2.20	2.39	2.84	2.71	2.90	2.25
Gravel, ¾ in., cu.yd	2.25	1.90	2.25	2.00	+1.85	1.90	2.15	1.25	1.50
Sand, cu.yd	1.25	1.24	1.95	2.00	+1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd	1.75	2.00	2.50	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	65.00	42.00	53.00	—58.50	—44.75	+60.00	41.00	+32.00	90.00
Lime, finishing, hydrated, ton	18.20	23.50	22.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	3.00@3.25	1.50	2.50	1.50	1.50	2.70	1.75	2.80	—10.00
Common brick, delivered, 1,000	23.50	14.00	12.90	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	+.109	.115	.1032	.0836	.065	....	.11	.115
Hollow partition 4x12x12, per block	.1573	+.109	.115	.0825	....	.065	.108	.11	...
Linseed oil, raw, 5 bbl. lots, gal	1.16	—1.24	1.35	1.37	1.29	1.39	1.24	.86	1.38
Common Labor:									
Common labor, union, hour	.75	.35	....	......	....	.50@.55	.55	....	..
Common labor, non-union, hour	....	.30	.30@.50	+.85	+.55	.35@.50	.50	.50@.62½	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 81¼c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.65½). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Heavy steel rail buying constitutes the principal feature of the current market; car materials, tank and ship plates also in demand at Pittsburgh mills. Production continues at a high rate with increasing improvement in mill shipments. Demand assuming conservative proportions as better deliveries induce buyers to show less concern over forward requirements. The $2.50 base holds firm for structurals, with the maximum on plates at $2.60 per 100 lb. for prompt deliveries. Bars at minimum of $2.40, f.o.b. Pittsburgh.

Some advances in steel structurals reported in Dallas, Denver, San Francisco and Montreal. Cement and brick prices remain fairly firm throughout the country. Lumber prices have changed but little recently. Denver and Seattle, however, report advances in Douglas fir; Minneapolis, a decline in fir and Chicago a drop in yellow pine timbers, during the last two weeks. Linseed oil dropped 2c. per gal. in Atlanta; no other changes in oil reported. Both 40 and 60 per cent gelatin dynamite dropped ½c. per lb. in New York, effective June 6.

Latest changes in the labor situation may be briefly stated as follows: **Seattle**—Journeymen plumbers and steamfitters advanced to $10 per eight hr. day; helpers to $6, effective June 1. San Francisco—Carpenters union demands $9 per day as minimum wage, against $8, as at present. **Chicago**—Bricklayers advanced from $1.15 to $1.25 per hr; structural iron wrokers, from $1.05 to $1.25; hoisting engineers receive $1@$1.25; hodcarriers 88¾c. and common laborers, 82½c. per hr. according to the new scale effective June 1. Bricklayers and strucural iron workers on closed shop basis. **New York**—Plan proposed to grant bricklayers $11 per day for two and one-half years. Bricklayers demand contract at $12 per day for two years. Employers previously offered agreement of $10 per day for two and one-half years. Thirty-eight of the forty-four crafts belonging to the old Building Trades Council have accepted advances of $1 per day offered by employers. Six crafts are still negotiating for wage advances with only one, the glaziers, voting to strike.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *Presiden*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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A Rational Change

TWO cement companies, Marquette and Universal, have changed over from the barrel to the sack as the unit for selling and invoicing cement. This is a rational change that has against it only the minor objection of requiring more figures to express amounts. In all other respects the sack unit is preferable. The barrel has only historical interest in the domestic cement market, for the sack is the universal container and, because of its equivalent content of one cubic foot, is well nigh the universal unit of measure in estimating. The saving to both purchaser and buyer in avoiding the conversion factor 4 in reckoning back and forth from sack to barrel is a step toward economy well worth taking.

Industrial Relations Court Restricted

WHILE the Kansas Court of Industrial Relations is not killed by the recent decision of the United States Supreme Court, as most of the newspaper comments assume, its activities are unquestionably seriously restricted. The case in point was decided on a special issue, viz., the definition of an emergency which permits a state to assume that a business has a public interest and therefore subject to state control. The Supreme Court says in effect that in this case no such emergency did exist and therefore the state has no right to step in to "curtail the right of the employer on the one hand or of the employee on the other to contract about his affairs." Such a decision was foreshadowed when the Industrial Court tried to endow with public interest the wage relations of a small packing company and its workmen. Whether its authority will be denied in controversies of obvious public interest remains to be seen. Whatever be the practices of the court, the idea in its formulation was a good one. To protect the public in industrial warfare is a desirable function of the state. That both management and labor have been denouncing the court is fair evidence that it has not been partial and that it has intended, at least, to serve the public in the way for which it was designed. Its activities are bound to be kept within proper legal limits by court decisions, and it is hoped that it will learn by this latest decision just how far it can go in its future performance.

Interstate Power Transmission

THE latest group of decisions of the United States Supreme Court have particular interest to the engineer. We have already called attention to the rate cases with their reiteration of the reproduction-cost-new theory of value, and to the Kansas Industrial Court decision. A third case, more important in its implications than in its direct application, is the West Virginia natural gas ruling noted in the news columns this week. Natural gas is a disappearing commodity so that few need worry about its future disposition, but electrical energy, especially that generated by falling water, is the power source of the future. If it is to be permitted any state to prohibit the transmission of such energy outside of the state where it is generated—as the state of Maine now prohibits—the full development of the country will be seriously hampered. It is inconceivable that the barrier of state lines will be continued into that not distant future when so-called super-power schemes with intertied transmission lines become an economic necessity, but the tendency of certain eastern states is toward such an end. The Supreme Court's decision that natural gas cannot be kept within the state would seem to point to a future application of the same rule to the analogous electric transmission situation and to a reversal of the home-use-only tendency of some of the states.

Cost of Detouring

COST of detours is an item which the average traveler seldom includes when he thinks of the expense of constructing roads. Engineers know that detours cost money, but even they do not give this cost the consideration it deserves perhaps because the main item is increased vehicle-operation cost, which is paid by the motor car owner and never gets onto the construction cost sheet of the engineer's report. Ordinarily the highway official keeps detours in good shape for travel and continues them no longer than he must because he respects the irritation of traffic driven out of its usual route. The fact that the detour adds to the car mileage of all who must travel that way is rather ignored in comparison, and perhaps wisely, since the traveler himself does not think of it greatly so long as the going is good. Yet in Wisconsin last year, as is told in this issue, an average of 1,320 vehicles a day for 81.6 days traveled 2.15 miles further than by the original route on 159 detours. At the reasonably low cost of 10c. a car mile for motor vehicle operation these figures give $3,686,000 as the extra operating cost due to detours in a state having a construction program no greater than that of perhaps a score of main road building states. This sum contains nothing for the direct cost of detour marking and upkeep nor does it include indirect costs which can be thought of, as for example drivers wages in motor-truck haulage. Detours are one of the costs of paved-road work and although they are an unavoidable cost and one which the improvement may return they are nevertheless real costs which the public at the moment must pay and their reduction is a worthy problem for any state highway department.

Fire-Protection Progress

NOT often is the meaning of forty years' advance in fire protection outlined so strikingly as in the case of the great Philadelphia trainshed which was destroyed last week. Under modern practice the fire would have been impossible; the large loss, and the disorganization of a great railroad machine, would have been saved, and the imminent risk of a shocking list of casualties—which fortunately did not materialize under the circumstances—would also have been eliminated. The views of forty years ago tolerated the practice of placing a huge building of public assembly, filled with high values and during most of the twenty-four hours full of people, over a combustible floor and, what is much worse, a floor honeycombed with closed wood-lined spaces in which a conflagration might breed unnoticed. It is now many years since the bad fire hazards residing in such construction have been fully realized and largely made impossible in new building. The advance in both the science and the art of fire protection has been steady, but sufficiently unobtrusive to be little noticed by the general public. The continuance of existing hazards, created long ago, is a natural sequel. Moreover, even the most hazardous construction frequently finds itself validated, in effect, by a long period of safe existence, during which good fortune, coupled perhaps with constant watchfulness, keeps fires from happening, and the structure thus builds up a history of constant safety. Fortunately, the development of the study of fire hazards is sufficiently developed to be able to analyze even such time-approved risks and point out their dangers and how to correct them. In short, fire protection, though it may yet have far to go, has achieved most remarkable progress within the past two generations. In order that this advance may be fully applied to the public advantage, however, it is of utmost importance that existing hazardous points should be restudied, no matter how long their history of safety, and that such protection and safeguarding be added to them as the modern resources of the art make available.

A Neglected Resource

IF the resources of modern bridge construction are to be made fully available for the solution of the community's needs, more particularly in the field of highway construction, a restudy of suspension bridge possibilities is a necessary step. More or less by tacit consent the type has been relegated to a field of rather infrequent service, namely, long-span highway service, with only sporadic application to long-span railway or short-span highway crossings. It has been considered unsuitable for short spans, very largely, no doubt, on the ground of excessive flexibility under the high load concentrations of railways trains—or, to take the other side of the case, the cost and difficulty of making a suspension structure rigid under such service. Generalizing from the conclusions based on railway service is of doubtful validity, however; the fundamental requirements of highway service are quite distinct. It has been difficult to approach a more precise study of highway suspension possibilities, because no sound basis for fixing permissible deflections—that is, the required minimum degree of rigidity—has become established. Thus, the discussion presented by O. H. Ammann in this issue reopens a subject of marked present-day importance. With the aid of further thinking in the same field that other bridge engineers can contribute, it gives promise of building up new and sounder views of suspension bridges, and perhaps of initiating a distinct new departure in the art. The engineer will observe, of course, that if the subject is important to the public, by dealing with the possibility of more economical bridge construction, it is no less important to the bridge-building art itself. The restudy of the subject is in fact essential to well balanced progress of the art. The possibility is to be kept in view, moreover, that out of such study may develop new types of suspension bridge construction, born of the application of the greatly improved present-day resources of practice to a problem whose solution was mainly outlined a century ago.

Road Location by Legislature

REGARDLESS of other advantages or deficiencies the road bill just passed by the Illinois legislature is a glaring example of the evils of political interference with highway development. The governor has backed the bill strongly and that he will sign it is taken for granted, though this action will be in bad contrast to the vetoing of a somewhat similar bill by the governor of New York. This Illinois bill as originally drafted for roads estimated to cost $100,000,000 was condemned severely by numerous public bodies on account of its vicious character, the 30-year term of the bonds and the enormous expenditure which it contemplated. But during its consideration in the legislature it was amended enthusiastically and recklessly by the addition of numerous additional stretches of road proposed by individual members. In this way the mileage was increased to such an extent that the bond issue will be insufficient to provide for it. Furthermore, with these additions tacked on haphazard there is no systematic layout but rather an indiscriminate collection of improved roads. One saving feature is that the bond issue must still be submitted to public vote and not until November, 1924. But the fact that such a bill should be passed and signed is extremely discouraging to those interested in highway development. Political uses of the bill are foreseen in selecting the roads to be built from time to time, but even if an attempt should be made to carry out its provisions with a view to public benefit it would still fail to give the people of Illinois what it appears to promise them.

Work Ahead in Traffic Control

FOR some years the serious congestion of traffic in our cities was like Mark Twain's remark about the weather—"Every one complains about it, but no one ever does anything." Police regulation, of course, has grown in scope along with the increase in automobiles, but in the large centers, particularly, mere regulation has failed to keep step with the difficulties it was designed to meet, and where the police heads are frank they admit their inability to devise further means of reducing congestion or increasing safety in our city streets. Engineers everywhere now are beginning to see that the problem is one for the engineer to attack, but it is one of comparative novelty and therefore the methods of approach are neither obvious nor established. In nearly all of our cities the city engineers—or in some cases the engineering societies—have been studying how best to go about remedying traffic conditions, but they are all moving haltingly and, unfortunately, with little authority and little help from the authorities.

Some time ago this journal sent out a letter to the city engineers of all the sizeable cities in the country outlining the basic difficulties of the traffic problem and asking for information as to methods and prospects in the various cities as well as for ideas on a proper method of approach to the general problem. The response has been very favorable. It shows that many minds are being turned to the study of the problem and history of human events has long ago proved that any problem is solvable if enough people get to work upon it. The tabulation of the replies must wait until some further information is received, but in order to aid those who are thinking along these lines it should be worth-while to record some of the high spots in the study of conditions that are revealed by this correspondence.

It is apparent that in few cities does the city engineer have control or even advise in the matter of traffic movement, though the advisory capacity is more frequent than the control. This relates to such matters as installation of traffic control signs, marking of parking spaces, or any of the details connected with regulation. With very few exceptions, the traffic is controlled by the police department, although in some excepted cases it is controlled by the department of public safety or a special traffic committee. Traffic increases are obviously taking place in every city, but only a few towns have made specific observations and even in these places the observation has been largely spasmodic.

Information concerning the evidence of pavement wear is very indefinite. Most of the city engineers state that there is considerable evidence of wear, but this is usually qualified with a statement to the effect that the pavement on which the wear is evident is old pavement that would probably have broken down under any traffic or waterbound macadam which cannot be expected to stand up under automobile conditions. In one city—Hartford, Conn.—there have been some very accurate tests on the wear of concrete pavement extending over nearly ten years, and these show that the average wear is not appreciable. The general opinion seems to be that the relation of volume of traffic to wear is indefinite.

The replies as to constructive moves the cities are making toward opening new streets, widening streets, rerouting traffic, etc., are more encouraging. In almost every case the cities either have started work on some such plan or have such a plan in preparation. Such developments as the parkway at Philadelphia going northeast from the City Hall, the opening of the new street by the South Station in Boston, the proposed motor driveway at Seattle, are all indications that where congestion becomes unbearable, the solution does lie in the rather expensive street openings. On account of this expense, however, this would seem to be a move of desperation. Some few cities have discussed rather academically the question of second-story streets and arcaded sidewalks with widening of the roadway to the old building line. This, too, involves heavy expense which up to date, at least, few cities have been willing or attempt.

The suggestions for a general policy of improving traffic conditions bear down heavily on the parking evil. Engineers are agreed that there must be strict control of parking within the limits of the congested areas, that no parking should be allowed in busy streets during rush hours or none at all in streets that are congested most of the day and that in such areas vehicles should park in side streets or in vacant lots that can be provided for this purpose. In cities where most of the streets in the business area are narrow and congested throughout the day no vehicles other than the necessary business cars should be permitted to enter; make all pleasure cars park outside of the restricted area and require the people to walk the necessary few blocks to reach their places of business.

Other suggestions for definite reform may be summarized as follows: Provide additional properly paved routes and, what is most important, educate people to use them; where streets are narrow, develop streets with one-way traffic parallel to each other and have them equally well paved to facilitate traffic movement; on such streets make surface cars conform to the one-way regulation and on all streets where street cars are operated where there is traffic congestion increase the distance between street car stopping points; provide streets with heavy special pavements for truck movement and require trucks to use them as far as possible; provide attractive routes for pleasure cars away from the more direct or economical routes used by business cars and trucks; increase the size of street intersections and order their form to be as nearly circular as possible; make general traffic control signs and methods of directing traffic movement general throughout the country so that strangers will not have to feel their way in strange cities, thus delaying traffic considerably; when a traffic rule is made stick to it for some time; wherever possible open up streets or roads as detours for through traffic passing by cities so that it will not be necessary for such traffic to pass through the congested streets; wherever conditions make it desirable use a system of block signals to control traffic; on streets where it is not possible to divert heavy traffic to side streets make the traffic move in two lines, so that slow moving vehicles will not restrict the movement of lighter cars; put street car lines on streets that are not required for dense motor-car movement.

These, then, are the specific suggestions. No one of them is new, but the collection of all of them may have some value to an engineer studying his local situation, for every city has its own peculiar conditions which can be met only by special applications of some general rule. It is obvious, however, that it behooves the engineers of each city to take into their own hands the study of this problem. If they do not, there seems to be little hope of its early solution. The police are at the end of their rope. The automobile associations, while doubtless interested, are biased in favor of vehicle traffic. The ordinary citizen can only observe and complain.

No better work can be done today by a local engineering society than the organization for study of the traffic situation in its own city. Study of the conditions is imperative, but more than study are required some specific recommendations which must be followed up by the power of continued appeal through all publicity means available. The work is peculiarly the duty of the engineering societies because the cities have not yet been educated up to the necessity of employing some one engineer to study the question, and no individual engineer will be deprived of his just work as he would be if the society were to make special recommendations regarding such things as water supply or sewerage, in which the city quite appreciates the necessity for expert advice.

Street congestion is the big engineering problem of the next decade. Will the engineering profession rise to its opportunities?

Possibilities of the Modern Suspension Bridge for Moderate Spans

A Reconsideration of Some Current Views of Suspension-Bridge Limitations, With Special Reference to the Development of the Type and the Influence of Recent Changes

By O. H. Ammann
Civil Engineer, New York City

IT MAY appear venturesome, in view of the quite general teaching of bridge literature that the suspension bridge is suitable only for very long spans, to come forward with a plea for more general use or rather revival of the oldest and most picturesque type of metal bridge. But the construction in recent years of a number of highway and light railway suspension bridges of moderate span—300 ft. and less to 800 ft.—and their successful service fully justify a discussion on the present-day merits and economic status of this type.

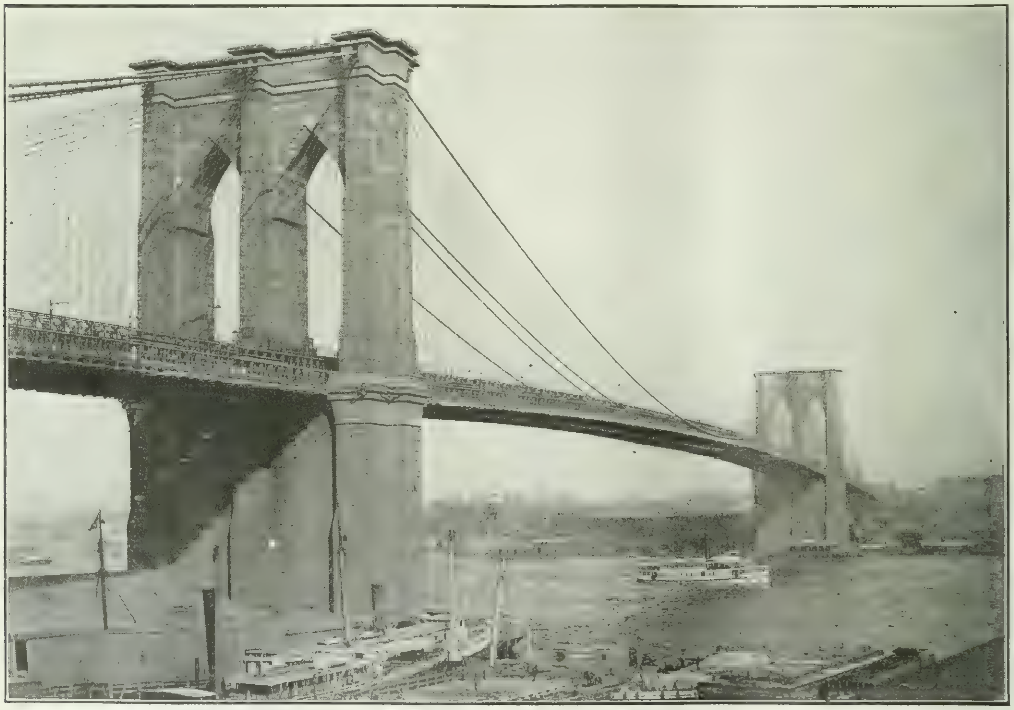


FIG. 1—BROOKLYN BRIDGE OVER THE EAST RIVER AT NEW YORK

This structure, with a main span of 1,595½ ft., is distinguished for the beauty of its lines. It has been in service for forty years, most of the time greatly overloaded; yet its main structural parts are of undiminished service value.

Recent Favoring Developments—One of the recent developments favorable to the suspension bridge of moderate span is the more general use of heavy floors in highway bridges, paved floors in place of the old light wooden floors, in railway bridges ballasted solid floors in place of open tie floors. To carry the heavier floor does not require as much increase of cost in the suspension bridge as in other types. Introduction of heat-treated eyebars of high strength and elastic limit at comparatively low price will also favorably affect the suspension bridge. It will permit the eyebar-chain bridge to compete with the wire-cable bridge and with other types of bridge dependent largely upon a lower-grade material for their compression members. It has been recognized in late years (as the result of the Quebec Bridge failure and of tests) that the eyebar chain has a greater margin of strength than compression members, and that relatively higher unit-stresses are justified for the former. This also should influence favorably the economy of the chain suspension bridge. Last, and not least, there is a noticeable tendency on the part of engineers and the public towards recognition of the value of aesthetics in bridge building.

The extensive development of highway traffic, which brings a large population into close touch with remote parts of the country, demands that roads and their bridges should meet certain aesthetic requirements. For this reason it may be expected that the suspension bridge, because of its pleasing appearance, will regain its deserved position alongside the other types. It has always and everywhere been regarded as an aesthetically superior type.

It is not necessary to go outside this country to look for examples illustrating the natural beauty of the suspension bridge. Thus, the historically famous bridge at Newburyport, Mass., though crude in its proportions and construction, was so excellent in its general appearance that popular demand properly caused its reconstruction along almost identical lines. The Brooklyn Bridge, with its simple massive towers, is as famous for its beauty as for its size, and promises to maintain this position many years to come.

Part I. Development of the Suspension Bridge

For a full appreciation of the unfavorable status of the suspension bridge of moderate span it is necessary to review briefly the underlying causes.

Its Rise and Decline—Bridge building has undergone periodical modifications due both to the introduction of new materials and means of construction and to changes in human conceptions and tastes. The suspension bridge had its era in the first half of the 19th century. Subsequently it gave place to other types, and it is significant that in America, the country of origin of the modern suspension bridge, this type is today least appreciated except for very long spans, while in France, where it was introduced much later, it still retains a prominent position.

The cause of this decline lies largely in the early shortcomings of the suspension bridge. Having developed during the infancy of iron bridges, when the theory of stresses was unknown and methods of fabrication and details of construction were crude, it had to undergo more severe trials than the later types. The suspension bridge began to lose favor even before its nature was fully understood. Methods of proportioning the stiffening system were yet crude in 1850, when Stephenson, after a series of tests with models, decided in favor of a tubular beam for the Britannia bridge in place of the projected suspension bridge. About the same time Roebling was severely criticized for using the suspension type for the Niagara railway bridge, although his design represented a great improvement over former bridges and proved to be successful under conditions prevailing at that time.

Most suspension bridges existing today belong to the class of early bridges, which were defectively built. There is only a small number of properly designed suspension bridges.

Another unfavorable circumstance, applying to railway suspension bridges in particular, is found in the rapid increase in loads. While it is to the credit of the suspension bridge that such increases impair its safety less than that of other types, there resulted excessive deflections, due to the insufficiency of early stiffening systems—not, as is often claimed, to inherent lack of rigidity of the suspension type.

The suspension bridge has also undoubtedly fallen victim to the commercialization of bridge construction, which set in in the latter part of the 19th century, following the general trend toward cheap mass production coupled with growing lack of appreciation of aesthetics in bridge building. The suspension bridge does not lend itself as well to standardization and cheap fabrication as do some other types, to which it had to give way in spite of its superior appearance. This development has been apparent in Europe as well as in America.

Early Imperfections—The first rational suspension bridges were built in America by James Finley at the end of the 18th and the beginning of the 19th century. They were remarkably well designed structures for that time. Finley fully appreciated the importance of rigidity, vertically as well as horizontally, and he endeavored to provide for it by a stiff wooden floor. His chains, of forged wrought iron links, had a considerable sag, about one-seventh of the span. The floor was suspended from them by vertical rods; a strong railing assisted in stiffening the floor. The Merrimack River bridge at Newburyport, one of the most remarkable bridges built after Finley's plan, lasted for a century (built in 1809, replaced in 1909).

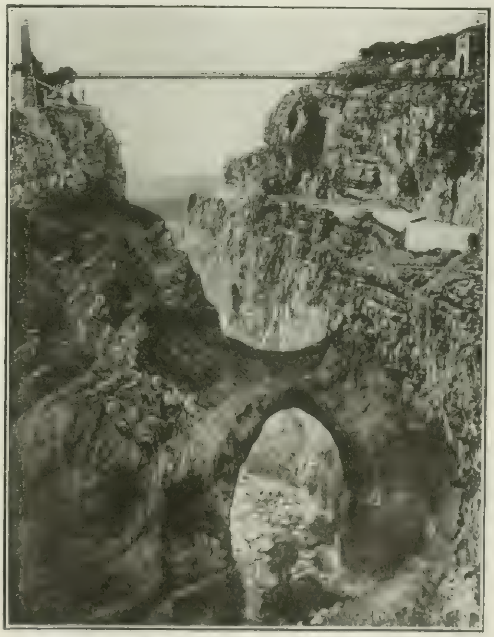


FIG. 2—CONSTANTINE BRIDGE, ALGERIA, TYPICAL OF MODERN FRENCH PRACTICE

Had Finley's sound principles of construction been adhered to many of the early suspension bridge failures would have been avoided. But instead of adhering to rigid floor construction, later builders resorted to various seemingly more economical arrangements, such as inclined stays, inclined planes of cables, flat catenary, etc., all of which proved of limited effectiveness.

Inclined stays, first introduced in England and widely used there in the early part of the 19th century, proved particularly fateful. A number of suspension bridges with such stays failed, on account of insufficient resistance to wind pressure and this led to the complete abandonment of that type in England. Not until 1840, when Rendel repaired the Montrose Bridge in Scotland, which had previously collapsed, did the effectiveness of a stiff floor again receive recognition. In the second half of the 19th century inclined stays were revived in America; in connection with the stiffening truss and efficient lateral bracing, introduced meanwhile, they proved more effective, although they led to occasional trouble on account of uncertain distribution of the load.

Wire Cables—The advent of the wire cable constituted a retrogression, and was unquestionably responsible for much of the later mistrust in suspension bridges. The smaller weight of the wire cable, and more especially its greater elasticity due to higher working stresses, made the problem of vertical and horizontal stiffening in bridges of moderate span more difficult. Moreover, the wire cable, because of the small section of its constituent parts, was subject to rapid deterioration where not properly protected, and this has been the cause of many failures, to this day.

First introduced in America in 1816 in a bridge across the Schuylkill in Philadelphia, the wire-cable suspension bridge found application in the first half of the 19th century mainly in France and Switzerland. Primitive as its construction was in those days, it seemed to offer a cheap means of crossing deep valleys and wide rivers. Many of these wire-cable bridges had no vertical and lateral bracing whatever. The wire cables were often carelessly erected and poorly connected and anchored, with the result that some strands were found to be strained beyond the elastic limit while others remained slack. The collapse of many of the early French wire-cable bridges, due to these causes in connection with overloading, shook public confidence in the suspension bridge and brought about the substitution of other types. Suspension-bridge building came almost to a standstill in France between 1850 and 1870. One of the most serious accidents was the failure of the bridge at Angers in 1850, which caused the drowning of 226 soldiers. During the years 1869 to 1881 not less than six wire-cable bridges collapsed in France alone. Not until after the French government in 1870 had set up rigorous specifications regulating the construction and maintenance of suspension bridges, and important improvements had meanwhile been effected by American engineers, was suspension-bridge building revived in France. The French type of wire-cable bridge was introduced in America by Charles Ellet several decades before, but here also its lack of rigidity was revealed, in the failure during a wind storm of the Ohio bridge at Wheeling in 1854, only seven years after its construction.

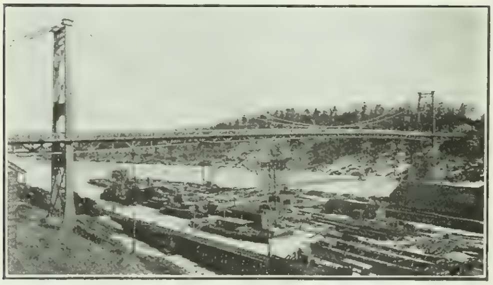


FIG. 3—RONDOUT CREEK BRIDGE AT KINGSTON, N. Y.
A link in a main state highway, this bridge was completed a year ago. Main span 705 ft. Stiffening trusses continuous between anchorages. Floor of reinforced concrete on steel.

Effect of Improved Theory—The introduction of theory in proportioning suspension bridges for a time retarded rather than stimulated progress in the proper direction. Navier's excellent treatise on suspension bridges (1823) inspired confidence in the unstiffened flat catenary, with the result that in contrast to the deep sag of $\frac{1}{7}$ in Finley's bridges a sag of from $\frac{1}{10}$ to $\frac{1}{15}$ was adopted in later bridges. Since the effect of temperature and elastic cable stretch is the more severe the flatter the catenary, it became necessary to give the floor more flexibility. The resulting loss in rigidity was not compensated by the smaller vertical undulations of the flat catenary under moving load, nor by its smaller horizontal motions due to wind. After Stephenson had made his extensive tests on models, the function of the stiffening trusses in increasing the rigidity of the floor became more clearly understood, and it was the privilege and merit of the American engineer, Washington Roebling, to use for the first time rational stiffening trusses in the Niagara railway bridge, completed in 1855.

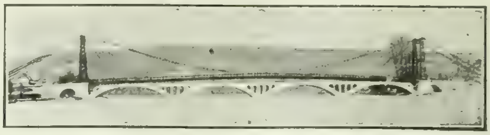


FIG. 4—MODERN FRENCH SHORT-SPAN SUSPENSION BRIDGE
Seine River crossing at Andelys, built 1917-18; span 496 ft.; Arnodin type.

Efforts to stiffen chain bridges by connecting two or more chains in a vertical plane were made very early, as in the Menai bridge at Bangor. The Weser bridge at Hameln, built in 1836 and still in use, was the first one in which a complete diagonal system between a pair of chains was introduced, but the depth of truss thus created in this and similar bridges of that time was insufficient. In 1860 such a system was used in the railroad bridge across the Danube Canal in Vienna. The replacement of that bridge after 24 years of service became necessary not for lack of rigidity of the system, but for defects of construction which were the cause of unequal stresses in the chains and excessive wear and tear.

The system of deep braced chain trusses proved highly successful in later highway bridges, such as the Seventh Avenue bridge across the Allegheny River in Pittsburgh, built by G. Lindenthal in 1884, and the Grand Avenue bridge in St. Louis, built by Carl Gayler in 1890. Stiffening trusses attached to the chain either above or below appeared in the second half of the 19th century and were successful. The Point Bridge in Pittsburgh, built by Hemberle in 1877, was the first one in this country. When tested after completion it showed remarkable rigidity, and like other bridges of the same type it has given good service since. Neglect and consequent deterioration, and greatly increased loads, made it necessary in 1904 to replace the floor of this bridge and carry out other repairs.

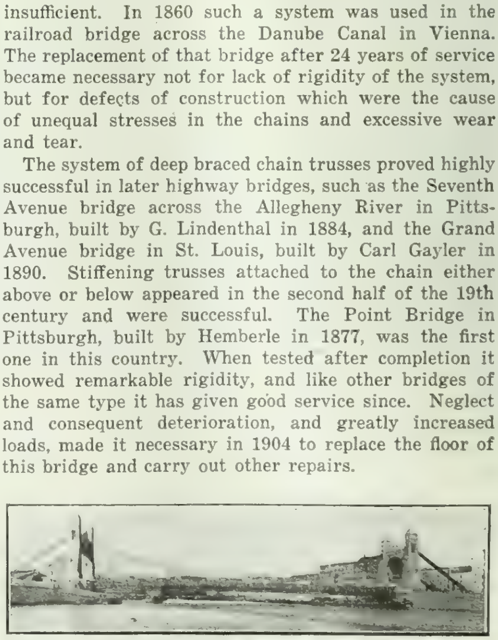


FIG. 5—RIVETED-CABLE TYPE—BRESLAU BRIDGE
Span 415 ft. between tower centers.

The Modern Suspension Bridge—Passing to a survey of suspension bridges built during the last twenty years, it is apparent that no change has taken place in broad conception of design. No new types have been introduced, but the proportions and details of the old types have been improved.

Distinct types are today preferred in different countries; the wire-cable bridge with separate stiffening truss in America, the wire-cable bridge with inclined stays in France and its colonies, and the chain or riveted-chord bridge with stiffening girder in Germany and Austria. It seems paradoxical that in America, the home of the cheaply manufactured forged eyebar, the wire cable should govern the field, whereas in Germany, where excellent wire is made and no special equipment for cheap manufacture of chain bars is available, the chain or even the riveted chord should be preferred. Obviously the selection of type is influenced very largely by other factors than mere economy, not in the least by adherence to precedent and conventional practice.

American Practice—The modern American suspension bridge is typified in the Manhattan Bridge across the East River in New York. Its characteristics are wire cables suspended from slender steel towers or bents and stiffened by parallel-chord stiffening trusses. Several smaller bridges of this type with spans ranging from 775 to 400 ft. have been built in recent years, notably the Ohio bridge at Parkersburg, built by Hermann Laub in 1916, and two bridges built by H. D. Robinson, one across the La Grasse River at Massena Center, N. Y., in 1911 and one across Rondout Creek at Kingston, N. Y., in 1922. The only distinction between them is the degree of continuity of the stiffening trusses. Continuous trusses, as adopted in the Kingston bridge, represent an improvement as regards both economy and rigidity.

While these bridges give good service for highway traffic under present loads and may be economical in first cost, they cannot be regarded as the most advanced type suitable for moderate spans. For that we must look to the eyebar chain, which has the advantage of greater weight and greater resistance against corrosion. Eyebar chains moreover permit efficient attachment of the stiffening web members, with which they form a unified and rigid main carrying system.

French Practice—Modern French suspension bridges, like the American ones, are wire-cable bridges, but they embody two features that make them very economical, namely: the use of wire ropes instead of parallel-wire cables and the arrangement of inclined stays. Although wire ropes have a somewhat lower strength than straight parallel wires this disadvantage is more than offset by their lower cost of erection. The ambiguity of stresses which caused trouble in earlier bridges with inclined stays has been minimized in the modern French bridges by partial omission of the vertical suspenders and by careful adjustment of the stays during erection. In the system introduced by F. Arnodin, the builder of many of the modern French suspension bridges, the inclined stays extend from the towers to near the quarter-points of the span, while the middle portion of the span is suspended from the cables.

These bridges have spans as low as 250 ft. and up to 900 ft. The more recent ones have a reinforced-concrete floor. The bridge at Constantine, Algeria, which with a span of 540 ft. crosses a gorge 570 ft. deep, is one of the most remarkable examples of this type.

The Gisclard system is less appealing to the eye, but appears to be particularly adapted to railway traffic. In that system the inclined stays extend across the entire span and form a main carrying system in which the material is utilized in tension to the greatest possible extent. The system was first used for a number of short-span highway bridges in the French Congo, and proved so successful that in 1907 it was adopted for the 510-ft. span carrying the electric railway line between Villefranche and Bourg-Madame in the Pyrenees. The maximum live-load deflection of this bridge under test was only 6 in., or 1/1000 of the span. The system has since been used in bridges of moderate span carrying light railway traffic; they are said to be free of vibration. In a competition in 1914 for a highway bridge of 430-ft. span across the Seine at Vitry the Gisclard type proved cheaper than either beam, cantilever, arch or combination system.

Chain Bridges—Only a few suspension bridges have been built in central Europe, and nearly all are of the chain type. The Elizabeth Bridge, built in 1903 in Budapest, is the most prominent of them, and with its span of 950 ft. is the longest suspension bridge in Europe. Other prominent examples are the Kaiser bridge in Breslau, with a span of 415 ft., the Borsigsteg in Berlin, with a span of only 167 ft., and the bridge across the Rhine at Cologne, completed in 1915, with a span of 605 ft. None of these chain bridges represents the most economical type, and in their selection among competitive designs economic requirements were outbalanced by aesthetic considerations or local policies.

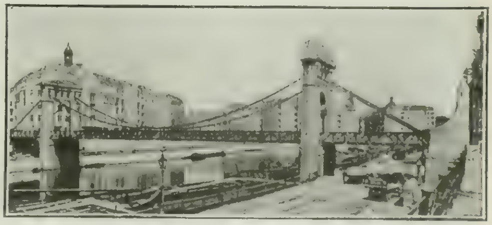


FIG. 6—A SMALL CHAIN-CABLE BRIDGE
The Borsigsteg at Berlin, Germany; span 167 ft.

Part II. The Suspension Bridge Compared with Other Types

A bridge must be judged above all by its usefulness as a means of communication. It should afford to the traveling public the same feeling of security, comfort and pleasure which is enjoyed on *terra firma*. That requires confidence in the safety of the bridge, a certain minimum degree of rigidity and, as far as possible, open view, undisturbed by a net of steelwork. Even for moderate span-lengths these requirements can be met in a properly designed suspension bridge as well as, or better than, in other types.

Safety and Permanence—There is probably no element in a steel bridge which, after recent experiences, can inspire as much confidence in its safety as a cable, or, even more so, an eyebar chain. While many early suspension bridges have failed by the breaking of cables or chains, the causes are as outlined heretofore and do not lie in inherent weakness or low margin of safety.

Further, these early failures of suspension bridges are overshadowed by a much larger number of later, even very recent, failures of bridges of other types—small truss highway bridges broken down by a motor vehicle bumping against a web member, and the greatest railroad cantilever ever projected, destroyed by the buckling of one of its compression-chord members. In a suspension bridge the possible hitting of a suspender by a vehicle will at most cause local damage, and even the buckling of a truss chord is not fatal.

The safety of a bridge is in a way evidenced by its durability, as this indicates the ability of the bridge to withstand emergency conditions, increase in live-loads and deteriorating effects. There are over fifty suspension bridges of moderate span here and in Europe which have attained a life of half a century. More than a score, mostly chain bridges, date from the first half of the 19th century. At the top of the list are as centenarians the Merrimack River bridge at Newburyport, the Tweed bridge at Berwick (1820), and the Rhone bridge at Tain (1823). Closely following are the Menai bridge at Bangor and the bridge at Conway Castle, both built by Telford in 1826. All the foregoing are chain bridges ranging in span from 240 to 580 ft. The Saane bridge at Fribourg in Switzerland (1834) is the oldest existing wire-cable suspension bridge. Its span of 870 ft. was for many years the longest. No other type of steel bridge can show such a record.

Many suspension bridges of moderate span have lasted longer than bridges of other types built contemporaneously. Roebling's Niagara bridge, often cited as a discouraging example of a railway suspension bridge, served its purpose for 42 years, whereas many more modern simple-span railway bridges did not last over 25 years. It is a significant coincidence that the Victoria bridge at Montreal, a tubular girder, a type which at the time of its building was a rival of the suspension bridge and by many was considered superior, was built and replaced almost simultaneously with the Niagara bridge.

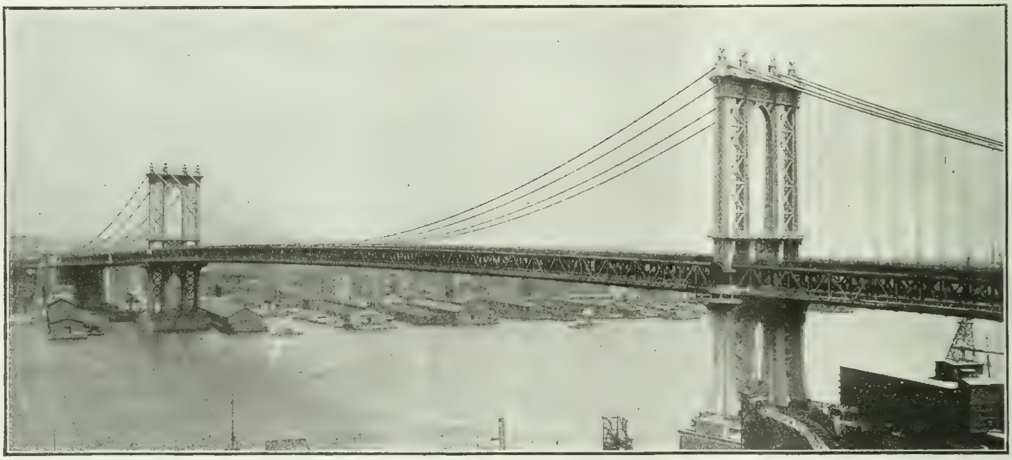


FIG. 7—MANHATTAN BRIDGE, MOST RECENT OF THE LONG-SPAN SUSPENSION BRIDGES AT NEW YORK

Carrying a double deck designed for heavy loading, this structure differs structurally from the Brooklyn Bridge chiefly in its steel towers, two-hinged stiffening trusses, and absence of diagonal stay ropes. With its parallel-chord trusses, it is typical of spun-cable suspension bridges as developed in American practice.

Rigidity—There is probably no argument which has been used so indiscriminately and unjustly to condemn the suspension bridge as that of its alleged lack of rigidity—and this in spite of the proof to the contrary which is given by well designed structures that are in satisfactory service in many countries.

It is true that the suspension bridge in general is not as rigid as some other types, but that does not imply that it is insufficiently rigid for the needs of traffic. The extreme rigidity of a simple span, for instance, is incidental to its most economical proportions, and is not necessarily a virtue or a point of superiority. Whether a very rigid structure is safer and more durable than an elastic one is by no means a settled question. Synchronized motions of the load and vibrations of the structure may subject the rigid structure to much more wear and tear than the elastic one. Suspension bridges may be designed with any degree of rigidity from that of a flexible cable to that of a simple truss span, but economy demands minimum rigidity compatible with traffic requirements.

The deflections of a properly proportioned stiffening truss have nothing in common with those of an unstiffened cable. The former are limited by the elastic changes of the material, while the much larger deformations of the unstiffened cable are due mainly to the displacement of the line of equilibrium of the cable; in a large cable its elastic deformation may play an important part.

Deflection Figures—In a suspension bridge of 300-ft. span carrying a light highway floor the calculated deformations of the unstiffened cable are about eight times as large as the deflections of the economically stiffened cable. For a span of 3,000 ft. the ratio is about as three to one. The fact that so many old, unstiffened or improperly stiffened, suspension bridges of comparatively short span and light floor have given good service for generations should therefore dissipate any concern about the rigidity of properly stiffened modern highway suspension bridges with spans as low as 300 ft., particularly if a heavy paved floor is used.

Such reasoned considerations are fully confirmed by actual observations. Old highway suspension bridges have been observed to deflect as much as 1/80 of the span under load, without signs of weakness in the structure and without serious impediment to the traffic. In several cases where older bridges have been reconstructed by providing a proper stiffening system the deflections have been reduced to one-fifth or less of their original amount.

Let us now see whether and how far the minimum required rigidity is compatible with economic and aesthetic proportions of a stiffened suspension bridge. For that purpose we will assume the most flexible type of suspension bridge, the wire-cable bridge with separate stiffening truss. A short simple-span highway bridge is generally considered sufficiently rigid if its depth is not less than $\frac{1}{12}$ of its span length. That corresponds to a maximum live-load deflection of about 1/750 of the span. A two-hinged stiffening truss of a suspension bridge, to have the same maximum rigidity, should have a depth of not less than $\frac{1}{24}$ of its total span or $\frac{1}{12}$ of its half span (because each half deflects very nearly as a simple span). Such a depth is excessive for economy and good appearance, and therefore the suspension bridge is not well adapted for very short spans, say below 300 ft.

As the length and width of the bridge and therewith the number of traffic units necessary to produce maximum deflection increase, it becomes permissible to allow relatively greater deflections under maximum load. In other words the permissible rigidity is not to be measured by the deflection from a maximum possible load combination, but by the deflection produced by a traffic unit, as a single truck or a group of a few trucks, an electric car or a single train, because the deflection from a combined load is not only the less probable and the less frequent the greater the number and variety of traffic units, but is produced only very gradually and is therefore neither disturbing to the traffic nor detrimental to the structure as long as the stresses remain within permissible limits.

For a highway bridge of 300-ft. span and a roadway for more than two lanes of vehicles the probability of the deflection ever reaching even one-half of the maximum is extremely remote, and it is therefore permissible in a suspension bridge of that size to make the depth of the stiffening truss about 1/40 of the span. As the span and width increase the depth may decrease further, so far as rigidity is concerned. A continuous stiffening truss will permit a relatively smaller depth than a hinged truss.

The Kingston highway bridge, 705-ft. span, has a continuous stiffening truss with an average depth of 12½ ft. or 1/56 of the span. In the Cologne chain bridge, 605-ft. span, the depth of the continuous stiffening girder is 1/54 and the theoretical maximum deflection is 1/547 of the span. Cable suspension-bridge designs submitted in competition showed theoretical deflections of as much as 1/316 of the span, which was however not considered excessive by the able engineers who composed the jury. In the Brooklyn Bridge, 1,595-ft. span, the depth ratio is only 1/93 and the maximum theoretical deflection must be close to 1 [illegible] of the span. Yet all these bridges are known to have ample rigidity under actual traffic conditions.

The Point Bridge in Pittsburgh, one of the first chain bridges with stiffening truss attached to the eyebar chain, when tested after completion showed a deflection at the quarter-points of 2¾ in. or only 1/3500 of the total span under a load of two-thirds of the maximum, and the vibrations did not exceed $\frac{1}{16}$ in. either laterally or vertically.

For railway bridges the deflection is generally limited to 1/1000 of the span length. Moreover, a single traffic unit, as a heavy train, may produce nearly full deflection in case the bridge carries only one or two tracks. If the number of tracks is not more than two the suspension bridge for railway traffic is therefore properly restricted to very long spans. But if the number of tracks is greater, or if highway traffic is added, and especially if a ballasted solid floor and a braced-chain system of suspension are used, the railway suspension bridge becomes practicable with ample rigidity for spans as low as 800 ft. This was proved by a suspension bridge design made by G. Lindenthal for the four-track Hell Gate bridge in New York (Trans. Am. Soc. C. E., Vol. 82, 1918, p. 852), which compared very favorably in economy and rigidity with other designs.

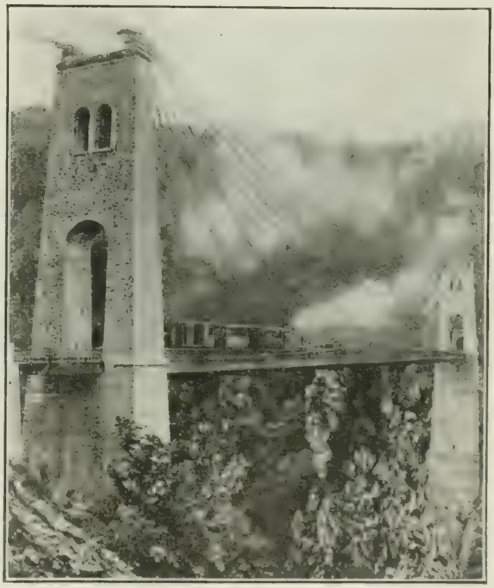


FIG. 8—RAILROAD SUSPENSION BRIDGE, GISCLARD SYSTEM

Span of about 500 ft. across the Luzège at Lapleau, France.

Several suspension bridges of comparatively short span have been built in France for light narrow-gage railways. They are said to give very satisfactory service, vibration being practically absent.

Economy—Much has been written on the comparative cost and the so-called economic span limits of the different types of bridges. While the value of such economies cannot be questioned, attention must be called to the fact that, unless all possible latitude is allowed in the many factors entering into such investigations, the results may be not only valueless but highly misleading.

There are, to be sure, certain economic laws which are applicable if broadly applied, but most bridge economics have been based on narrow assumptions or personal preferences of the analyst as to the basic elements—specifications for loads, stresses and details, character of foundations, prices, and the like. This is clearly shown by the widely divergent conclusions of different investigators. One authority finds a continuous bridge 20 per cent cheaper than a simple-span bridge, while another finds just the reverse. Two different current specifications require, for the same bridge and live-load, sections differing by as much as 40 per cent. The lower economic limit of a railroad suspension bridge is found by one authority to be 2,700 ft., while another one finds the suspension type more economical than any other type for a span of 800 ft. Likewise the economic limit of highway suspension bridges is found by different persons at all the way from 400 to 1,500 ft.

Competitive bids, based upon given specifications, have in one particular case of an 1,800-ft. span resulted in the victory of the cantilever over the suspension bridge, while in another case of a 430-ft. span the suspension bridge was victorious over all other types, with a good margin.

OLD "CHAIN BRIDGE" AT NEWBURYPORT, MASS.

NEWBURYPORT BRIDGE AS REBUILT

The old bridge reached an age of 100 years and was so much admired for its appearance that the law providing for its rebuilding specified that its successor should be rebuilt to similar lines.

It must also be considered that the results of any economic analysis are subject to radical modifications in comparatively short periods, due to changes in the relative cost of materials, in shop practice and in facilities and methods of erection. As previously mentioned the introduction of the heavy paved floor in highway bridges and of the ballasted solid floor in railway bridges is favorable to the suspension bridge, for with increasing dead-load the weight of the stiffening system of a suspension bridge decreases, whereas the total weight of a simple truss or cantilever increases nearly in proportion to the added weight. This favorable influence is particularly marked in short spans, since in these the added weight of a solid floor forms a large proportion of the entire dead-load.

The introduction of a comparatively cheap steel for eyebars will also favorably affect the economy of the suspension bridge, for it will favor the braced chain, which, on account of its superior rigidity, is better adapted to short spans than the wire cable. High-grade steel for riveted members, allowing high stresses in the stiffening system, also tends towards comparatively greater economy in suspension bridges.

Relative Unit Stresses—Economic comparisons or competitive designs are often based upon specifications which discriminate against the suspension bridge. In fact most of the leading specifications are not applicable to that type. Thus, it is not fair to apply the same rigorous specifications for loads or unit-stresses to an ordinary truss bridge and to the stiffening system of a suspension bridge. This has been recognized in some designs of suspension bridges, but is not generally appreciated. The stiffening system is not essential to the safety of a suspension bridge, but merely produces rigidity, and if it breaks, as has happened, the bridge will not collapse and the damage can be repaired. But if a member of an ordinary truss breaks the whole bridge will go down, and the truss therefore must be designed with a greater margin of safety. Further, a stiffening system (owing to its greater flexibility) is not subject to the impact stresses of a truss bridge.

It is reasonable, also, to allow somewhat higher unit-stresses in the cables or chains of a suspension bridge than in tension members of trusses, because the former are comparatively free of secondary stresses from all sources. They are also less subject to shock and vibrations.

The most economical type and proportions of a suspension bridge depend, more than those of a truss, upon the character of load and the comparative quality and cost of material in cables or chains, stiffening trusses and towers, and require careful investigation in any particular case. It is found, however, that some of the investigations into the economy of the suspension bridge are based upon more or less arbitrarily selected type and proportions, not always conducive to economy.

The economic span limit between two types of bridge is very sensitive to changes in the basic assumptions. Graphically it is obtained as the intersection point of two cost curves that are nearly parallel. It jumps considerably with a comparatively slight change in the relative location of these curves as affected by the assumptions.

While, therefore, the question of ultimate economy is too complex to justify exact figures in a general comparison of types, and a proper comparison in any particular case can only be had by competitive bids based upon rational specifications, the following general conclusions may be set down:

Under favorable conditions, rational specifications and proper selection of type, proportions and general arrangements, the suspension bridge for highway traffic will be found economical for spans of 300 ft. and even less. For railway purposes the suspension bridge can compete with other types on spans as short as 800 ft.

Some of the Legal Aspects of Land Surveying

Supreme Court Decisions Affecting Technical Problems Discussed and Summarized

By M. E. Chamberlin
Civil Engineer, Montevideo, Minn.

The principles and results of land surveying are vital factors involved in property rights. Hence it is an important element of a state's economic system. It has long constituted a considerable part of most surveyors' and numerous civil engineers' professional work. By reason of obliterated original monuments, conflicting sub-divisions, ambiguous deed descriptions and technical discrepancies in earlier surveys, land surveying is no longer simply the application of mensuration.

Rarely is there now a call for a wholly original survey. A re-survey often constitutes the entire problem, and in most cases is far more complex and difficult than the original. Its successful solution requires the exercise of a judicious mind.

Though without authority, the surveyor who is employed to make a re-survey must often act as both judge and jury, interpreting the law, hearing the testimony, sifting the evidence, weighing the facts, and making a consistent decision. Having encountered such perplexities the conscientious engineer usually dodges when requested to make a re-survey.

Since the land office officials of the U. S. Department of the Interior have ruled, and supreme courts have repeatedly held, that the purpose of a re-survey is to replace lost or obliterated monuments and boundary lines in their original location rather than where they evidently should be, the surveyor should be especially diligent in securing every possible piece of evidence which may have any bearing on the problem.

The available evidence may consist of testimony of biased land owners, fragments of nearly obliterated monuments the history and identity of which are unknown, faulty deed descriptions, erroneous plats, and inconsistent original survey field notes. This mass of evidence may seem to present, and often does present, an incompatible, puzzling problem. Hence the necessity that the surveyor possess pertinent legal knowledge.

The degree of accuracy obtained in land surveying should be somewhat in proportion to the market value of the tract, or the nature and importance of the project hinging on the results of the survey. In this connection possible future litigation should be an incentive to the surveyor to solve the problem according to the most applicable legal decisions. "The field notes," one author asserts, "should be full and explicit, and, especially in re-surveys, should state in plain, concise words every material fact in regard to the work." This advice applies especially to field notes which must be used as a guide in writing deed descriptions.

A competent surveyor would seem to be the proper person to write deed descriptions; a highly important form of professional service. Every such description should be clear, concise and complete.

The following abbreviated citations indicate the attitude of various supreme courts on questions often involved in the land surveyor's problems:

Surveyors have no more authority than other men to determine boundaries of their own motion.
Cronin vs. Gore, 38 Mich. 381.

New surveys disturbing old boundaries are not to be encouraged. *Toby vs. Secor, Wis. N. W. Rep. Vol. 19.*

A deed must be construed according to the condition of things at the date thereof.
Quillen vs. Betts, Del. 39 A. 595.

The evident intention of parties to a deed must be given effect. *Hale vs. Docking, Kan. 51,798.*

A grant of land bounded by a highway takes to the center of the highway. If it be designed to exclude the highway, it must be so stated. *Champlin vs. Pendleton, 13 Conn. 23.*

A conveyance by metes and bounds will carry all the land included within them, although it be more or less than is stated in the deed. *Butler vs. Widger, 7 Cow. N. Y. 723.*

A long established fence is, in this case, better evidence of actual boundaries, settled by practical location, than a re-survey made after the monuments of the original survey have disappeared. *Diehl vs. Zauger, 39 Mich. 601.*

When the interested parties have long acquiesced in the location of street lines in supposed conformity to the plat, these lines should be accepted as fixed monuments in locating lots and blocks contiguous thereto.
Van den Brooks vs. Coreon, 48 Mich. 283.

Where the division line between lands of adjoining landowners is unknown, they fix its location by parol, each party mutually agreeing thereto and acting thereon, which agreement is binding, but if the original line is known, then the transfer of the land between the two lines must be in writing. *Jenkins vs. Trager, 40 F. 726.*

A large per cent of property line disputes involved in re-surveys are settled according to the advice of the surveyor in conformity to the principles set forth in the above citations; and many more might be so settled to the advantage of both parties.

In applying the general rule to relocate obliterated boundaries, the order of application of the evidence should be: 1, as to natural objects; 2, as to artificial marks; 3, as to courses and distances. (As to area, should be included as 4. Author.) *Yanish vs. Tarbox, 51 N. W. 1051.*

Where the description in a deed refers to a survey or plat, the evidences of such survey and the particulars shown on the plat are to be given the same consideration as though expressly cited in the deed.
Maddox vs. Turner, Tex. 15, S. W. 237.
Davis vs. Rainsford, 17 Mass. 219.

Seventy acres lying in the southwest corner of a section is a good description, and, in absence of definite evidence to the contrary, will be in a square.
Walsh vs. Ringer, Ohio 327.

Where a plat shows all the lots except one, as lot A, to be of equal width, and the width of all the lots, including lot A, is clearly indicated, and a re-survey shows that the whole block exceeds the total platted distance the excess must be apportioned among all the lots in proportion to their respective platted widths.
Pereles vs. Magoon, Wis. 46 N. W. 1047.

The general rule that riparian rights extend along straight, converging lines to the center of a meandered lake bed (*Shell vs. Matteson, Minn.* [illegible] *N. W.* [illegible]) does not hold where the shore line of the lake is so irregular that such a uniform sub-division would be inequitable.
Scheifert vs. Briegel, Minn. 90.
Jones vs. Johnson, 18 How. U. S. 100.

Regarding the last cited decision some legal authorities apply the original common law rule that riparian rights extend to the deepest point of the lake or channel, on the theory that the use of the water, as it recedes, is the chief consideration.

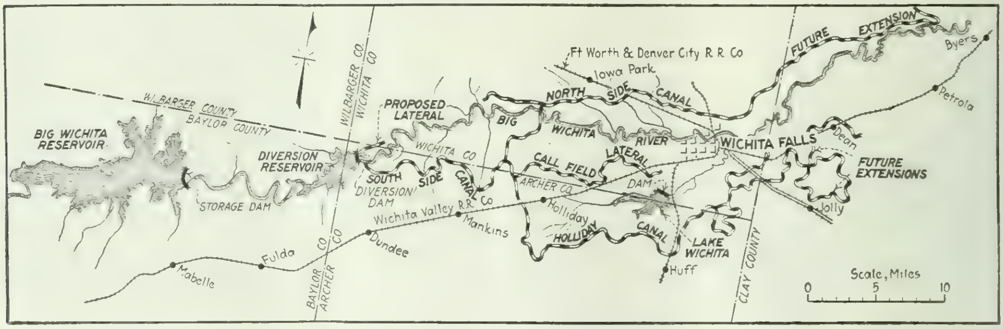
Water Supply and Irrigation Works, Wichita Falls, Tex.

Earth-Fill Storage and Diversion Dams Impound 545,000 Acre-Feet—Canal System Planned to Irrigate 110,000 Acres

By Albert S. Fry
Morgan Engineering Co., Memphis, Tenn.

A LARGE hydraulic-fill storage dam, a smaller diversion dam 15 miles downstream, and a system of main and lateral canals are under construction near Wichita Falls, Tex., by Wichita County Water Improvement District 1 to furnish a water supply for the city of Wichita Falls and to irrigate 110,000 acres of agricultural land in the valley of the Wichita River. The works will cost about $4,500,000.

Above the storage dam site, which is 40 miles west of the city, the Big Wichita River has a drainage area of 2,650 square miles. Like many of the water courses in the arid and semi-arid regions it is a flashy stream. The river bed is entirely dry at certain seasons of the year, with only a small underground flow through the sand, but at flood times the channel carries a large volume of water. The land in the drainage area above the storage dam is of little value as it consists for the most part of broken country badly eroded and cut by numerous gulches and breaks. Below the diversion dam the valley widens into a fertile plain of bottom lands several miles wide. When supplied with a dependable source of water, after the irrigation works are constructed, this area will be very profitable for cultivation.



MAP OF BIG WICHITA RIVER IRRIGATION AND WATER SUPPLY PROJECT

The average annual rainfall in this region is 27 in., and this rainfall, if properly distributed throughout the growing season, would be sufficient for agricultural purposes. However, the annual rainfall has been as low as 15½ in., and there are periods of drought nearly every year which cause the crops to perish. In consequence it is essential for the successful cultivation of crops in this valley year after year to supplement the natural rainfall with irrigation.

The available records of discharge on Wichita River indicate that there is a sufficient quantity of water both for water supply for present and future demands of Wichita Falls and for the irrigation of the agricultural lands.

Storage Dam—The storage dam is a hydraulic-fill earth structure 7,500 ft. long with a maximum height of 100 ft. It contains about 1,500,000 cu.yd. of earth. The storage reservoir behind the dam is 13 miles long and 3½ miles wide. At the level of the spillway it has a storage capacity of 500,000 acre-feet and covers an area of 20,000 acres. The major portion of the embankment, 3,000 ft. long, is being constructed by a 20-in. electrically-operated hydraulic dredge. Underneath the dam a cutoff trench has been constructed and backfilled with impervious puddled material. Steel sheet piling extends below the cutoff trench into a hard shale formation across the river channel and valley.

Under one side of the dam are six concrete conduits. Four of these conduits will be closed permanently after the dam is completed, their purpose being to provide for the discharge of flood water during construction before the spillway is built and is effective. The remaining conduits will be used to control the discharge from the storage dam to the diversion dam.

A circular concrete spillway with a crest length of 565 ft. will protect the dam from large floods. This spillway, with a depth over the crest of 10 ft. and a freeboard of 5 ft. to the top of the dam, will discharge about 75,000 sec.-ft., which is equivalent to a runoff of slightly more than 1 in. in 24 hours over the total area of the watershed. An emergency spillway of 125,000 sec.-ft. capacity will provide for extraordinary floods. The capacity of the spillways was fixed after a study of storm rainfall and recorded floods in the vicinity of the dam. In general, large storms that pass through central and eastern Texas originate in the Gulf of Mexico and swing northerly and easterly. Some storms, however, have moved in a northwesterly direction nearly to Wichita Falls. Study of the movement of storms in Texas showed that it was possible for a storm of much greater intensity than any so far recorded to occur some time over the drainage of the Wichita River and that it was possible for such a storm to come when the reservoir was full. Such being the case, it was necessary to provide ample spillway capacity. The topography at the dam site makes it possible to secure a large emergency spillway capacity at a low cost, which accounts for the large capacity adopted for the emergency spillway.

Diversion Dam—The diversion dam is an earth dam with a concrete overflow spillway at one end. This dam is 4,200 ft. long and will have a maximum height of 55 ft. above the river bed and a height of about 40 ft.

above the valley floor for the greater part of its length. The concrete spillway is 310 ft. long and is a gravity overflow section designed to discharge 100,000 sec.-ft. with the water 15 ft. deep over the crest. The earth section of the diversion dam contains 550,000 cu.yd. The upstream slopes are 3 to 1 and 2 to 1 and the downstream slope is 2 to 1. The upstream face will be paved with a 12-in. layer of rock riprap laid on a 6-in. gravel blanket. Riprap will also be placed on the downstream face of the dam across the river channel. The reservoir behind the diversion dam is 6 miles long and about one mile wide. At the spillway level the reservoir will have a storage capacity of 45,000 acre-feet and will cover 3,000 acres of land.

Distribution System—The distribution system will consist of three main canals. The 34-mile South Side Canal carrying 1,000 sec.-ft. begins at the south end of the diversion dam and follows along the south side of the Wichita River valley to just above Wichita Falls. Water from this canal will be used both to irrigate 30,000 acres and to feed water into Lake Wichita which is the present source of water supply for Wichita Falls. Lake Wichita is 6 miles from Wichita Falls, whose rapid increase in population from 16,000 in 1918 to 42,000 in 1922 has made necessary the additional supply. The North Side Canal will branch from the South Side Canal 15 miles below the diversion dam and will cross the Wichita River valley to irrigate 35,000 acres on the north side. The Halliday Creek Canal will also branch from the South Side Canal and irrigate 45,000 acres of land southeast of Wichita Falls.

R. A. Thompson is chief engineer for the district and in direct charge of the work. O. N. Floyd is assistant chief engineer. The Morgan Engineering Company is consulting engineer, L. L. Hidinger, president of the company, giving immediate supervision to the work The general contractor for the project is the Callahan Construction Co., Dallas, Tex.

Extending London "Tube" Railway

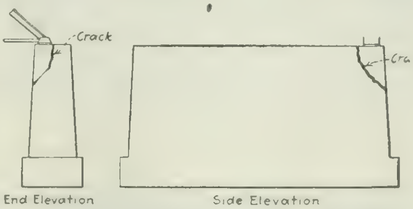
A six-mile extension is proposed for the City & South London Ry., the first line of the large system of deep-level electrically operated "tube" railways in London, England. These lines are distinct from the so-called "underground railways," which are near the surface. This extension from the present southern terminal at Clapham will connect with the newly authorized suburban line of the Wimbledon & Sutton Railway. Five miles would be in tunnel and it is stated that the work would afford employment for 20,000 men for two years. The cost is estimated at $5,930,000 for construction and $6,920,000 for equipment. According to the president of the company the tube lines did not serve the public to advantage until they began to extend beyond the business district. A great increase in passenger traffic is expected from extension into suburban territory. On the existing line, 7½ miles long, the tunnels are being enlarged to accommodate the rolling stock of other "tube" railways. This alteration was planned originally to be carried out without stopping traffic, work being prosecuted only at night and trains running through the shields. Owing to some slips and an inrush of water at one point it is stated that part of the line has been closed to traffic, arrangements being made to have tickets honored by bus and other surface lines between certain stations.

Repair of Defective Bridge Piers Cracked by Expansion

By Landon G. Smith
Bridge Engineer, Alabama Highway Department, Montgomery

A COUNTY bridge built in Alabama last year shows instructive results of bad design and construction. Soon after completion it developed such dangerous symptoms that the writer was requested to inspect the bridge and make recommendations for its repair. This county employs an engineer regularly to handle its road and bridge construction and this particular bridge was under his supervision, but I cannot say whether he or the company which fabricated the steel made the design.

The structure consists of six 50-ft. pony-truss steel spans with concrete floor, on five concrete piers and two concrete abutments. On the downstream side, pier 2 is cracked under both shoes, pier 3 cracked under one shoe, and pier 5 cracked under one shoe. On the upstream end pier 2 is cracked under one shoe, and pier 4 is cracked under one shoe (numbering is from the north). These cracks are in various stages of development, one especially having reached such a condition as to endanger the truss on that side, extending from the center of the pier downwards and outwards to the face about 3 ft. below the bridge seat. A sketch of a typical crack is shown.



TYPICAL CRACKING OF PIERS UNDER SHOES

The concrete is of very poor quality and poor finish, can be dislodged with a small hammer and crumbles readily. No good samples of the aggregates used were available, but a small quantity of sand which was said to be from the storage pile was found quite dirty, and samples of the concrete broken from piers indicated that straw or grass was present in the aggregate.

A very serious defect is found in the method of seating the trusses. No masonry plates are provided, the shoes resting directly on the masonry, which in any case would offer so much resistance to the movement of the trusses from expansion and contraction as to set up very high stresses in the concrete piers directly under the seats, especially as the top of the piers were left rather rough. Such construction, with the shoes anchored with two bolts in each, would be a large contributing cause to failure of the piers from cracking off under the bridge seats.

The following method of repair was recommended: (1) Incase the present piers in a sheathing of 1: 2: 4 concrete at least 8 in. thick, extending from the projection of the footings to tops of piers. In this casing place ¾-in. rods horizontally 18 in. apart. Pour new coping 18 in. thick reinforced with ½-in. rods 6 in. on centers placed across the narrow portion of the piers, and 2 in. above the present top of piers. (2) Set masonry plates of proper design to take care of expansion and contraction on the new coping and anchored thereto.

An Interview:

With W. W. FISHER and JOSEPH GRADISON
Division Engineer, Department of Highways, Cincinnati, Ohio. *Gradison Construction Co., General Contractors, Cincinnati, Ohio.*

Winter Construction of Concrete Roads

By C. S. HILL
Associate Editor, Engineering News-Record

Advantage to the Contractor Important, and Careful Tests Indicate that The Engineer Loses Nothing in Strength and Finish of his Pavement

THERE IS no fund of experience in winter construction of concrete roads. The operation has been attempted only a few times. Perhaps no contractor has undertaken it more than once. Any conclusions that any one can draw from his own knowledge are, therefore, individual and must be held open to revision as evidence accumulates. It can be said, however, of the specific operation of which the following experience is related, that it is one of the most extensive and most seriously considered winter road jobs ever completed and indicates several conclusions with considerable certainty.

The operation consisted of improving with plain concrete pavement the Cincinnati-Brockville road for a distance of 4.7 miles. The pavement was 20 ft. wide with an 8½—10½—8½-in. section. All curves were superelevated and all sharper than 5 deg. were widened. In every respect a high-class structure was the object. The winter season in Southern Ohio lasts about four months, from November to April. On Nov. 24 the work was ordered suspended, as the specifications direct, on account of cold weather, at which time 1.2 miles or approximately 13,500 sq.yd. of concrete pavement remained to be placed. The contractor immediately applied for special permission to continue the laying of pavement, which was granted according to the specifications, with the additional stipulation that no concreting could be done at temperatures below 26 deg. F.

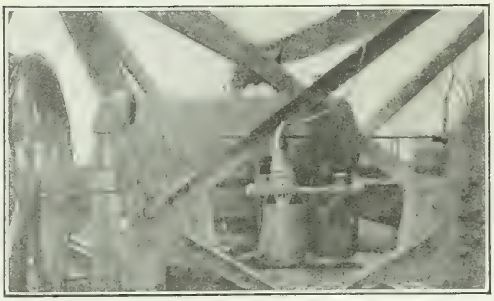


FIG. 1—OIL BURNERS HEAT CONCRETE IN MIXER

The Ohio specifications recognize weather as an element by the following clauses:

> *Suspension of Work:* For such period as is necessary or during such time as the weather is unsuitable for doing the work the Director may suspend the work at places or altogether, if in his opinion public need requires it. Upon any stoppage of the work, all material shall be safely placed so as not to obstruct or impede travel on the right-of-way.
>
> *Protection from Freezing:* No concrete shall be mixed or placed during freezing temperature except by SPECIAL PERMISSION of the Director. If at any time during the progress of the work the temperatures drop below forty degrees F., the water and aggregates shall be heated. Special precautions shall be taken to prevent all concrete from freezing after it is placed in position until the concrete has thoroughly hardened. Manure shall not be used as a protection for green concrete.
>
> Any concrete showing injury by freezing shall be removed and replaced at the expense of the contractor. In no case shall concrete be deposited upon frozen subgrade.

Consideration of the operation takes two directions: (1) Contracting problems involved in performing the work, discussed by Mr. Gradison, and (2) the engineering results, from information given by Mr. Fisher.

Contracting Problems—When orders were received to discontinue work there was about one mile unfinished on the 5-mile contract section B and three miles unfinished on Section A, a 4-mile contract. The situation was as follows:

Section B was being constructed by a combination truck and industrial railway haulage plan, the sand and gravel being washed in the contractor's own pit, transported in batch boxes on trucks about three miles to an unloading station, where the boxes were transferred from trucks to cars, and then hauled by locomotives to the mixer. Section A was being constructed of materials delivered by railway, hauled to the job, dumped on the subgrade and fed to the mixer by wheelbarrows. About 10,000 bbl. of cement on hand were stored in different sheds along the road under construction and at the railway.

Confronting the contractor were two problems, if work were discontinued. The first was the storage and care of the cement to prevent deterioration. The second was the disruption of a skilled organization if the men operating the gravel plant, trucks, locomotives, pumps, tractors, and other machinery were laid off. These problems involved chiefly the work on Section B. At the time the order to discontinue was received work was proceeding on both sections. No effort was made to continue on Section A as only unskilled labor was involved, but, for the reasons indicated, permission was secured to continue Section B, and operations were actually resumed on Dec. 11, after 16 days' delay making ready for winter work.

In preparation for cold-weather operation the 2-in. water supply line was relaid with drain cocks at low points and covered in a trench averaging 2 ft. in depth. Two oil burners with flame projectors were installed above the mouth of a Koehring paving mixer so that the flame was projected directly into the drum. A coil in the radiator tank heated the mixing water. A four-burner (oil) asphalt heater was used to remove any frost observed and to dry the subgrade. Another portable heater was bought to thaw out batch boxes of sand and gravel which had stood over night. In the sand and gravel bins at the pit, steam jets were installed, taking steam from the boiler of the crusher which reduced oversize stones. The washed sand and gravel easily froze if it stood in bins and boxes.

To prevent frost action on the green pavement and on the subgrade they were covered. For the concrete slab peaked frames 10x23 ft. were built of light timbers and covered with tarpaulins. When placed over the slab, lanterns and oil lamps were hung under the tarpaulin, their number depending on the expected temperature. The frames and lanterns were kept in place 48 hours unless before the expiration of that time the temperature rose above freezing, and then the frames were taken off and moved ahead and the slab was covered with 4 to 6 in. of straw. There were enough frames and tarpaulins to cover 250 lin.ft. To protect the subgrade it was covered with 6 in. of straw for 250 to 350 ft. ahead.

Briefly the cold-weather operations led to the following observations:

1. It was necessary to wash every day the gravel for the day's work. As long as washing was continuous there was no trouble but if it was stopped for any time the pipes froze and had to be thawed.

2. The most difficult task was keeping up the water supply to the mixer. Constant attention was required. Pipes and pumps had to be drained every night and every morning the pumps had to be primed. With all this, quite often, low places had to be looked after where the accumulation of a little slush would stop the flow and the pipes would freeze.

3. The increased cost of operation was small except for the outlay for special equipment; the actual extra labor cost was small. In summer the slab has to be covered with burlap and sprinkled for 10 days, and the labor of covering to prevent freezing is no greater.

4. Labor for subgrading was increased very little because no attempt was made to subgrade when it was cold enough to freeze the ground under the covering.

5. The extra cost was for oil for heating the mixture and thawing the subgrade and this varied as the temperature conditions varied.

6. It was absolutely no trouble to keep the concrete from freezing after it was laid. Keeping frost from the raw materials was the greatest difficulty.

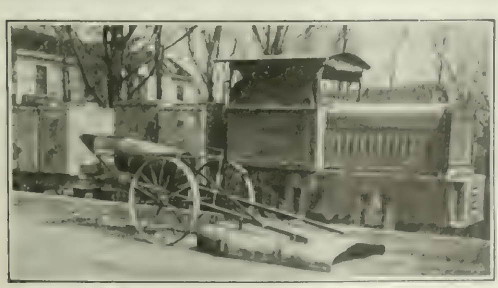


FIG. 2—OIL HEATER THAWS CRUST AND DRIES SUBGRADE

In general, the conclusion, quoting Mr. Gradison directly, is as follows:

"Our deductions are that winter work is not only advisable, but should be made compulsory. It helps the legitimate contractor to build up an organization of men who are skillful and able, and who, by knowing that they will have work all year round, will make contracting their profession. Usually, contractors' help is a floating help; men work for contractors when they cannot get anything else to do. By continuing work through the winter, it relieves the cement mills and gravel plants and railroad companies from the terrible burden they have to carry during the working season, which in our territory is limited to the period from May to November; the cement mills and the gravel plants, which have to distribute their 12 months' overhead over a production season of five months, should be able to sell their product cheaper; and the railroads by having their equipment moved all year round should be able to derive the same revenue at cheaper freight rates. Of course, there is no question but that work during the winter is more expensive than during the summer, mostly on account of the shortage of daylight; on the other hand, labor is easier to get."

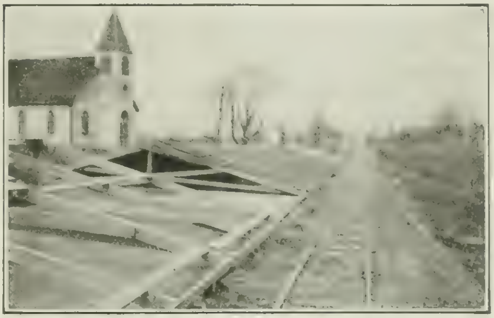


FIG. 3—TARPAULINS ON FRAMES COVER PAVEMENT

Engineering Results—During the period from Dec. 11, 1922, to March 10, 1923, inclusive, concrete pavement was laid on 34 days as follows: 4 days in December, 22 days in January, 4 days in February and 4 days in March. A total of 4,587 ft., or about 10,547 sq.yd. was laid, averaging 134.9 ft. or 310.2 sq.yd. per working day. Tests made on 6x12-in. cylinders of the same concrete cured under the same conditions as was the pavement showed the following compressive strengths:

Date Made	Days' Old	Total Load	Lb per Sq In
1- 3-23	21	150,100	5,300
1- 3-23	28	146,900	5,200
1-19-23	14	90,500	3,200
1-19-23	28	96,600	3,420
1-26-23	21	103,300	3,660
1-26-23	28	107,600	3,800
3- 9-23	28	140,700	4,980
3- 9-23	28	152,600	5,400
3- 9-23	8	55,700	1,970

From an engineering standpoint, Mr. Fisher observes that conclusions on winter construction of concrete roads must necessarily be general and open to revision when based on the limited amount of pavement laid during the past three months. The results obtained, however, indicate that the quality of concrete and finish compare favorably with summer work.

In the work described, it was possible to carry on subgrade since the old macadam road was used as a base after scarifying, spreading the stone to full width of new concrete, and rolling. The preparation of an earth subgrade would have been impossible. Only by anticipating winter work and preparing and protecting from freezing a long stretch of subgrade ahead could concreting proceed on an earth subgrade; and even then difficulty would be encountered in the final rolling necessary to compact the inevitable rutting of subgrade far ahead of the mixer. A specified stone or gravel subgrade would necessarily increase the cost of road construction.

The economies of winter concreting involve, of course, a comparative study of summer and winter costs, and public convenience, in addition to careful and extensive tests of construction methods and the quality of work obtained. Present practice has established that the best results in construction, economy and public convenience are obtained by completing contracts before winter. How better progress can be obtained during the usual construction period is a question for authorities letting road contracts; possibly allowing estimates on stated lengths of completed pavement or a bonus and penalty clause in contract might tend to speed up the completion of contracts.

The next article in this series will appear in an early issue.—Editor.

Fires in Formwork in Concrete Buildings

TWO FIRES in formwork of concrete buildings under construction occurred within three days of each other last January and have been reported recently. The first, on Jan. 4, was in the McDougall terminal warehouse at Duluth and the second, on Jan. 7, in the James Butler warehouse at Long Island City, N. Y.

The Duluth building is to be 488 ft. long and 130 ft. wide and was five stories high at the south end and four stories high at the rest of the building at the time of the fire. It is of a flat-slab reinforced-concrete type, floor slabs 9 to 10 in. thick, roof 6 in., all reinforced by ⅜-in. and ½-in. steel rods. The columns are 22 to 30 in. in diameter, reinforced with four to eight ¾- and 1-in. straight rods and ⅜-in. spiral reinforcement. The concrete was one part cement, two parts lake sand, and four parts gravel for the slabs, and for the columns a 1:2:3 mixture of the same material. The first floor was completed in October, the second and third in November, and the fourth during December, with the exception of the north end of the fourth floor which was completed the day before the fire.

The floor form boards and struts had been removed from the first and second floors, but at the time of the fire were still in place on the third, fourth and fifth floors. These forms were made of ⅞-in. lumber, surfaced on one side and two edges. The struts were 4 x 4-in. rough sticks, set 4 ft. on the centers throughout the third, fourth and fifth floors, there being about 1,000,000 b.ft. in all the building. The fourth and fifth floors were covered with 3-in. shavings and these floors were heated with salamanders burning hard coal, coke being unobtainable. The third, fourth and fifth floors were inclosed with heavy canvas curtains. There were no division walls and, with the exception of the curtains inclosing certain floors, the building was entirely open.

On Jan. 4 there was a temperature of about 30 deg. above zero and a northwest wind of 10 to 12 miles an hour. The fire was discovered at 5.15 p.m. after most of the men had left. It was at the north end of the third floor in the canvas curtains and presumably originated from one of the salamanders. An alarm was immediately turned in but the fire spread so rapidly that within 15 min. the entire fourth and fifth floors were ablaze and the three men who were in the building had difficulty in getting out. The fire burned rapidly and fiercely for some 20 min. and continued for about 1½ hr. before it was under control. Notwithstanding the fact that the building was accessible on all sides, the fire department had little chance to be of value except to save exterior framework, the concreting tower and the derricks. The fire was in the falsework and in the shaving protection of the floors.

As the struts burned and fell, the ends of the floor forms dropped down allowing the fire to get in between the floor forms and the concrete, completely destroying the lumber and heavily damaging the slabs. The outer coverings on all columns, on the fourth and fifth floors and part of the third floor, was cracked and disintegrated and the cores inside the spiral reinforcement were in some places damaged beyond repair. The fourth and fifth floor slabs were badly chipped and cracked on the under surface, making necessary replacement of a large part, and the outside columns on the west side of the third, fourth and fifth floors were badly chipped and cracked. The fourth floor at the north end of the building was finished the day before the fire and completely collapsed. The total loss was figured at from $175,000 to $200,000.

The fire in this building is described in the *Quarterly* of the National Fire Protection Association for April, 1923, and also by A. R. Lord in the *Proceedings* of the American Concrete Institute, Vol. 19, 1923.

The James Butler Fire—The James Butler Grocery warehouse in Long Island City is to be a six-story reinforced-concrete warehouse. The floors were also of the flat-slab type. At the time of the fire all the slabs on the first and second floors had been poured with the exception of 25 per cent of the second floor at the southwest corner. Struts and forms for the unfinished part were not up, but forms for about 10 per cent of the third floor were in place near the northeast corner. None of the slabs on the third floor had been poured. There were thirty open coke-fuel furnaces used as salamanders to prevent fresh concrete from freezing.

The fire originated in a canvas curtain on the first floor at the northwest section of the building, either from a flying spark or from contact with a salamander. A space 100 by 120 feet at the northerly end was curtained off by canvas and the thirty salamanders were in use here to dry the floor. The fire was discovered by a watchman who had shortly before placed fresh coke on the salamanders. He attempted to extinguish the burning canvas while another watchman blew his whistle to attract attention. The fire department arrived soon thereafter, but by that time all the canvas curtains on the first floor were ignited and these in turn set fire to the wooden forms for the second and third floor concrete arches. All of these forms were either completely burned or badly damaged and five half panels of new concrete floor slabs collapsed. The concrete columns and the steel plate girder protection were badly spalled.

In the conclusions regarding these fires, the *Quarterly* of the National Fire Protection Association states that they illustrate the importance of the fire hazard involved in the construction of concrete buildings due to (1) the large amount of lumber for construction of the wooden forms for floor arches, columns, and walls, and (2) the high fire hazard resulting from the use of numerous salamanders or similar furnaces for heating large areas in order to make it possible to pour the concrete during freezing weather. The canvas curtains for inclosing the heated area act as effective kindling material to ignite lumber contained in the wooden forms.

Experience with Activated-Sludge Plant at Eldorado, Kan.

After Oil Boom Septic Tank and Chlorination Plant Changed to Activated Sludge—New City Managers Practice False Economy

By Albert H. Jewell

Chief Engineer, Kansas State Board of Health, Lawrence, Kansas

In his letter transmitting this article Mr. Jewell says, "I heartily endorse the editorial, 'No Royal Road to Sewage Treatment,' in your issue of April 5, 1923, p. 609. The situation at Eldorado illustrates the point of the editorial. There is no one set system to be used in all cases and in most cases individuality will have to be expressed by the engineer using such combinations of sewage treatment as are needed to accomplish the end in view."—Editor.

When oil was found in Butler County, Kansas, in 1915, Eldorado, the county seat, had a population of 2,705. In 1918 the population had increased to 16,246. It is obvious that the water and sewerage systems were entirely inadequate. On account of the town's mushroom growth, it was not plain whether improvements of a temporary or a permanent nature should be made. Sewage had been disposed of by means of two septic tanks each 18 ft. wide and 58 ft. long, having an average depth of 8 ft. The effluent from the tanks was chlorinated in a mixing chamber having a detention period of about a half-hour. The effluent was discharged into the Walnut River, which is used as a source of water supply by the town of Augusta, fifteen miles downstream, and later Douglass.

Change to Activation — Preliminary investigations showed that if secondary treatment were to be employed the sewage would have to be pumped and that there was a limited area which could be used for secondary treatment. An estimate of tank treatment with sprinkling filters was $125,000. Activated sludge was investigated by Bert Wells, city manager, and C. A. Haskins, then engineer for the Kansas State Board of Health. They received valuable help from sewerage commissioners of Chicago and Milwaukee as well as several consulting engineers. An estimate of the cost of remodeling one of the septic tanks into an activated-sludge plant and of constructing two settling basins was about $20,000, the difference between a sprinkling filter installation and the activated-sludge plant being about $105,000. Interest at five per cent on this difference would give $5,000 per year to take care of the higher operating cost of the activated-sludge plant. In the estimates it was considered that in either case two men would be required at an expense of not less than $2,400 per year. Power for the sprinkling filter plant would be $1,500 per year and for the activated sludge plant $3,000 per year. Taking all of these conditions into consideration, with special emphasis on the fact that it was a mushroom growth with a probability of decrease in population after the oil boom, it was decided that the activated-sludge plant with its lower initial cost would be the best adapted for these conditions.

One septic tank was therefore converted into an aeration tank by deepening it to 15 ft. and installing 216 filtros plates, making a ratio of the plates to the surface of the tank of 1 to 4.8. Two Nash Hytor compressors with a capacity of 500 min.-ft. supply air to the sewage at the rate of 1.25 cu.ft. per gallon of sewage. The old mixing and sterilizing chamber was deepened and made into two sedimentation tanks of the inverted pyramid type, the inlet being submerged and the outlet taken off over a rectangular weir on the opposite side. A small Johnson press was installed to take care of sludge. The remodeling cost was $15,600.

Unfortunately the city manager resigned shortly after the plant was placed in operation. Since that time there have been three city managers, none of whom had had any former experience with activated sludge, and in an attempt to cut down operating expenses some difficulties were encountered. An attempt was made to operate the plant on two 8-hr. shifts. This resulted in losing the activation and also clogging the filter plates, as well as loosening and blowing out some of these plates. Since placing the plant on 24-hr. operation, there has been no difficulty with the aeration tank.

Further Changes—It was soon found that the sedimentation tanks were not large enough to take care of the peak loads, so a third tank was built the year following the completion of the plant and this past year it was found necessary to build a fourth tank.

The Johnson sludge press was found to be very unsatisfactory and the city has never been able to make use of it. The sludge has been pumped to a nearby draw but undoubtedly in the future some better method of disposal will be adopted.

An effort has been made to increase the efficiency of the sedimentation basins by constructing baffles, but the velocity is so great at peak loads that sludge is carried out in the effluent. The effluent is now taken off at the center of each tank by means of rectangular wooden troughs. Experience with a Dortmund tank is contemplated to try to increase sedimentation.

It is interesting to note that the quantity of sewage has increased with the decrease in population. The 1920 census gives Eldorado a population of 10,995. This is accounted for by the fact that a good many of the boom shacks did not have sewer connections. The people who remained after the boom have built modern homes so that there has been a gradual increase in sewer connections.

Cost—Records kept by the city managers show the following cost of operation and addition to capital investment:

Operation	1921	1922
Salaries	$3,142	$2,835
Power	2,003	3,900
Miscellaneous	426	
	$5,571	$6,735
Construction cost of additional sedimentation tanks	$3,370	$865

The writer is indebted to E. H. Hawkins, formerly city manager of Eldorado, for much of the foregoing information.

Provisional Census Mortality Figures: 1922

Slightly higher mortality rates in 1922 than those for 1921 are shown by provisional figures announced by the Bureau of the Census. The 1922 rate for the 33 states in the death registration was 11.9 against 11.6 in 1921. Maine stood highest in 1922 with a death rate of 14.7 per 1,000, and Idaho was lowest with a rate of 8.1. The provisional birth rate for the 24 states in the birth registration area was lower for 1922 than for 1921, the figures being 22.7 against 24.4, the highest 1922 rate being 30.2 for North Carolina against 18 for Washington.

Philadelphia Trainshed Wrecked by Fire

Wood Decking of Track Floor and Combustible Roof Sheathing Allow Fire to Spread—Early Development Favored by Concealed Spaces Between Track Floor and Ceilings Below

FIRE which started under the track floor of the Broad St. station trainshed of the Pennsylvania R.R. at Philadelphia just before midnight on Sunday June 10, wrecked the entire track floor and the huge trainshed and destroyed a large amount of baggage and railway property in the story below the track floor, including the power plant, which supplied heat and power to the station building. The terminal and office building, lying east of the trainshed, was not injured. The size and rapid spread of the fire resulted from the antiquated construction of the station, built partly in 1881 and partly in 1893.

Wooden framing and decking covered with a waterproofing layer formed the track floor, being supported by a system of steel columns, floorbeams and stringers. Below the supporting steelwork were metal ceilings supported by wood framing, to cover the rooms below, which housed record storage, baggage and mail and other railroad facilities, besides the power plant. Fire started in the space between floor and ceiling, according to present evidence, and got a thorough start by spreading in the long continuous open spaces under the track floor, where woodwork was exposed everywhere. The actual origin of the fire is not known, but electric wires have so far been charged with the responsibility. When the fire was first noticed it was breaking through the floor of one of the platforms between tracks, but at this time it had already grown to such size below the floor that it could not be controlled.

The entire track floor, including the platforms and their supports and the wooden track supports, burned, and the flames soon ignited the wood sheathing and roofing of the trainshed above, consuming all this combustible material, and injuring the ironwork of the roof extensively. Below the track floor, the contents of the ground-floor rooms were burned out and the ironwork of the floor was extensively wrecked. Several of the trains in the trainshed at the time of the fire could not be pulled out soon enough and were destroyed.

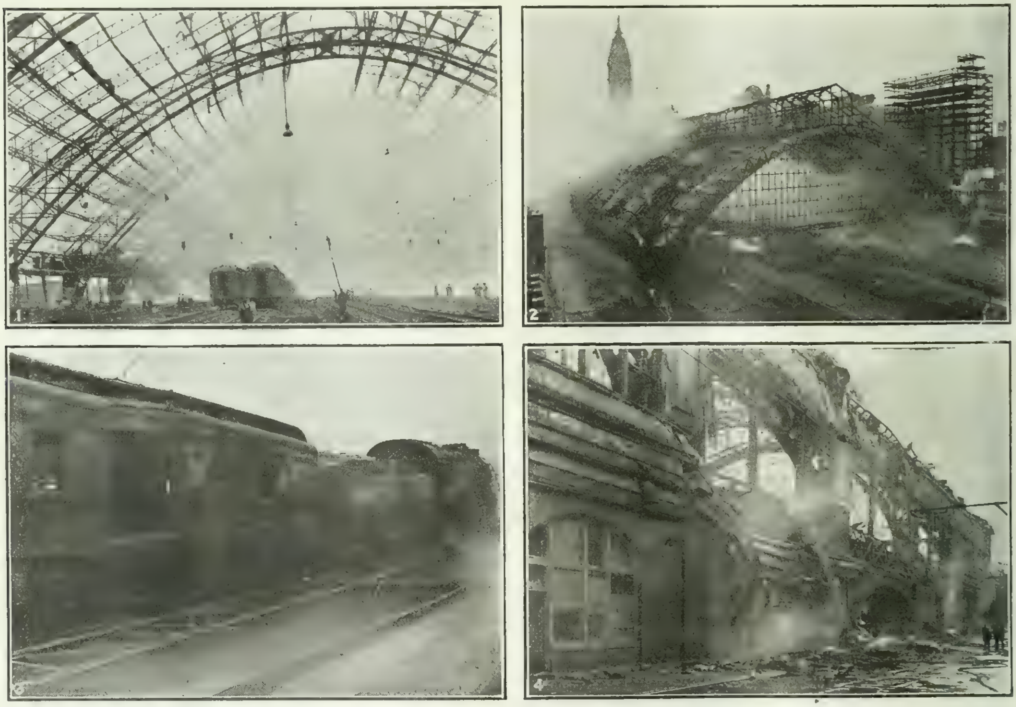


FIG. 1—PENNSYLVANIA R.R.'S PHILADELPHIA TRAINSHED FIRE

As it appeared Monday, June 11, before fire was fully extinguished. Roof sheathing burned away. Main arches of roof are in good condition, but minor steel framing is extensively distorted. Lower view shows part of a train that was caught in the fire; the track rails were left without support after the wood upper framing of the floor burned.

A narrow strip of the outer or westerly end of the trainshed did not have the floor construction described, but was of earth fill on masonry arches. The damage here was only that due to the transmitted heat and to the fire of the trainshed sheathing above.

Wind conditions were not particularly bad at the time of the fire, but the great area covered and the large amount of combustibles in the construction made the fire hot and refractory, so that it required nearly

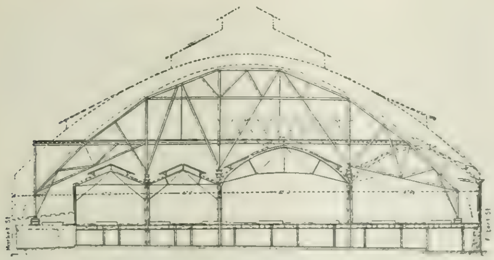


FIG. 2—CONSTRUCTION OF TRAIN SHED IN 1893, SHOWING EARLIER FOUR-SPAN SHED AND ERECTION TRAVELER

two days to extinguish. Practically no damage was done to buildings outside the station area, however, although the station is in the heart of the business district and only a stone's throw away from the City Hall with its prominent tower.

In the wrought-iron framing of the trainshed roof, practically all the minor members are bent, buckled, or sagged as a result of the heat, while the arches themselves show no injury. No detail examination was possible up to the time of writing, but there is no appearance that either the arches or their tie rods (in the floor) were seriously enough affected to make them unfit for further use. However, as soon as the extent of injury to the roof framing as a whole was apparent, it was decided to take down the trainshed roof and construct umbrella-shed shelters over the new platforms pending the reconstruction of the terminal. A contract for taking down the shed has been awarded to Henry Hitner & Sons.

With the central point of the Pennsylvania System out of service through the fire, work to restore traffic was taken in hand immediately and with admirable energy. New signaling and dispatching wire lines were run outside the trainshed even while the fire was still in progress, the West Philadelphia and North Philadelphia stations were made terminal points, and crews started to repair overhead conductor wires at the west end of the station to permit electric traffic to be resumed at the earliest moment, using the platform extensions and sheds outside the main shed. By Tuesday morning, 30 hr. after the outbreak of the fire, work was actively in progress building new platforms on the wrecked steelwork of the trainshed floor, and as the views herewith show, by the following morning several of these platforms were in service. Before this, stairs had been built for direct access from the street level to the surviving platform extensions west of the shed, and these went into service even on Monday. A brief summary of events as related to traffic is as follows:

At 11:45 p.m., June 10, when the fire was discovered, the entire station traffic of 529 trains daily was paralyzed. By 5 a.m., Monday, arrangements had been made for trains to terminate at North Philadelphia, West Philadelphia, 31st and Chestnut Sts., and (for the Atlantic City trains) Camden, abandoning bridge train service from the coast. Conductor-wire reconstruction was so rapid that before four o'clock Monday afternoon electric service was resumed from the west end of the station shed to Paoli and Chestnut Hill, this service being made complete by midnight. By Thursday, June 14, normal steam-train service on two branches was resumed from Broad St. station, and bridge train service was resumed, terminating at West Philadelphia. Within 72 hr. after the discovery of the fire, 246 trains, or nearly half the total, had been restored and nine of the sixteen tracks were available.

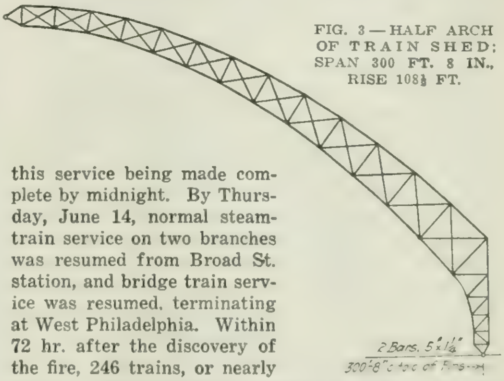


FIG. 3—HALF ARCH OF TRAIN SHED: SPAN 300 FT. 8 IN., RISE 108½ FT.

Broad Street station trainshed was among the three or four largest steel arch roofs in existence; at the time it was built, thirty years ago, it was the largest. It was 300 ft. 8 in. in span, c. to c. end pins, with a rise of 108½ ft. c. to c., and was 598 ft. long. The arches were in pairs, forming ten towers 9 ft. wide, 56 to 67 ft. apart. The material was wrought iron. The tie bars between the arch shoes, however, were of steel. When the shed was erected the track floor and its supports were left unchanged, except for some lateral extension. This lower construction dated from 1881. (See *Engineering News*, June 1, 1893, p. 507.)

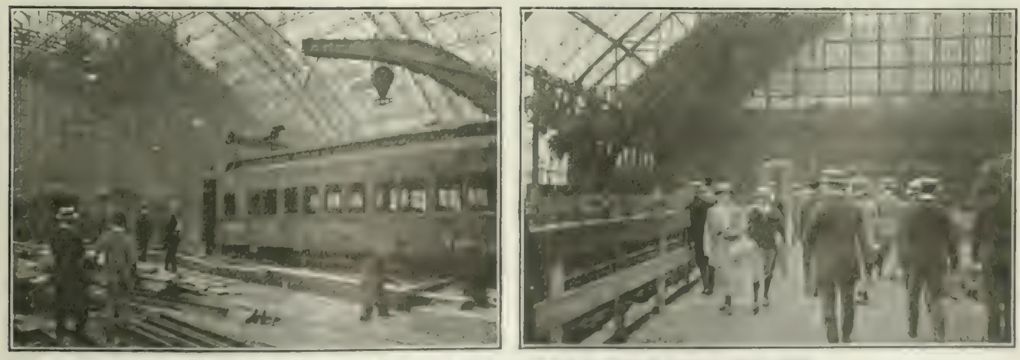


FIG. 4—RESTORING TRAFFIC IN BROAD ST. STATION AFTER THE FIRE

Platform construction and removal of wrecked cars in progress. Several platforms already in service June 1[illegible]

Cost of Detours in Constructing Wisconsin Roads

Cost to Traveling Public Based on Records for 1922 Estimated at About $1000 per Mile Under Construction

By N. M. Isabella
Assistant Maintenance Engineer, Wisconsin Highway Commission, Madison, Wis.

WISCONSIN had upwards of 300 road construction operations under way at one time on its state trunk highways during the season of 1922. The majority of these were improvements where traffic could be maintained over the regular route with a fair degree of comfort, but there were also many, such as concrete road construction, large bridges, heavy grading in clay and very sandy soils, which necessitated detours properly to care for traffic.

The construction season usually opens about April 1, and extends to about Dec. 1. During this period in 1922 there were approximately 3,000 miles of highways actually affected by some type of construction. In practically every case involving an improvement of concrete or similar type pavement, a detour was necessary. In many cases detours follow secondary roads, which, under ordinary circumstances, do not carry much traffic, and when the through travel of the trunk highway is directed over them, they become very badly worn. It is rather expensive to maintain a road of this kind under heavy travel. The detour further imposes the inconvenience of additional mileage on the traveler.

There were 159 detours on the state trunk highways during the season of 1922, varying in length from 0.5 mile to 20 miles. The shortest time a detour was in use was seven days. The longest period a detour was in service was 220 days. In many cases the detours did not cause any additional mileage for the traveler. In a few cases they were actually shorter than the regular route. In the great majority of cases, however, the detour was considerably longer than the section of the regular road under construction, thus causing the traveler to make extra mileage.

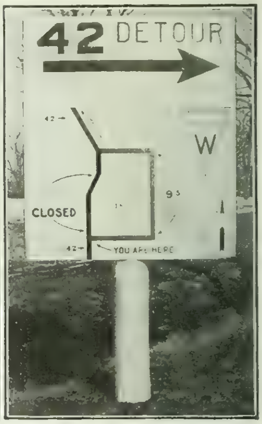
Analyzing the situation of 1922, we find that, of the 159 detours, three were shorter than the regular route, 13 caused no additional mileage, and 143 caused increase in mileage for the traveler, varying from 0.5 mile to 12 miles.

The increase in mileage due to the 159 detours was 342 miles, or an average of 2.15 miles per detour. The total number of days that the 159 detours were in service was 12,977, or an average of 81.6 days for each detour. From traffic counts taken at over 100 representative stations, it was found that the average number of vehicles per day passing a given station, and likewise over a majority of the detours, was 1,320. In practically all cases the traffic stations were so situated as to be in close proximity to the various detours. In many cases a single traffic station furnished proper counts for several detours that were immediately adjacent. Thus, due to the fact that most detours were in the heavily traveled communities, it is believed that the figures given above on traffic are fair from the standpoint of average conditions, and if anything, conservative.

As stated previously, the great majority of these detours existed in the well settled and thickly populated sections of the state, where the traffic is more concentrated than in other sections, and the tonnage hauled per mile is much greater. If we disregard the additional cost of maintenance, marking and signing of the detours, also the loss of time, and analyze the extra cost to the traveling public for the operation of their motor vehicles only, we would have as follows:

Let us assume that the average cost per mile for operating all types of motor vehicles is 10c. We would then have 2.15 × 12,977 × 1320 × $.10 = $3,680,000, for the total extra cost to the traveling public excluding the items mentioned above. Reduced to a daily basis, this would mean approximately $45,000 per day.

MARKERS ALONG ROUTE OF DETOUR



DETOUR MAP PLACED AT ENDS OF DETOUR

At first sight it would appear that this is a considerable loss to the traveling public that seemingly is not justified. There are several angles from which we might discuss this. Probably some of the best methods of reducing this penalty imposed upon the traveling public would be (1) the early letting of contracts to contractors who possess the proper equipment and ability to speed up construction and thus shorten the time all detours are in service; (2) the storing of enough materials to keep construction in continuous operation over any period of poor transportation service on the railroads; (3) getting legislation that would permit the concentration of work on through highways and thus not have the same road closed year after year for several jobs; (4) shortening the period in which concrete road is allowed to cure, by use of a cement that will set and cure in a few days after it has been laid. It is general practice now to allow about 14 days for a concrete road to cure. Cutting this down several days would affect a material saving to the traveling public.

As stated before, 81.6 was the number of days that the average detour was in service. It can readily be seen that if this figure could be cut down to say 70 days, there would be effected a reduction in cost to the traveling public on the total detours 11.6 ×1320 × 159 × $.10 × 2.15 = $524,000. There are limitations, however, to the number of days that can be cut off, even if the most modern methods are employed.

There are advantages that accrue to the traveler in the future in the use of the completed highway, even with this temporary loss. There is no question but what the cost of operation of a motor vehicle on the new highway would be decidedly less than that on the old highway, were it to be used indefinitely. This, of course, would, over a short period, offset the cost and the inconveniences caused by the detour. However, this does not excuse those in charge of highway construction from trying to reduce the inconvenience and additional cost due to the detour. Work should be planned well in advance and contracts let early enough so that at least the shorter jobs may be completed before heavy travel commences.

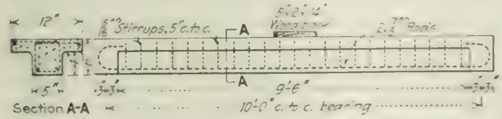
Test Two Beams To Determine Strength of Light-Weight Aggregate

By B. S. Myers
Chief Engineer, Capitol Steel & Iron Co., Oklahoma City, Okla.

On account of the proposal to use concrete made with the light-weight aggregate Kansas Haydite in several important buildings in this city, it was decided to make a comparative test, using Haydite in one case, and rock and sand, obtainable in the locality, in the other.

The quantity of the Haydite available for this test was very limited, and the size of the test beams was restricted accordingly. The Haydite used was obtained from a local contractor who had been furnished samples of the material from regular stock of the Haydite Co. of Kansas City, Mo.

The drawing shows the form and dimensions of the test beams, also the reinforcement used. The test beams were reinforced sufficiently to guarantee failure in the concrete in compression. In both cases the concrete was proportioned carefully by volume, a 1:2:4 mixture being used with a minimum amount of water.



DETAILS OF THE BEAMS

After the beams were poured, they were placed in a room in which the temperature was kept at about 70 deg. day and night until the test was made on the tenth day. The test specimens were covered with sand and kept well wet down.

The table shows the theoretical stresses on the steel and the concrete and the deflection of the beam 7 in. from the center line for the loads indicated.

The beam made of rock and sand concrete required a load of 7,300 lb. to cause failure, at which time the concrete was stressed to 3,112 lb. per sq.in. The concrete in this beam was very dense, and the beam had a smooth, neat appearance when the forms were removed. When the forms were removed from the Haydite beam, the concrete appeared to be quite porous and of not as good a quality as the other beam.

About twenty-five engineers and architects witnessed the test, and it was their unanimous opinion that the Haydite beam would fail under a considerably less load than the rock and sand concrete beam. However, a load of 8,000 lb. was required to cause failure, at which time the concrete was stressed to 3,400 lb. per sq.in. maximum. The Haydite concrete weighed 108 lb. and the rock and sand concrete 144 lb. per cu.ft.

Haydite is an artificial aggregate for concrete, made by burning clay or shale to a clinker in much the same way as the clinker is formed in the process of manufacturing cement. This clinker is crushed to the desired sizes required for the making of concrete. The above tests seem to indicate that the strength of the Haydite concrete is at least equal to that of ordinary concrete in cross-bending, and that Haydite concrete would be satisfactory for ordinary concrete construction.

STRESSES AND DEFLECTIONS IN TEST OF LIGHT-WEIGHT AGGREGATE

Load, Pounds	Stress, Lb per Sq In		Deflection	
	Steel	Conc	Stone and Sand, In	Haydite
1,000	6,000	425	0.11	0.13
2,000	12,000	850	0.21	0.24
3,000	18,000	1,275	0.32	0.36
4,000	24,000	1,700	0.44	0.48
5,000	30,000	2,125	0.59	0.61
6,000	36,000	2,550	0.75	0.75
7,000	42,000	2,975	1.02	0.93
7,300	43,800	3,112		
8,000	48,000	3,400	....	1.60

New Stresses for Fir and Southern Pine Deduced From Tests

An extended series of comparative tests of Douglas fir and southern pine, both long leaf and short leaf, has been carried on during the past two years by an expert committee appointed by the New York Lumber Trade Association. High strength values were found for all species. The following figures represent the averages for modulus of rupture (minimum and maximum values in parentheses): Douglas fir, small specimens, 8,925 (4,730-12,300), large timbers, 6,125 (3,970-9,655); longleaf pine, small specimens, 9,585 (6,580-12,820), large timbers, 6,940 (4,810-9,110); shortleaf, small specimens, 8,140 (6,840-9,230), large timbers, 5,870 (4,320-7,520). The elastic limit generally was about two-thirds the modulus of rupture. These timbers were of the following grades: Douglas fir, No. 1 common; longleaf pine, merchantable grade, 1905 interstate rules; shortleaf, 1910 specifications. It is reported that the tests on the small specimens show that clear portions of equal density of the two species are of approximately equal strength, and that by proper grading rules it is possible to obtain structural Douglas fir timbers equal in bending strength to longleaf yellow pine, except that the shear values are proportional to the relative weights.

It was found, however, that a large proportion of the materials selected for test was of considerably higher grade than the minimum of the respective grade rules, and that several higher classes of material could readily be established. An additional grade of Douglas fir which came into the eastern market after the tests were begun gave occasion for a supplementary set of tests, showing for the large timbers an average modulus of rupture of 7,345 (6,170-8,340), with a large proportion of the new grade giving even much higher values.

On the basis of all the tests the investigators proposed that working stresses in bending be fixed at 1,600-1,800 lb. per square inch for southern pine and 1,350-1,800 lb. per square inch for Douglas fir, as follows: Longleaf yellow pine, 1905 merchantable, 1,600 lb. per square inch; select structural southern yellow pine, 1,800; No. 1 common Douglas fir, 1,350; structural grade Douglas fir, 1,600; dense structural grade Douglas fir, 1,800 lb. per square inch. The recommendation was approved by the New York Lumber Trade Association.

Nashville Concrete Bridges to Be Repaired

City Appropriates $300,000 to Remedy Deterioration on Sparkman St. and Jefferson St. Concrete Trusses

AS NOTED in *Engineering News-Record,* Dec. 8, 1921, p. 934, serious disintegration of the concrete in the Sparkman St. and Jefferson St. Cumberland River bridges at Nashville, Tenn., has been causing the city authorities concern for some years. Last year the city appointed the Freeland-Roberts Co., engineers of Nashville, to study the situation and report on proper remedies. The engineers have rendered a preliminary report, abstracted below. The Tennessee legislature has passed a special enabling act to allow the city to issue $300,000 in bonds without submitting them to referendum. As soon as these bonds have been sold plans and specifications for the repair work will be prepared.

The Freeland-Roberts report follows:

Both the Sparkman and Jefferson St. bridges consist of three steel truss spans across the river proper, reinforced-concrete viaduct approaches at each end and concrete on earth fill leading up to these viaduct approaches. No specifications covering the work could be found, but we have been informed that the concrete mix used was one part portland cement, two parts fine aggregate and four parts coarse aggregate.

The cement used was not tested by a commercial laboratory specializing in the testing of cement, but each car was tested by the consulting engineer in charge of the work. We have no data on hand to show the results of these tests nor the amount of cement actually used on the job. None of the original fine or coarse aggregate is available for testing, but the larger part of these came from a quarry located near Newsom Station and a small part came from a quarry at Carter's Creek. There is nothing to show that any provision was made to make the concrete waterproof.

Preliminary examinations were made of these structures prior to Dec. 18, 1922, after which date we began a comprehensive detailed examination of the structures. We have given them constant study and surveillance since that time.

We have made an examination of the plans and checked the design of the reinforced-concrete work and find that in all instances except one the stresses in the structure under an assumed loading do not exceed those recommended for safe engineering practice, and a sufficient amount of reinforcement has been used to safely carry the loads assumed. Safe engineering practice recommends that the shearing stress in concrete shall in no case exceed 120 lb. per square inch, but in the one exception, referred to above—viz., in the floor-beams, this limit has been exceeded.

Disintegration of the concrete is apparent in both structures, giving evidence of the failure of the concrete at such places as are exposed to the action of water and other weathering agents. The concrete at such points is badly disintegrated, the mortar neither adhering to itself nor to the coarse aggregate, but being apparently rotten. The steel at all such places is badly rusted and the mass of concrete seems to be slowly but surely going to pieces. The corners of the columns supporting the structure, in nearly all instances are spalling off, exposing the steel reinforcement underneath, and this steel is badly rusting. The floor-beams are as a rule in fair condition but there are instances where cracks have developed through them, evidencing their failure. Where these beams cantilever to carry the sidewalk beams and slabs, there are many instances of their failing in the cantilever portion. It appears on all floor-beams on which sliding plates rest that these plates have frozen together and the concrete beam has been severely damaged by the resulting pressure from expansion and contraction.

The longitudinal beams, under the roadway proper, are in better condition than almost any other part of the structures, but at every construction and expansion joint and at all other places where water has gone through the slab, and run down over these beams, the concrete has disintegrated and the steel reinforcement rusted. The floor slab, under the roadway proper is in a similar condition to the beams under this portion of the structure, disintegration of the concrete and rusting of the reinforcement having occurred at all places where the water has run on and into these surfaces. The beams under the sidewalk slab and the sidewalk slab itself are in much worse condition than any other portion of the structure. The slab has developed numerous cracks in every direction, allowing the water to get into the slab and filter through it onto the beams underneath, and at every one of these places the concrete has badly disintegrated and the reinforcement rusted.

The principal causes of the disintegration of the concrete are:

1. Disintegration of both fine and coarse aggregates under the action of water due to improper materials and limestone containing shale, rotten stone, etc.
2. Separation of parts of concrete mix when dropped into column forms.
3. Steel too close to surface of concrete.
4. Porous concrete which allows water to be absorbed, thus rusting the steel reinforcing and causing the concrete to be broken up when this water freezes.
5. The use of limestone dust which balls up in mixing and coats the coarse aggregate so that the mortar will not stick to these particles.
6. There also appears to have been a movement of the structure down the hill causing breaks in the tie beams between columns.
7. Construction joints and temperature cracks allowing the water to run through the slabs and onto the beams underneath.
8. Finishing the surface of handrails thus taking off the waterproof coating of mortar.
9. Laitance.

The most potent factor in the disintegration is the first, but all the others named are at work to more or less extent. The other causes contribute to the decay and disintegration of the aggregate by allowing more exposure, rusting of the steel reinforcing which breaks the adhesive bond between the steel and the concrete, alternate freezing and thawing of the water in the concrete breaking the bond in the concrete itself, and the gradual breaking down of the whole concrete mass due to the ever increasing exposure to the weather.

Disqualification from Holding Public Office

Massachusetts legislation against bribery and corruption of municipal officials has been amended by an act of the legislature just signed by the governor entitled, "An Act Providing for the Removal of Mayors in Certain Instances." The original act provides that any public official convicted of bribery or corruption shall, besides being subject to fine and imprisonment, be disqualified from holding any public office thereafter. The amendment adds that "an executive, county other than judicial, or municipal officer who is finally convicted of the crime of larceny, embezzlement or obtaining money under false pretences committed in connection with the performance of the duties of such office shall, in addition to the penalty imposed by law for the punishment of such crime, forfeit his office and be forever disqualified to hold any public office, trust or appointment as aforesaid." A similar bill was rejected by the Massachusetts legislature in 1922 because it referred exclusively to the mayor of the city of Boston.

Economics of Railway Water-Supply Systems Reviewed

Relation to Train Service and Boilers—Results of Treatment — Problem in Efficiently Handling Many Small Plants

Abstract of a paper read before the Western Society of Engineers by C. H. Koyl, engineer of water service, Chicago, Milwaukee & St. Paul Ry.

ON ALL railroads there is constant study as to the expenditure which is justified for provision and maintenance of facilities for the hauling of trains, and the basis in each case is the determination of the number of train-minutes which that facility will save.

Cost of Train Delays—The average freight train costs about $1 per minute, of which the coal and the wages of the train and engine crews make 20c. Consider the case of a regular water station out of water for one day, due to the breakdown of a pump or pumping engine, the freezing of a river suction, the bursting of a pipe, or any other cause.

The damage is principally in the delay to trains and grows with the density of traffic. If the lack of water necessitates one engine cutting loose and running for water and thus causes one train to lose one hour, the immediate loss in coal and crew's wages is $12. If it delays ten trains one hour each, the immediate loss is $120; and if it should happen on a busy line with thirty trains per day, the immediate loss will be not merely $360 but probably three times that much from the tying up of traffic. The prevention of such losses depends on the vigilance of competent water-station attendants and on duplication of equipment at important places.

Location of Water Tanks—There is sometimes the mistake of placing the tank in a hollow or sag of grades because the creek is there. Engineers, I suppose, must bear the blame, for no operating man would do such a thing. It costs a little more to run the discharge pipe up the hill and to pump the water up the hill, but the extra cost is so small as compared with the continuous waste of money in starting heavy trains from the hollow that there is no justification for the practice.

Water-Car Service—On most railroads there are points, generally on branch lines, where a supply of 20,000 to 25,000 gal. is necessary because of the distance to the next station on each side, but where water is so difficult to get that an equipment to supply even 20,000 gal. per day would cost as much as a large main line water station. It may be decided, therefore, to run a water car on each freight train and sometimes an extra tender on each passenger train between the two nearest water stations on each side, say fifty miles apart. The cost of operating these water cars is usually small but I have found water car cost for a northern branch line as high as $800 per month in winter.

Chemical Treatment of Water—On the subject of quality of water there is less knowledge, but our experience is growing rapidly. A water-treating plant for a railroad must be capable of cleaning muddy or slimy water, softening hard water, neutralizing acid water and delivering to the tank clean soft water whose only variable from one station to another is the amount of sodium sulphate or sodium chloride in solution. Several railroads have one or more engine districts completely fitted with water-treatment plants.

Examples of Water Treatment—On the Great Northern Ry., in 1914, we put a water-treating plant at every water station on the Montana main line for a distance of 420 miles. As February is the hardest month for railroading in that part of the country, we made a careful comparison for that month. In February, 1914, the average load per train was 1,364 gross tons, and in February, [illegible], it was [illegible] tons, an increase of 38 per cent; and the average running time over a division (including delays) had been cut down from 14 to 10 hours. The result showed an increase from 100 to 193 ton-miles in one year for the same engines.

Although I was not able to compute the exact total value of the improvement in service, my best estimate was a saving of $1,000 per mile of road per year where there was an average of ten trains per day. That this is not too high an estimate is indicated by the fact that in 1908 the El Paso & Southwestern Ry. abandoned deep-wells along 128 miles and supplied mountain water through a pipe line of 120 miles, built at a cost of $700,000. The chief engineer reports that in less than two years the pipe line was paid for by savings of $2,700 per mile per year.

On the Chicago, Milwaukee & St. Paul Ry., we began in 1920 the installation of water-treatment plants on the lines east, west and south of Mitchell, S. D., where the water is very bad (see *Engineering News-Record*, Oct. 5, 1922, p. 560). It is now two years since we started the first of the new plants in operation, and since then not one of the boilers using treated water exclusively has gone to the shop for boiler repairs. Previously, every boiler spent about two months in the shop every year.

In addition to improved service on that 130 miles, and a reduction of $129,000 in operating expense, we have released three of the fourteen engines, whose construction cost was more than that of the water-treating plants. And what is true on the 130 miles is true all over the treated-water district. Water-treating plants may repay more than their construction cost in a few weeks by the release of engines and by increasing the speed and service value of cars.

Colorado-Nebraska Water Treaty Signed

LITIGATION over water rights between Colorado and Nebraska has been concluded by a compact recently signed by officials of both states. Thus ends a controversy started in 1916 by Nebraska in the federal courts against Colorado appropriations of water, which would normally come to Nebraska, and state water officials. It affected the rights of all appropriations in Colorado with priority junior to June 19, 1897. Studies made of the legal and physical phases included elaborate surveys of seepage and return supplies available for the service in both states. The *Engineers' Bulletin* of the Colorado Society of Engineers sums up the situation:

> A limited area can be served in Nebraska by ditches diverting water in that state, but the fertile lands in Perkins County can be reached by a canal to head in Colorado above Julesburg. The possibilities of service to these lands by the interstate canal (the proposed Perkins County canal) was early brought to the attention of the authorities in Nebraska and the desirability of a treaty between the states for settlement of pending disputes and opening the door to future development has been discussed by counsel for Colorado ditches with the Nebraska officials since 1917.
>
> In 1917 the Colorado legislature enacted a statute forbidding the diversion of water in Colorado for use upon lands in another state without previous consent of Colorado. Nebraska has been unable to commence construction of its canal until the conclusion of a treaty with Colorado.
>
> In early days the South Platte River was dry during the summer months at points below Fort Morgan. The irrigation of lands upon the tributaries and along the upper river produced an ever increasing return flow which has brought about the development of the country from Greeley to Julesburg. This return flow now supplies the valley lands below Julesburg in Nebraska, as far east as Ogallala. Nebraska makes no use of the water during the winter months, but Colorado stores all of the winter flow to as far east as Balzac and also a part of the winter flow below that point. The use and storage of the return flow coupled with the use and diversion of the flood flow has changed the dry stream of early days to one of constant flow at the state line. More than 100,000 acre-feet of water now pass unused into Nebraska each winter, after supplying all Colorado appropriations. The future development in Colorado will come largely from the storage of flood waters while the development in Nebraska will result altogether from the use and storage of the ever increasing return flow which otherwise would pass the interstate line.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Testing Materials, Machines and Structures

REVIEWED BY H. F. MOORE
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MECHANICAL TESTING: A Treatise in Two Volumes—By R. G. Batson, M. Inst. C. E., M. I. Mech. E., Associate of King's College, London, Senior Assistant in the Engineering Department of the National Physical Laboratory, Teddington; and J. H. Hyde, A. M. Inst. C. E., M.I.A.E., A. M. I. Mech. E., Senior Assistant in the Engineering Department of the National Physical Laboratory. Vol. I. Testing of Materials of Construction; pp. 413; $9. Vol. II. Testing of Prime Movers, Machines, Structures and Engineering Apparatus; pp. 446; $10. [The Directly-Useful (D. U.) Technical Series.] New York: E. P. Dutton & Co. Cloth; 6x9 in.; many line cuts and halftones.

The scope of this admirable treatise covers the field generally included under the name "Engineering Mechanics." All of Volume I and part of Volume II deal with laboratory problems in strength of materials and strength of parts of machines and structures. Other chapters deal with dynamometers, both absorption and transmission, efficiency tests of gears, the mechanical testing of lubricants and bearings, tests of static and dynamic balance, tests of cutting tools, tests of pressure-measuring apparatus, and mechanical tests with aircraft models.

The chapters on testing materials constitute what is perhaps the best treatise on this subject since the publication of Professor Unwin's well-known "Testing of the Materials of Construction." Enough discussion of theory is included so that the testing engineer who is "rusty" on his theoretical mechanics will need no other reference book at hand in order to follow this book intelligently. The diagrams and photographs of apparatus are numerous and clear. The typography is good. The text descriptions are clear and concise.

The authors have given considerable attention to the significance of test results, to the necessary degree of precision for various tests and to the effect of test conditions upon the accuracy of results. This is a feature especially to be commended, since in engineering laboratory practice sensitiveness and accuracy are often confused, and not infrequently a combination of extremely accurate instruments and instruments of mediocre accuracy is used in such a way that the effectiveness of the accurate instruments is lost.

The book is, of course, written from the viewpoint of British practice and that fact is evident throughout. This does not, however, seriously diminish its usefulness to the American engineer. In the first place, it should be recognized that British laboratory practice is thoroughly good; on the whole present-day British laboratory practice in the testing of materials is fully as careful and precise as is the practice of any other national group of materials testing laboratories. In the pages of this work any American laboratory will find many helpful suggestions for supplementing current test methods.

While this book is written from the British viewpoint it is fairly generous in its references to laboratory practice in other countries, but the authors have not kept in very close touch with recent developments in America. A striking example of this, among several which might be noted, is found in the chapter on tests of concrete slabs where some American tests of several years ago are quoted, but no reference is made to such an important test as that carried out on the floor of the Western Newspaper Union Building by Talbot and Gonnerman. Some time lag in reporting experimental results from the laboratories of another country is unavoidable but that lag seems rather large in this book.

The authors of this work are not content with empirical methods where rational methods can be used. American practice, especially in materials testing, tends to develop toward codified methods of testing and standard specifications. British and continental European practice seems to tend to develop more toward what in America would be called academic methods of testing, and, when specifications and standardized test methods are considered at all, toward specifications and test methods which vary for different consumers. This fact is reflected in the relatively large part of this work given to the theory of testing and the relatively small amount of space given to codified standards of testing.

This book is worthy of careful study by every testing engineer. It is a scholarly discussion of the general principles of testing illustrated by numerous examples rather than a handbook of standard testing practice. It may be said to have been markedly successful in achieving its object which the authors state "is to place before the technical engineer, manufacturer and the student the conditions governing modern testing, together with particulars of standard testing plant and its limitations, and such information as will enable the results obtained to be apprised at their true values."

Steel Erection

HANDBOOK OF STEEL ERECTION—By M. C. Bland, M. Am. Soc. C. E., M. Am. Soc. M. E., Bridge and Structural Engineer, Harrisburg, Pa. New York and London: McGraw-Hill Book Co. Flexible; 4x7 in.; pp. 241; 39 line cuts and halftones. $2.50.

A collection of experience notes, discussions and stress analyses of various erection tools such as locomotive cranes, derricks, and ginpoles, and solution of a number of specimen problems of steel erection, form the substance of this novel book. Very little has been written on erection heretofore, and Mr. Bland's contribution therefore has an importance considerably beyond that which the small size of his book might suggest.

Perhaps the principal value of the book lies in the fact that, throughout, it suggests—by implication rather than expressed statement—that every erection problem and each part of the problem is special, rather than subject to any formula or rule for the solution to be applied. Resourcefulness, familiarity with all the available methods and devices, and a willingness to adopt original procedure based on the requirements of safety and economy are the erection man's prime requisites

In his analyses of derrick booms, a very large ginpole, and other typical pieces of equipment, the author analyzes the attacking **forces** and the resistance of the material clearly and thoroughly, and brings into the calculation numerous items that may easily be overlooked by the designer. This feature of the book is in some respects its strongest element, in the sense of making it a necessity for every responsible erection engineer.

Many Formulas for Index Numbers

THE MAKING OF INDEX NUMBERS: A Study of Their Varieties, Tests, and Reliability—By Irving Fisher, Professor of Political Economy, Yale University. [Publication of the Pollak Foundation for Economic Research.] Boston and New York: Houghton Mifflin Co. Cloth; 6x9 in.; pp. 526; 68 "ratio charts." $7.50.

With the close of the war the computation of index numbers, which was formerly regarded as a harmless diversion of academic statisticians, came to have a bread-and-butter importance to many thousands of people in different occupations. Today it is a matter of great practical moment to know how index numbers are made and to know the right way of making them. Professor Fisher discusses one phase of the question in his latest book, and it need hardly be said that his book merits wide reading.

An index number—as applied to prices, for instance—is a number which represents the general price level in a given field of activity or demand at a given time (or the average during a given month or a given year) as compared with another time taken as the standard; and the index number when written down in sequence for consecutive days or months or years is intended to represent the general price variation in that field during the whole period covered. It is constructed by selecting from the items of price quotation in that field a certain limited numer, and combining them in some plausible way. For example, the index number of construction costs which is quoted month by month in this journal is a composite of certain elements of labor and material, which do not portray any given construction operation but represent it (and any other construction operation) by delegation, so to say.

An index number, then, is always based on something different from that to which it is ultimately applied, or else it would be a direct price quotation. Being general rather than specific, it can not be exact, it is a sort of average both in its origin and in its use. Its nature, therefore, will depend upon the way in which the representative items are selected from the general field, upon the way in which they are combined, and upon the way in which the resulting index number is used. Incidentally, the index number will also depend, it is found in practice, upon the base price—for example, whether construction cost is based upon 1913 or some other year as standard.

Of the numerous points requiring consideration in connection with index numbers, Professor Fisher discusses one, namely, the mathematical procedure to be followed in combining the quotation items selected as components of the index number. Only a few pages are devoted to the selection of items which should go into the index number, and to such questions as the essential need for permanence or stability, freedom from pronounced influence of abnormal conditions in a restricted part of the field, simplicity, availability of data, and the like. Thus the book is essentially mathematical—though the mathematics is simple. Several hundred possible formulas for combining quotation items to form an index number are mentioned, classified and discussed, with the final result that one particular formula is preferred as the ideal. This discussion is very necessary, and as it represents in large part the opening up of a new field, the author's work deserves high commendation.

There is unfortunately no test for an index number. No comparison is available by which its value or its results can be checked definitely. For example, an index number of lumber prices cannot be tested by the quotations for one particular kind and size of lumber, or even by the average prices per thousand feet paid on a few large lumber-using jobs. Its only test is satisfactorily fitting any and all comparison of lumber prices between one year and another, though not fitting any one comparison precisely. Thus there would seem to be no way by which formulas for index number composition can be checked or the superiority of one over another can be determined; the only possible check is in the nature of broad general experience. Suppose a cost-of-living index number be constructed: Its test is not that one particular family spent more in 1916 than in 1915, let us say, nor that 100 families, or all families in the country, spent more. The test is general experience, according to which people quite generally know that it cost more, or less, in 1916 than in the preceding year to maintain existence.

In this difficulty Professor Fisher advances two tests of an index-number formula (*not* a test of an index number itself, it should be noted), and does away with a third that was current heretofore. His two tests, which he apparently considers of absolute validity, are time reversal and factor reversal. According to the former, an index number computed for a particular year (the given year) from the base year must be the reciprocal of the index number found by basing on the given year and calculating the value for the original base year. Factor-reversal means that the formula should be homogeneous in price and quantity, so that when prices and quantities are interchanged a number will result which when multiplied by the original index number will give the actual total-value ratio. But in spite of his faith in these tests, Professor Fisher finds that many formulas can be devised that will satisfy both tests and yet give different results.

Of a great many interesting quotations that might be given here, two may be cited as suggestions of the difficulties involved in the subject-matter of the book:

"When the number of samples used is small, an unwise choice can spoil the results; even the best available assortment and number of commodities cannot yield the same degree of accuracy as the merely mathematical accuracy of the formula (p. 331).

"We cannot justify using the same weights for comparing the price level of 1913, not only with 1914 and 1915, but with 1860, 1776, 1492, and the times of Diocletian, Rameses II, and the Stone Age" (p. 275).

Roads, Canals, Railways and Transport

HIGHWAYS AND HIGHWAY TRANSPORTATION—By George R. Chatburn, Professor of Applied Mechanics and Machine Design, Lecturer on Highway Engineering, University of Nebraska. New York: Thomas Y. Crowell Co. Cloth; 6x9 in.; pp. [illegible]; line cuts, maps and halftones. [illegible]; postage extra.

As a narrative of canal, railway and highway development and as a plea for the coordination of all these ways of transportation this volume is commendable. It is not a book that will greatly serve the highway or the automotive engineer in his technical tasks. This is not its object. It will serve engineers in a large way, however, by giving them a background of historic beginnings and early problems in the growth of ways of transportation. Touching as it does the romance of early trail making, the road work of the ancients, highway esthetics and aids and attractions to travel the book is particularly one for the general reader. It will also help him understand the financing and planning of highway systems. There are chapters on ancient roads, early trails, canals, railways and finally the modern wagon road. Then come five chapters on the planning and economies of highways. There is one chapter on automotive transportation, one on accidents, one on esthetics and one on aids and attractions to traffic and travel. The volume has a good index.

Flexural Action in Beams

Reviewed by George Paaswell

Consulting Engineer, New York City

ELASTICITY AND STRENGTH OF MATERIALS USED IN ENGINEERING CONSTRUCTION: Section II, Theory of Flexure—By C. A. P. Turner, M. Am. Soc. C. E., Consulting Engineer. Minneapolis, Minn.: The Author. Cloth; 6x9 in.; pp. 108, illustrated. $5.

This little book, forming Part II in a series on "Elasticity," purports to give an exposition of exact flexural action in beams by a practical and elementary treatment of matter now found only in treatises upon elasticity. The author lays much stress upon the failure of engineers to avail themselves of material in such treatises, overlooking the fact that the salient features of such exact analysis are incorporated in all modern design. It was St. Venant who indicated the error of the ordinary theory of flexure insofar as a plane section was assumed to remain plane after bending, pointing out that such sections become warped, due to shear action; but the exact problem of flexure was solved only for the cantilever carrying a load at its terminal and for the simple beam with a uniform load. The important result was the fact that the warping of the plane cross-section by shear becomes of serious nature near the support or places of maximum shear only. This is duly appreciated by all designers but is apparently overlooked by Mr. Turner. The reader is therefore led to anticipate novel data on beam design, which, of course, are not forthcoming.

Beyond this, the book is characterized by the fact that in undertaking to carry out the plan of an "elementary" discussion the author has been compelled to sacrifice both clearness and rigor in the demonstrations. In any attempt to prove a controversial question it is fatal to fill gaps in the reasoning by flat statements, supported only by the authority of the demonstrator, and while it may be excusable in a handbook to present a bare formula, a textbook must go farther, even when it deals with flexural action, where connected description cannot be given without the aid of the calculus. It is not surprising, therefore, that the labored and verbose discussion in the book is far from convincing, and in a number of instances becomes unsound and even erroneous reasoning.

Thus the statement that shearing strains rotate the normal section of the beam about the gravity axis by an amount proportional to the slope of the deflection curve cannot be reconciled with the observation that shearing strains merely warp a section into an anti-elastic surface.

Further serious difficulty for the reader arises from the author's confusion of shearing stress distributed over an entire section with shearing intensity at a point, which leads him to results that violate the fundamental laws of statics. It is fatal to any demonstration to leave the reader with an impression that basic laws of statics are void for one particular stress type.

The author discusses arch action and flexural action as if the two involve separate types of stress. This not only leaves a wrong impression in the reader's mind but makes it exceedingly difficult to derive a proper expression for such arch action. Arch and beam differ only in their terminal conditions, and it is evident that when the equation of the elastic curve is determined on the assumption that there is no displacement at the supports it will define arch action precisely. In other words, "arch action" is merely a special name for a certain type of flexural action easily calculated by the ordinary laws of flexure.

The book contains an excellent and clear discussion on continuous girders, giving a graphical picture of the moments and reactions in girders of any number of spans carrying a uniform load.

Present-Day Penstock Design

REPORT OF HYDRAULIC POWER COMMITTEE, N.E.L.A.—Prepared by the Hydraulic Power Committee of the Pacific Coast Electrical Association. A Condensed Report of Recent Advances and Improvements in Penstock Design, More Particularly in High-Head Installations Such As Are Typical of Western Development. New York: National Electric Light Association. Paper, 8x11 in.; pp. 80; illustrated. 55c.

The National Electric Light Association at its recent convention in New York City adopted a report on penstock design that embodies much useful information evidently made available in this convenient form only after much work by a representative group of hydraulic engineers. Although the action of the convention makes this an official report of the hydraulic power committee of the association, the work of compilation has been done in the West under the direction of the hydraulic power committee of the Pacific Coast Electrical Association, a branch of the parent body. O. G. Thurlow was chairman of the national hydraulic committee. The report deals almost wholly with high-head developments and other problems peculiar to the West.

The committee was made up of about thirty representatives of Western power companies, municipalities and manufacturers. Under the direction of H. L. Doolittle, assistant chief engineer, Southern California Edison Co., this committee held several sessions at which there was a general discussion of the subjects covered. The discussions were directed toward bringing out those features of each company's experience that would constitute information of value to other companies in considering similar problems. The report has in it nothing of an elementary nature nor does it go deeply into mathematics, the purpose being rather to present a symposium on the latest and best methods of meeting the more important problems in penstock design and construction. For example, reasons for the present practice, as indicated by experience with recent installations, are cited in the planning of expansion joints, air vents, and anchorages, and in determining friction losses, pipe thicknesses, etc.

While no favoritism is shown, trade names and the names of manufacturers are mentioned freely. Statements by manufacturers are an interesting feature and those included within the body of the report proper are in keeping with the spirit of the report as a whole and are evidently earnest endeavors to contribute information without any attempt at advertising. The inclusion of specifications adopted by the A.S.T.M. indicates a desire to make the report of value as a reference work on penstock design.

There is no index nor are the several subjects arranged and introduced separately. The data on draft tube tests should be studied in connection with later reports on the same subject made on tests for the U. S. War Department at the Muscle Shoals plant. As a whole, however, the report is in a much higher class than the ordinary committee production; no space is wasted on non-essentials and it contains much valuable information not heretofore published. In the West where there has been a limited advance circulation, the report has been very favorably received and pronounced "the most valuable collection of data on penstock design ever compiled in one publication."

A Comprehensive Structural Treatise

REVIEWED BY CHARLES A. MEAD

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STRUCTURAL MEMBERS AND CONNECTIONS—Compiled by a Staff of Specialists—Editors-in-Chief, George A. Hool, S.B., Consulting Engineer, Professor of Structural Engineering, University of Wisconsin, and W. S. Kinne, B.S., Professor of Structural Engineering, University of Wisconsin. New York and London: McGraw-Hill Co. Cloth; 6x9 in.; pp. 611; illustrated. $6.

Many excellent works on structural analytics have been produced since volumes of joint authorship began to make their appearance thirty years ago but none have given the subject matter such comprehensive and logical treatment as this one. It is the second of a series of six volumes, each dealing with a principal subdivision of structural engineering, and is sponsored by Messrs. Hool and Kinne, who with nine associate editors, specialists of wide reputation, have given of their best to produce it.

Three principal structural materials are dealt with: ferrous metals, wood and concrete. Following complete definition, general theory is developed, which in turn is followed by the design of members and their connections. The effect of unsymmetrical and essential loading is treated at great length. Where approximate solutions are permissible within practical limits they are also given. Helpful suggestions of practical limitations are sprinkled throughout the work and numerous illustrative problems are worked out numerically so that the student is not left in the dark as to the practical application of the problem. The diagrams are well drawn and unusually clear.

A work of this character must represent modern practice in order to be valuable, and therefore must contain material copied from mill books and shop practice sheets. It is refreshing to note that all such borrowed material is up to date and truly represents modern practice. As each volume of this series purports to be a complete treatise in itself, it is excusable if some of the material occurring in other works by the same authors has been reproduced here. The volume is particularly free from padding in any sense, however.

Often different methods of solving a problem are given, illuminating it from different angles. The book is written from the true teacher's standpoint which has in mind the student's attitude. It will therefore find a useful place in the student's library, whether he be undergraduate or practitioner. In short it is a comprehensive presentation of just what its title indicates, and is worthy of high rank among books of its class.

The Electric Power Industry

ATLAS OF U. S. A. POWER INDUSTRY, Outlining Suggested Regional Power Districts and Proposed Constant-Potential Transmission Systems for the United States of North America—By Frank G. Baum, Consulting Hydro-Electric Engineer, Fellow A.I.E.E., M. Am. Soc. M. E., M. Am. Soc. C. E., San Francisco, Calif. New York and London: McGraw-Hill Book Co. Cloth; 17x11 in.; pp. 21 of text and pp. 34 of map and diagrams. $10.

An immense amount of labor is represented in this interesting and valuable survey of the electric power industry and brief for regional power districts. After giving a brief history of the electric power industry in America and stating the problems of the industry, Part I of the book presents the advantages to be gained by grouping small plants into large systems and then suggests a group of regional electric power districts and a constant-potential electric transmission system. This is followed by a summary of the mechanical and electrical power used by industries and utilities in this country, by a description of water-power development, and by much valuable information on the generator capacity and output of central stations, the use of mechanical and electrical power in manufacturers' plants and in mines and quarries, and on the steam and electric operating situation of the railways of the United States. This part of the book closes with a discussion of the effect of diversity on load factor and the economic proportion of hydro-electric and steam power.

Part II is devoted to a discussion of the present power transmission systems, the need of large-capacity transmission lines, and a description of the constant-potential system by the author. The 24 pp. of maps and diagrams in Parts I and II give a complete graphical representation of the material in the text and supplementary information as well.

Part III, General Data, United States and the World, consists of 10 pp. of maps and diagrams which give such information as the developed and undeveloped water powers of the world, coal fields and gas and oil fields of the United States, precipitation and land altitude for both the United States and the world, and the forest resources of the United States.

PUBLICATIONS RECEIVED

Notes on Pamphlets and Reports

THOSE WHO NEED SOME LIGHT READING, combining entertainment with engineering instruction, will find Brearley's "A Symbol of Safety" well worth their time. The author recounts the evolution and the present work of the world-famous Underwriters' Laboratories, and succeeds in presenting a really effective picture of its many-sided activities. Going beyond the electrical safety and quality testing—which, in fact, was the foundation of the laboratories and still constitutes one of the most important sections of its work—and the investigation of building materials and building units, he takes up the little known but decidedly interesting work being done on burglar protection, on automobile safety, airplanes, and the like. The style is easy, and the matter appears quite free from the distortion and exaggerated emphasis common in semipopular writing. There are many excellent illustrations. (Garden City, N. Y.: Doubleday, Page & Co.; $2.50.)

FOR MORE SUBSTANTIAL TECHNICAL READING the engineer will find it profitable to take up the second report on Fatigue of Metals just issued as Bulletin 136 of the Illinois Engineering Experiment Station (by H. M. Moore and T. M. Jasper; Urbana, Ill.; pp. 100; 50c.). Most of the results reported amplify and substantiate the results previously presented, which tend to establish a definite endurance limit, namely, a stress at or below which an indefinitely large number of reversals can be carried by the material. Among the new tests are some which indicate that a few moderate overstressings will not reduce the endurance strength of the material to any great degree. However, the important new element in the work now reported is a large series of tests in which the upper and lower stress limits were not equal and opposite, but instead the variable stress ranged from a moderate compression to a high tension, or else varied in tension only. The results do not support the range-of-stress theory advanced by Goodman in England some years ago, according to which the effect of the variable item of stress is double that of the constant stress item. The endurance limit in these tests seems to bear a linear relation to the ratio of minimum to maximum stress.

A Descriptive Survey of the Detroit water-works has been issued by the Water Commissioners of that city (G. H. Fenkell, superintendent and manager). This unique pamphlet of only 40 pp. contains twenty-three short papers each describing a branch of the organization or its work and each written by the official in charge. Thus Mr. Fenkell treats of the general organization; H. W. Gould, superintendent, describes the pumping stations; F. H. Stephenson, assistant superintendent, the distribution system. Others take up finances, records, construction, meters, billing, accounting, auditing, pitometer operations, personnel, etc. Over 3,000 copies have been distributed among the public and parochial school teachers of Detroit and further copies are available, Mr. Fenkell states, for any one interested anywhere.—The Detroit Filtration Plant is described in a separate pamphlet, by Theodore A. Leisen, consulting engineer, Detroit water-works.

Municipal and Many Other Engineers should welcome Use of Geodetic Control for City Surveys, by Hugh C. Mitchell, mathematician, U. S. Coast & Geodetic Survey, an illustrated pamphlet containing a map showing areas of United States now covered by triangulation and also net of precise leveling (20c. from Superintendent of Documents, Washington, D. C.).

The Mechanics of the Activated Sludge Process, a paper by J. A. Coombs, an engineer on the staff of Activated Sludge, Ltd. (14 Howick Place, Victoria St., Westminster, England) has been reprinted from its April *Journal* by the Institution of Sanitary Engineers, 120 Victoria St., Westminster, England (pp. 48, including 7 pp. of discussion; illustrated; 1 s.). The paper will be found interesting and valuable by all who are following sewage treatment in detail and particularly by those who wish to get an idea of British practice and opinion from the viewpoint of the British promoters of the activated-sludge progress.

The Sewerage and Sewage Disposal of New York City is reviewed in a supplement to the May *Sewage Disposal Bulletin* of the Board of Estimate and Apportionment, New York City, issued in honor of the "twenty-fifth anniversary of the Greater City of New York." Arthur S. Tuttle is chief engineer and Kenneth Allen is sanitary engineer of the board.

The Ministry of Public Works of Czechoslovakia (Prague) has begun issuing a press information sheet in English entitled Zpráry veř. služby technické (News of Public Technical Service).

Australian Governmental Activities and Statistics for the whole country and for the separate states are detailed in the 1922 Official Year Book of the Commonwealth of Australia. The general and local government schemes are outlined and personnel is given, as well as statistics of various public works and the present status of local water supplies, etc. (Melbourne: Bureau of Census and Statistics.)

Activated-Sludge Studies, third series, 1920-22, by the Illinois State Water Survey, Dr. A. M. Buswell, chief, are described in the results summarized in a bulletin just published at Urbana. There are sections on the biochemistry of the process, microbiology and the theory of activated sludge, and sludge-drying experiments.

Valuable Information and Opinion on many phases of water treatment is given in the report of the Ohio Conference on Water Purification held at Columbus last November, edited by F. H. Waring, principal assistant engineer, Ohio Department of Health, Columbus. Besides committee reports and general discussion the report contains eighteen papers by various experts and operators.

Permissible Explosives and Mining Equipment approved by the Bureau of Mines prior to Jan. 1, 1923, are listed and discussed in Technical Paper 333 of the Bureau.

An Appropriation of $200,000 has enabled the California State Department of Public Works, Division of Engineering and Irrigation, assisted by a consulting board of engineers and other engineering advisors, to publish an extensive report on the Water Resources of California. Besides the main report to the Legislature as of Jan. 1, 1923, there are these four appendixes: Flow in California Streams, with many tables and diagrams; Irrigation Requirements of California Lands; Utilization of the Water Resources of California; Relation of Settlement to Irrigation Development, prepared by Dr. Elwood Mead, University of California.

New Books and Revised Editions

DIE BERECHNUNG DES SYMMETRISCHEN STOCKWERKRAHMENS mit geneigten und lotrechten Ständern mit Hilfe von Differenzengleichungen—Von Dr. techn. Josef Fritsche, Ingenieur, Assistent an der technischen Hochschule in Prag. Berlin: Julius Springer. Paper; 6x9 in.; pp. 90; line cuts.

THE BUSINESS LETTER: Its Principles and Problems—By Carl A. Naether, Associate in Journalism, University of Michigan. New York and London: D. Appleton & Co. Cloth; 6x9 in.; pp. 516. $4.

A detailed analytical and descriptive work on the subject.

THE ELECTRICAL HANDLING OF MATERIALS: A Manual, in Four Volumes, on the Design, Construction and Application of Cranes, Conveyors, Hoists and Elevators—By H. H. Broughton, M. I. Mech. E., M. Inst. E. E. Vol. IV. MACHINERY AND METHODS. London: Ernest Benn, Limited. Cloth; 9x12 in.; pp. 334; 279 line cuts and half-tones, some on folding plates. 50s. net.

The earlier volumes were: I., Electrical Equipment; II., Structural Steelwork and Mechanical Equipment; III., Cranes and Crane Mechanisms. The present and concluding volume takes up elevators and conveyors, belt conveyors, automatic feeders and skip hoists; Lessons from America in the Bulk-Handling of Materials; handling and storing grain, coal, ore, etc. There is a chapter on Panama Canal Coaling Stations.

ELEMENTS OF GRAPHIC STATICS—By Clarence W. Hudson, C.E., Am. Soc. C. E., Professor of Civil Engineering Polytechnic Institute of Brooklyn, N. Y., Consulting Engineer, and Edward J. Squire, C.E., M.S., Assoc. M. Am. Soc. C. E., Assistant Professor (as above). New York and London: McGraw-Hill Book Co. Cloth; 5x7 in.; pp. 91; illustrated. $1.25.

Confined to what authors think are the essential to working requirements for civil and other engineering students, "especially as to the calculations of reactions, stresses, shears and moments. * * * may be found useful to the practicing engineer in enabling him to review in brief and compact form the application of the subject to the solution of structural problems."

THE EMPIRE MUNICIPAL DIRECTORY AND YEAR BOOK for 1923-24: Complete and Authoritative Lists of all the Corporations, County, Urban and Rural District Councils, with their Populations, Municipal Undertakings, Names of their Administrative Officials, etc., in Great Britain, the Colonies and Overseas Dominions, and a Compendium of Information relative to Municipal Engineering and Public Health Work and Practice. London: Sanitary Publishing Co., Ltd. Cloth; 7x9 in.; pp. 349. 11s. postpaid.

New features of this useful directory include sections on labor saving plant and appliances and on institutions that grant degrees or diplomas in public health.

FOUNDATIONS, ABUTMENTS AND FOOTINGS—Compiled by a Staff of Specialists—Editors-in-Chief, George A. Hool, S.B., Consulting Engineer, Professor of Structural Engineering, University of Wisconsin, and W. S. Kinne, Professor of Structural Engineering, University of Wisconsin, Assisted by Horace S. Baker, S.B., Chief Engineer, Frank D. Chase, Inc., Chicago. New York and London: McGraw-Hill Co., Inc. Cloth; 6x9 in.; pp. 414; illustrated. $4.

HANDBUCH DES WASSERBAUES für Studium un die Praxis—Von Hubert Engels. Third Edition. Cloth; pp. 1,649, in two volumes; 1,736 line cuts. Leipzig: Wilhelm Engelmann.

In the present revision the size of this book has been increased by 35 pp. The first edition was reviewed in *Engineering News*, June 21, 1915, p. 116, and the second edition in *Engineering News-Record*, June 16, 1921, p. 1045, in each case by Allen Hazen.

MOTOR TRANSPORTATION OF MERCHANDISE AND PASSENGERS—By Percival White, Research Engineer; Formerly Manufacturer of Projecta Cars, London, England; Director of Development, Aluminum Manufacturers, Inc., Cleveland, Ohio; and Ordnance Expert, War Department; M. Am. Soc. M. E., Soc. Automotive E., etc. Cloth; 6x9 in.; pp. 486; illustrated. $4.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Rudolph Hering

Sir—With the passing of Rudolph Hering from the active stage of engineering progress the profession has lost one of the most distinguished and picturesque characters among the older men.

He was a sanitary engineer who was particularly noted for his ability and wide learning in the specialty of sewerage works.

The writer was associated with Dr. Hering on several commissions and had an excellent opportunity for becoming acquainted with the wide range of his learning in this and other branches of engineering science.

He was ever ready to discuss intricate questions connected with his specialty and to counsel younger men whenever the opportunity occurred.

Dr. Hering was deeply interested in the welfare of engineering societies and added frequently to their investigations and discussions of the Am. Soc. of Civil Engineers.

DESMOND FITZGERALD.

Brookline, Mass., June 13, 1923.

Coating Does Not Restore Corroded Sprinklers

Sir—The article by Mr. C. C. Brown on the care of sprinkler heads on page 869 of the May 17 issue of *Engineering News-Record*, while well meant, is liable to lead to false conclusions and dangerous practices. Sprinklers from industrial plants of all kinds and therefore subject to a variety of external and internal deteriorating influences are being constantly tested under standard conditions in laboratories equipped especially for this purpose. The data thus obtained are studied, classified and compared with previous experience. Then suitable recommendations are made.

The experience of the Factory Mutual Laboratories covering more than thirty years of sprinkler testing would not confirm in all respects Mr. Brown's conclusions or his recommendations. We have not found that sprinklers subject to salt air should be either protected or inspected every few months as Mr. Brown has decided. There are millions of sprinklers along the Atlantic sea-board which have been exposed to salt *air* for many years without being more than tarnished. If supplied by pumps taking suction from salt *water* there may be some trouble from leakage after long continued exposure. We wonder if this may not be one of Mr. Brown's difficulties.

Although we have seen hundreds of sprinklers which have suffered mechanical injury, we know of no cases where the solder has "come loose," although occasionally sprinklers subjected to excessive temperatures may have the soldered joint weakened.

The statement in Mr. Brown's article which we consider dangerous is the advice to clean corroded sprinklers and then coat them with a protective material. Many attempts have shown that it is not practicable to clean a corroded sprinkler with the assurance that it will be reliable for fire protection. Corrosion frequently attacks the solder and oftentimes progresses part way into the soldered joint. This trouble cannot be remedied by cleaning; neither can the corrosion be removed from the fine joints in the releasing mechanism. The protective solution which Mr. Brown recommends, consisting of linseed oil, rosin and paraffin, will harden with age as the oil oxidizes and may prevent the operation of the sprinkler just as effectively as corrosion. Dipping the sprinklers, which are rated to fuse at about 160 deg., in a solution heated to 190 deg. is also considered unwise advice as it is likely to weaken the soldered joint.

We are calling these matters to your attention because readers of your paper may be misled by Mr. Brown's article and attempt to test, clean and protect their automatic sprinklers with harmful results.

Yours truly,
FACTORY MUTUAL LABORATORIES,
C. W. MOWRY,
Director.

Boston, Mass., June 13.

Sir—Regarding the article by C. C. Brown in the May 17 issue of the *Engineering News-Record* we are sorry that this article has had the prominence its publication in the *Engineering News-Record* gives it. We feel sure that you will find that experience of laboratories tests shows conclusively that it is not possible to restore the sprinkler head to operating condition, once it has been affected by corrosion, by any process of cleaning. Also, that corroproof coatings should be applied to new clean heads which have never been installed in a sprinkler system or subjected to corroding influences.

The suggested recipe contained in Mr. Brown's article for corroproofing is open to criticism because it contains boiled linseed oil and rosin, both of which are extensively used in varnishes because of their oxidizing qualities. Experience shows that sprinkler heads painted or varnished are not only tardy in action, but frequently fail to operate because the parts are liable to stick due to the paint. Another objectionable feature of this mixture is the temperature at which it is applied, viz., 190 deg. or thirty degrees above the temperature of the average sprinkler head.

We feel sure that all fire protection engineers will agree that the suggested treatment would be very harmful to the sprinkler heads.

W. J. CHATTIN,
Manager Engineering Dept., New York Reciprocal
Underwriters and Affiliated Underwriters.

New York, June 18.

A New Employment Service by A. A. E.

Sir—Development of employment service in the American Association of Engineers has been proceeding lately somewhat along the lines proposed by Morris L. Cooke in his article in *Engineering News-Record*, May 10, 1923, p. 830.

At its meeting in Norfolk the board of directors of the Association authorized taking out a charter to conduct an employment service for the engineering profession on a non-profit basis. The charge will be 25 per cent of the first month's salary or about 2 per cent of the annual salary. The name of the new corporation is "Association Employment, Inc." It is designed to serve engineers who are not members of the American Association of Engineers.

This new service is distinct from that to members which is rendered by the national office for 10 per cent of the first month's salary and free by all Class A chapters except one. The fees for member service are in the nature of a contribution, and are not collectible at law.

The board of directors regarded the departure into the field of employment service under the wing of the Association to all engineers as an experiment and an expedient; an experiment because the field is uncharted and an expedient because our clients are calling for several times more engineers than can be supplied fr[illegible]. The first test of good employment s[illegible] of satisfaction to the employer that he will find it superior to any other method of finding just the man he wants.

Any paid employment service for all engineers obviously should be managed along lines proposed by Mr. Cooke or along similar lines. Speaking for the American Association of Engineers, I can say that it is ever ready to co-operate with other societies for the solution of common problems This principle has been frequently stated by the Association in its annual conventions and by the board of directors, and was reaffirmed by resolution of the Norfolk convention. With specific reference to employment, the Association not only stands ready to co-operate in developing the most effective national employment service for professional engineers, but stands ready to take the responsibility of experimentation and leadership in this enlarged field.

WEBSTER L. BENHAM,
President, American Association of Engineers.
Kansas City, Mo.,
May 19, 1923.

Lettering Jigs Again

Sir—Referring to the letter by L. B. Tuckerman, in your issue of May 10, 1923, p. 843, as the inventor of the "Wrico lettering system," I have made a very thorough investigation of all available records of devices which have at various times been put forward, both in this country and abroad, for the purpose of alleviating the irksome task of lettering. With the knowledge thus gained of other devices, I feel obliged to say that the word "similar" as used by Mr. Tuckerman, in making a comparison between the "Wrico" system and others, must be taken in a very limited sense. It is a fact that most of them act as guides for the marking instrument, but there the similarity ends, for in no other device do I think is found the possibility of speed coupled with the perfect lettering which can be executed by the "Wrico" system.

EDWIN C. WOOD,
Manager, The Wood-Regan Instrument Co., Inc.
New York City,
May 31, 1923.

Terminals for Water-Borne Traffic at Chicago

Sir—I have read with considerable interest your editorials of April 5 and May 24, pp. 609 and 906, and R. I. Randolph's letter to the Editor in the issue of April 19, p. 721, all on the subject of closing the Chicago River. Without intending to be critical, but merely hoping to stimulate and continue the discussion thus ably begun, which must necessarily preface serious consideration and study of the problem, it is my belief that none of the articles referred to has gone to the very bottom of the matter. Possibly your editorial of May 24 did much to eliminate extraneous considerations from Mr. Randolph's elaboration of the problem, but it did little towards building up in the mind of the reader a true picture of the situation. Destructive criticism has never helped to solve as important a question as this one.

What is the question with which we are dealing? Is it about the engineering difficulties involved in the conversion of the Chicago River to a closed sewer? Is it about the legal difficulties to be encountered in denying to owners and operators of masted vessels the privilege of using the river as a highway, or in denying to riparian interests their access by water to the Great Lakes? Is it that it is cheaper to build and maintain fixed bridges than movable ones?

It is true that the determination of some of these problems may affect the real issue, but in general they may be solved to better advantage after the basic considerations have been properly disposed of.

Stripped of all side issues and irrelevancies the question might be put this way: What terminal facilities should the city of Chicago provide for its present and future water-borne commerce?

We have on the one hand, if you please, a definite amount of existing commerce which should be properly cared for and which will necessitate certain expenditures on the part of the city. We also have an indefinite amount of future commerce which requires no special expenditure at the present time other than that necessary to plan ahead for it and see that certain vital necessities are not dedicated to purposes which would forever preclude their being used as the part of any future plan of development.

On the other hand we have the determination of the value to the city of the advantages of a lake and river commerce which in all probability would thrive if provided for adequately. And we also have to evaluate, if that is possible in this case, the obligation of the city to the nation. For Chicago is not a city unto herself. She is a great city because she stands at the cross-roads of great highways of national commerce, and by virtue of such a position she is dependent upon the rest of the nation for her very existence.

This obligation to the nation, added to the advantages enjoyed in a commercial and industrial way from a strategic location at the head of Lake Michigan, must be weighed against any expense to which Chicago might be put to provide the requisite terminal facilities. Federal expenditures for the improvement of Chicago Harbor are not intended to be for the sole benefit of Chicago; they would not be justified unless the people of this nation, represented by a majority in Congress, saw fit to appropriate for the works as national improvements.

There is no question but that a wide, open, straightened river, coupled with ample facilities on the lake front, would represent an ideal solution as regards the shipping interests, both lake and river. A roofed-over river with certain terminal facilities on the lake front and a connection from the lake to the Illinois Waterway provided by way of the Sag Channel would represent the other extreme. Somewhere between the two lies a solution which will answer the proper demands of navigation and fulfill the obligation of the city of Chicago to the nation without demanding any great sacrifice.

Allow me to correct one misapprehension under which you are laboring. You say, "We are nearer facing the question of who in the last analysis is entitled to exercise control over the navigation of such a stream—the Federal Government or the community which the stream serves." There are numerous court decisions, and at least one of the Supreme Court of the United States, which indicate the national character of the Chicago River and hold it to be one of the navigable waters of the United States; and with respect to such waters Section 10 of the River and Harbor Act of 1899 states in part:

"That the creation of any obstruction not affirmatively authorized by Congress, to the navigable capacity of any of the waters of the United States is hereby prohibited; . . ."

As regards the constitutionality of that Act and its application to the Chicago River there can be little doubt.

Solve the water terminal problem at Chicago based upon sound premises as to classes, volume and routes of water-borne commerce, and all these other questions will be disposed of. But arguing them before the main issue is determined is a waste of effort and only delays the solution of the real problem.

RUFUS W. PUTNAM,
Major, Corps of Engineers, U. S. Army,
District Engineer, Chicago District.

Smaller Cement Sacks

Sir—Your editorial on smaller cement sacks in *Engineering News-Record,* March 29, 1923, p. 565, recalls the writer's brief experience, now nearly twenty years ago, as checker receiving and disbursing cement at the storage sheds for an important piece of work in Greater New York. Anyone in a similar position who is responsible for the receiving, sorting, cleaning and shipping of empty cement sacks should welcome the paper sack which he would never see again when once checked out. On a large piece of work the "Wop" at the mixer never shakes out all the cement and it is often worth while to employ a man for the disagreeable job of turning and reshaking the empty sacks.

In striking contrast to this the writer also distinctly recalls a still earlier time when natural cement was cheaper than portland and came in paper bags. The bags were broken by dropping on the mixing board or were spit open with a shovel and the paper pulled away clean. *All* the cement went into the concrete. The use of fifty pound packages should compensate for the loss which occurred by breakage of the larger packages during transit and handling. It therefore seems that a number of very obvious advantages would result from the suggested change.

Tientsin, China, May 9, 1923.
R. D. GOODRICH,
Engineer in Charge of Works,
Commission for the Improvement of the River System of Chihli.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The Pennsylvania R.R. Has Completed its track elevation through the City of Camden, N. J.

On June 25 the City of St. Louis, Mo., will sell the first block of $2,500,000 of 4½ per cent twenty-year bonds authorized under the recent bond issue, passed by that city, for $87,420,000.

Operating Expenses of the Government-Owned Alaska R.R. for the year 1922 totaled $1,772,376 while the operating income was only $718,920. This leaves a deficit of $1,053,456 for the year and a total deficit, since construction began in 1915, of $7,055,224.

License Has Been Granted by the Federal Power Commission to the Alabama Interstate Power Co. for the development of the Cherokee Bluffs site on the Tallapoosa River. Later the licensee will ask to assign the license to the Alabama Power Co. for construction and operation.

The Pennsylvania R. R. System announces a $2,000,000 improvement program in the Northwest, the improvement to include deepening the slip at Sandusky coal dock, extending its tracks from Webbs to Walbridge, increasing its trackage at Crestline, and installing a block signal system from Grand Rapids to Mackinaw City.

The Cleveland Union Terminals Co. has been authorized by the Interstate Commerce Commission to issue $15,000,000 bonds for the purpose of acquiring additional land and for construction work. The bonds are to be guaranteed as to principal and interest by the N. Y. C., the C. C. C. & St. L., and the N. Y. C. & St. L. railroad companies.

By a Public Reprimand of the Pennsylvania R.R. Co., the Railroad Labor Board has arraigned that company for its contempt of the findings of the board in the matter of determining employee representation on the Pennsylvania System. The Transportation Act provides no way whereby the findings of the Labor Board can be enforced, consequently this formal action closes the case, at least insofar as the present action is concerned.

The Canadian Government is Asking Parliament for appropriations amounting in all upwards of $25,000,000 for the construction of extensions to the Canadian National Rys., covering 29 projects which have been recommended by President Thornton. Of this total nearly $18,000,000 will be expended in the Prairie Provinces, $3,000,000 in British Columbia, $5,000,000 in the Maritime Provinces, $2,000,000 in Ontario and less than $500,000 in Quebec.

Yale and Union to Teach Building Construction

Through gifts from the trustees of the Louis J. and Mary E. Horowitz Foundation, courses in building construction have been established at Yale University and Union College. The organization in charge of the course will be known as the Thompson-Starrett Foundation.

The Thompson-Starrett Co. offers to provide two annual prizes of $2,500 each to be awarded each year to graduates of the course who shall commend themselves by the quality of their work and by their promise as practical building constructors, and who desire to connect themselves with the Thompson-Starrett Co. for practical training in their chosen calling.

The course in building construction is to be offered as a development of the civil engineering course, rather than an appendage to a course in architecture. This move is made upon the theory that building construction is looked upon more as a profession in itself than subordinate to architecture.

In proposing the establishment of such a course and undertaking to support it, the purpose in view was to supply a number of technically-trained and educated men to perfect the capacity and work of the constructor with the hope that building construction would become a profession as dignified as architecture, and on a parity with it. In establishing the courses the donors do not propose to diminish the importance of the architect or exalt that of the constructor, but to recognize the trend of events and the conditions existing in the building industry and to make every effort to meet them to the satisfaction of the public.

Concrete Formwork for Theater Damaged by Trainshed Fire

Slight damage was caused recently at the Fox Theater in Philadelphia by burning of the formwork for the concrete floor at the fourteenth tier of the steel structure. The fire was started by the disastrous blaze that destroyed the Broad Street Station trainshed of the Pennsylvania R.R. The Fox Theater is being erected at the southwest corner of 17th and Market Street, directly opposite the portion of the trainshed in which the flames reached the greatest height. Formwork, consisting of boards 1 in. thick, was practically complete for the fourteenth floor, and timber was piled on the fifteenth floor. The forms in three bays on the Market Street side were burned. City firemen extinguished the flames without difficulty and the timber on the fifteenth floor was not burned. The heat produced by the burning forms at the fourteenth floor was so great, however, that the 18-in. I-beams were badly twisted. The columns were not damaged and no damage was done to completed concrete work below, according to Wilfred, Inc., engineers for the Fox Theater.

A. P. Davis Forced Out as Reclamation Director

Aim to Put Bureau on "Business Basis" Leads Secretary Work to Replace Engineer by Politician

Washington Correspondence

With the announced intention of placing the reclamation service in the hands of a business man, rather than an engineer, the Secretary of the Interior has summarily dismissed Arthur P. Davis from the directorship of that service. Mr. Davis is to be succeeded by D. W. Davis, former Governor of Idaho, who will serve under the title of "Commissioner of Reclamation". Former Governor Davis has been serving during the past year as special assistant secretary of the interior. A. P. Davis was chief engineer of the reclamation service from 1906 to 1914 and has been its director since 1914.

All the information Interior Secretary Work cares to make public concerning the change is that "we are going to put this branch of the Interior Department on a business basis, and operate it in the interest of the settlers on reclamation projects, as well as for the protection of the government. That's all there is to it." From other quarters, however, comes the intimation that the influence which resulted in the resignation of Director Davis has been contributed in part by those who oppose the repayment of the reclamation fund. With a good political lieutenant in a position where an exceptional opportunity to influence votes exists, a better chance would be offered the administration to counteract in the west the influence being exerted by Senator Borah, some say. They point to the President's stop at American Falls, as further proof that this is a part of the political campaign.

It is known positively that Director Davis' resignation was not voluntary. He is understood to have refused to be a party to the giving out of the impression that he is retiring from the position of his own volition. His position is said to be that he does not want to see the $132,000,000 investment represented by government reclamation projects endangered, by retiring at a time when the so-called repudiators are occupying such a position of vantage.

Washington Construction Program Approved by President

President Harding and all members of the cabinet have approved plans for a $20,000,000 construction program to house government departments in Washington. Partial approval also has been given plans for an omnibus public buildings bill at the next session of Congress to provide buildings, principally for the Post Office Department, in various sections of the country.

It is emphasized that buildings are needed in Washington so that departments and bureaus now in expensive leased quarters may be housed in structures owned by the government.

F. A. E. S. Executive Board Meets in St. Paul

Problems Discussed Include Traffic, Smoke Abatement, Water Supply, and City Planning

Traffic, smoke abatement, water supply, city planning, state and municipal legislation relating to engineering matters, reforestation and registration of engineers were outstanding topics at a recent meeting of the Executive Board of the Federated American Engineering Societies held in St. Paul, Minn. The meeting was characterized by an enthusiasm over the accomplishments of the Federation and an optimism over its program of activities.

Several committee reports were submitted. Among these was the Committee on Transportation which is considering ways and means whereby the Federation may be of useful service in relation to the general transportation problem of the nation. The authority to continue its study was given the Transportation Committee by the Board.

The Committee on Storage of Coal reported that it had met and perfected plans in Washington May 25. Sub-committees are now being formed in some eighty centers to undertake gathering of data which will enable the Federation to present accurate coal storage facts to the Federal Commission also studying the subject. Dean P. F. Walker of the University of Kansas, has been authorized by the Committee on the Storage of Coal to devote all of his time for the next few months to the work. He will visit various centers and assist the sub-committees in organization and then in execution of their respective tasks.

Registration Law Read

The committee appointed some months ago to prepare a proposed registration law for engineers submitted a tentative draft and the proposed bill was discussed at length. The committee was instructed, however, to rewrite the proposed bill, including certain valuable suggestions and constructive criticisms offered at the Board meeting, and report at the next meeting of the Board in October.

The Board gave much consideration to a communication from the Washington Society of Engineers requesting the Federation to develop plans whereby local engineering groups might take a more prominent part in comprehensive city planning. The Board recognized the importance of the suggestion and instructed the president and executive secretary to call the matter to the attention of the member societies for the purpose of encouraging greater activity in comprehensive metropolitan planning by local engineering groups.

The Board also gave consideration to the request from the Cleveland Engineering Society that the Federation support a movement to help Congress appoint a technical commission to make a thorough study of the engineering and economic phases of the proposed St. Lawrence waterway before making any definite decision on the project. The matter was referred to the Committee on Public Affairs for a thorough study and report.

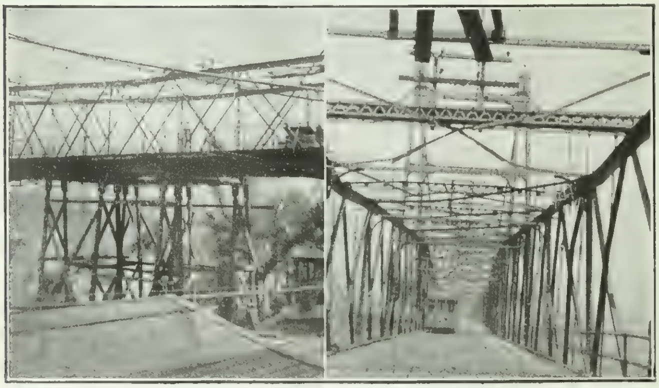
Reforestation Discussed

Reforestation was another subject discussed at length. As a result of the discussion the Board has requested the committee on that subject to submit at an early date a concrete plan of action, whereby the gospel of reforestation can be more effectively carried forward.

Among other action taken by the Board was a vote to participate in the World Power Conference to be held in London in 1924; acknowledgment of an invitation from the Association of Engineers and Architects of Czechoslovakia through the Czechoslovakian Minister at Washington for the Federation to send representatives to the annual meeting in Kasic, July 2-8; and the acceptance of an invitation from the Chamber of Commerce of Rochester, N. Y., to hold the October meeting there.

Members of the Executive Board were guests of the Engineers Society of St. Paul at dinner one evening during the session at which numerous prominent engineers spoke.

Shore Span of Steubenville Suspension Bridge



Temporary support of span, and buckled top chord of stiffening truss. For report of failure of the truss, see *Engineering News-Record* issue of May 31, p. 976.

Railroads Is Am.Soc.C.E. Convention Topic

Transportation and Terminals Will Compose Technical Program for Sessions in Chicago

The technical program of the fifty-third annual convention of the American Society of Civil Engineers to be held in Chicago July 11-13, will concern itself with railrorad transportation and railroad terminals. The symposium on railroad transportation will be held the morning of July 11 when the following speakers will discuss various phases of the problem: John W. Kendrick, consulting engineer, Chicago; John G. Sullivan, consulting engineer, Winnipeg, Canada; James R. Bibbins, consulting engineer, Washington, D. C.; Edwin F. Wendt, consulting engineer, Washington, D. C.; Charles A. Morse, president, Western Society of Engineers, Chicago; and John S. Worley, professor of railroad engineering, University of Michigan. Speakers on railroad terminals, a session to be held the morning of July 12, include H. R. Safford, Chicago, president of the Illinois Section of the Society; Alfred Fellheimer, consulting engineer and architect, New York; Charles E. Smith, consulting engineer, St. Louis; Jacob L. Crane, Jr., consulting engineer, Chicago; Daniel J. Brumley, chief engineer, Chicago Terminal Improvement, Illinois Central R.R.; Frederick E. Morrow, assistant chief engineer, Chicago and Western Indiana R.R., Chicago; Robert H. Ford, assistant chief engineer, Chicago, Rock Island and Pacific Ry., Chicago; J. D'Esposito, chief engineer, Chicago Union Station Co.; Rufus W. Putnam, Major, Corps of Engineers, U. S. A., Chicago; and William L. R. Haines, assistant engineer, Pennsylvania R.R., Pittsburgh.

Aside from the foregoing technical discussions there will be special meetings on the afternoon of July 11 of the Highway Division, Power Division and the Sanitary Engineering Division. Speakers who will address the Power Division will be W. L. Abbot, past-president of the Western Society of Engineers, and William T. Walker, superintendent of construction of the Minneapolis General Electric Co.

Inspection Trips Provided

Aside from the technical discussions there will be the usual social features as well as several inspection trips, which will include an automobile drive to the plant of the Universal Portland Cement Co. at Buffington, Ind., where luncheon will be served; a trip by automobile to the coal-gas and water-gas plant of the Chicago By-Product Coke Co.; a trip to the Calumet power station of the Commonwealth Edison Co.; a trip to the sewage treatment plants of the Sanitary District of Chicago; and an automobile drive given by the Chicago Engineers through the Chicago park and boulevard system, including Lincoln, Humboldt, Garfield, Douglas, Washington and Jackson Parks.

The program as a whole has been prepared under the direction of the Committee on Technical Activities and Publications, of which Richard L. Humphrey is chairman. The local committee of arrangement and reception is headed by Onward Bates, past-president of the Society, who is honorary chairman, and by H. R. Safford, chairman.

A. S. M. I. Meeting Place Changed from Memphis to Atlanta

Atlanta, Ga., has been substituted for Memphis, Tenn., as the place for the annual convention of the American Society for Municipal Improvements this fall. The transfer is due to changes in hotels at Memphis which make it impossible for them to care for the convention in accordance with arrangements which had been made. Charles C. Brown, St. Petersburg, Fla., secretary of the society, states that the date for the meeting at Atlanta will soon be announced, but that it will not be earlier than Nov. 12-16, the date set for the meeting at Memphis.

Flood Tops Oklahoma Dam

The main dam of the Oklahoma City waterworks, a hollow concrete dam 1,800 ft. long and 54 ft. high built in 1918, was overtopped a maximum of 16 in. for a period of 22 hours, June 13 and 14, by a rise in the Canadian River. No damage was done to the dam or embankments but nine pile bents in a highway bridge and five bents in an interurban railway bridge over the head of the by-pass channel were carried away. Two weeks before a hitherto-unprecedented flood in the river was taken care of by the spillways which were designed for a flow of 16,000 sec-ft. The latest flood is estimated at 22,000 sec-ft. The embankment of the by-pass had been paved for 6,000 ft. with a combined wall and slab of reinforced gunite, as described in *Engineering News-Record*, May 17, 1923, p. 880. This stood up under the flood but about 3,000 ft. of unpaved section was threatened and saved only by sand bagging.

New York Central Increases Its Dividend

The New York Central R.R. has increased its stock dividend from the rate of 5 per cent, which it has paid continuously since 1908, to 7 per cent. The directors' statement at the time of the announcement of this increase said that since the consolidation of the New York Central and Lake Shore in 1914, the surplus had increased from $29,000,000 to over $112,000,000, that a large part of the company's capitalization is in long-term bonds bearing low interest rates averaging about 4.4 per cent, which with the new dividend rate of 7 per cent makes the return paid upon capital 5.07 per cent, without allowing for any return on reinvested surplus.

The New York Central now owns 95 per cent of the stock of the Michigan Central and 90 per cent of the stock of the Cleveland, Cincinnati, Chicago & St. Louis. These companies, as well as the parent company, are doing a large amount of business which will require additional capital to keep pace with its growth. Such additional capital should come at least in part from the sale of additional stock, and the stock of the company as well as its bonds must be made attractive to investors because future financing cannot be done to advantage on the basis of a constantly increasing debt and a stationary amount of stock. Following this announcement the railroad company made application to the I. C. C. for authority to issue $100,000,000 worth of new common stock.

Illinois Road Bill Is Passed

The Illinois Legislature has passed the bill providing for a bond issue of $100,000,000 for improved roads, but individual legislators tacked on so many amendments that the cost of the mileage listed in the bill is estimated at $174,000,000. This bond issue must be submitted to public vote in November, 1924.

Natural Gas Subject to the Laws of Interstate Commerce

A decree for the complainants, the States of Pennsylvania and Ohio, against the State of West Virginia was directed by the U. S. Supreme Court, June 11, in suits instituted to restrain West Virginia from putting into effect a law compelling natural gas companies to serve consumers within the borders of West Virginia in preference to those outside that state, in the case of gas taken from within the state.

The decision was by a divided court, Associate Justices Holmes, McReynolds and Brandeis dissenting from the majority opinion, which was read by Associate Justice Van Devanter.

The majority opinion held that the West Virginia law was in violation of the Interstate Commerce clause of the Constitution. West Virginia had invited capital into the state to develop natural gas and had encouraged corporations to enter interstate business in this fuel. To cut off a supply to consumers in other states when the supply runs short, as the West Virginia act would compel, would mean a hardship to the interstate consumers, the opinion held.

The three dissenting justices held that West Virginia legally had the right to regulate the product because it does not assume interstate character until it is sent out of the state. Justice Brandeis held that the most the Supreme Court should do would be to compel the West Virginia gas companies to give the West Virginia customers at least as good service as those outside the state.

Philadelphia Bridge Anchorage Caissons Reach Bottom

One of the circular caissons of the west anchorage of the Philadelphia-Camden suspension bridge reached sound rock and was sealed on June 11. A second one was sealed on June 14. The two reached elevations of 64 and 62 ft., respectively, below city datum. These, as well as the rectangular caissons which form the forward wings of the anchorage, are being sunk by open dredging. Work is in progress on the south rectangular caisson, which is down to El. -55, but some delay is being experienced in dealing with the sloping rock surface.

The circular caissons reached bottom after a heavy chisel bar was used to break out the rock in the central part of the shaft, and the weight of the caisson then forced it down into the soft upper strata of the rock tightly enough so that it could be pumped out. The [illegible] line of rock was then cut down several feet to the sound schist, and the caisson sealed. It was not necessary to bulkhead the shaft and bottom the caisson under compressed air, although provision is made in the construction of the caisson for this.

In the case of the rectangular caisson, 40 x [illegible] ft., the slope of the rock is downward from west to east in the direction of the caisson length, and it will be necessary to excavate the rock at the west end to permit of bottoming the caisson at the east end. By partially filling the easterly pockets the contact is made tight enough to permit of pumping down the westerly pockets, and it is hoped to be able to carry out the required excavation under open air.

Reproduction Cost Theory Subject of Two Opinions

Supreme Court Issues Two Additional Decisions Regarding Theory for Rate Making Purposes

Washington Correspondence

Two cases involving questions of evaluation of a public utility for rate-making purposes, particularly the reproduction-cost-new theory of value, were decided by the United States Supreme Court June 11.

In the case of the Bluefield Water Works & Improvement Co. against the Public Service Commission of West Virginia, the court, in an opinion by Associate Justice Butler, held that the rates fixed for water service at Bluefield were too low, because on a reproduction less depreciation value the return was only 6 per cent, which the court deemed insufficient. Associate Justice Brandeis agreed with the other members of the court in reversing the state court, but noted the same position regarding replacement values that he took in the case of the Southwestern Telephone Co. against the Missouri Commission. (*Engineering News-Record*, June 7, 1923, p. 1010.)

The Public Service Commission fixed the water rates in 1920. The company declared the rates inadequate and confiscatory and applied to the State Supreme Court of Appeals for a suspension of the order. The company alleged the value of its property to be greatly in excess of that fixed by the Public Service Commission and complained that the commission did not allow for increased costs of replacement between 1915 and 1920. The state court denied the relief sought.

In the case of the Georgia Railway & Power Co. and the Atlanta Gas Light Co., its lessor, the supreme court, in an opinion read by Associate Justice Brandeis, affirmed the decree of the lower courts dismissing a suit against the Railroad Commission of Georgia to restrain reduced rates for Atlanta's gas supply. Associate Justice McKenna dissented from the majority opinion, holding that replacement value, as fixed in principle by the court in the cases of the Southwestern Telephone Co. and the Bluefield Water Works & Improvement Co., had not been applied in this Georgia case.

The majority opinion pointed out that in the Atlanta gas case, the Railroad Commission had carefully considered replacement value and increased costs, although it did not allow all the claims of the company in this regard.

The court also approved the finding of the Georgia Railroad Commission that "present fair value" is not synonymous with "present replacement cost," particularly under abnormal conditions.

Random Lines

Extracts from an Outline of Engineering

CONCRETE

Some stone, some highly standardized
cement,
Sand of just the proper size of grains,
Water to wet; then add one element,
A dash of an abused ingredient—brains.

SEWAGE DISPOSAL

Screen out the rough stuff, turn over the goo
To the bugs with such appetites low;
Let it settle and stew and bubble and brew;
But what to do with the sludge—we don't
know.

* * *

A Word in Protest

This is the time of the year when it is customary to depict the new college graduate as going forth to offer his services at nothing less than president or general manager, satisfied that his ability and training are too great for any ordinary job. Never was there baser fabrication. Most college graduates approach commencement with feelings made up of amazement at the fact that they have really managed to pull through, of thankfulness for the luck which through four years presented to them questions they were able to answer within the limits of failure allowed, and of awe at the vast areas of knowledge and experience they have never traversed. Down in their hearts they wonder that any one would have them for any job, much less an important one. If a college education does not teach humility it isn't good for much.

* * *

The 18th amendment has its compensations. Now comes a "brewery engineer"—representing a once lucrative and doubtless useful branch of the profession—with a proposition to build, for obvious uses, an island 3+ miles out from Sandy Hook. The proposal involves novel developments in long extension cylinder piles which foreshadow, the "brewery engineer" says, little islands dotting the transatlantic route, a boon to the seasick and the bridge builder alike. Out of evil oft comes good.

* * *

Not Knocking Newspaper Men

"I have explained the construction," says an engineer describing a new project in a recent newspaper article, "so not only the engineer but the layman can understand how plain and simple it is once you know how to do it. Even the newspaper men should understand this explanation, at least a part of it."

* * *

Street car conductors in Los Angeles, we learn, are prohibited by ordinance "from shooting live game—notably jack-rabbits—from the platforms." Now if they would only declare an open season on automobilists the traffic jam on Broadway might be speedily cleared up.

State to Build Poughkeepsie Bridge; Moran and Modjeski Engineers

Construction of a bridge across the Hudson River at Poughkeepsie as a state enterprise has been provided for by the state legislature of New York in a bill just approved by the governor. An appropriation of $200,000 is made in the bill for the preparation of plans and survey data. The work has been placed in charge of state highway commissioner Frederick Stuart Greene, who has engaged Daniel E. Moran and Ralph Modjeski as consulting engineers for the bridge.

It is not yet known what type of bridge will be determined upon or precisely what location will be adopted. The act leaves the location open within wide limits. It is believed possible that a suspension type of structure may be designed, the depth of rock being 140 to 150 ft.

The city of Poughkeepsie will provide land for the east approach, and a private owner has donated right-of-way for the west approach.

Plans for a bridge at Poughkeepsie were prepared a year ago by Henry Goldmark and Gen. George W. Goethals. They provided for a cantilever structure of five main spans, as illustrated in *Engineering News-Record* of Dec. 21, 1922, p. 1090. It is stated by the highway commissioner that the bridge is likely to cost about $5,000,000. With the best possible progress it is expected that foundations might be constructed during 1924 and 1925, and the superstructure erected during the following year, but the actual period of construction is likely to be longer. A change of administration or failure of the legislature to make appropriation for the continuance of the work would be likely to interfere with rapid construction, however.

Authority is given in the bill for charging tolls for traffic across the bridge, and the maximum amounts of toll are specified. Collection of tolls is to cease in any event when the revenues, less the expenses of maintenance and operation, shall equal the cost of the bridge.

Los Angeles Approves Bond Issues Totaling $26,500,000

At an election in Los Angeles on June 5 voters of that city approved by a two-thirds vote five out of six proposed bond issues. The issues that carried were as follows: (1) For the purchase of site and erection of a city hall, $7,500,000; (2) for the purchase of land needed for an extension to the Public Library, $500,000; (3) harbor improvement bonds, $15,000,000; (4) for construction of viaduct over Los Angeles river and the railroads paralleling it, $2,000,000; and (5) for public playgrounds, $1,500,000.

The sixth proposition was for a bond issue of $35,000,000 of which $10,000,000 would have been for improvement and extension of the present municipal electric power network within the city and $25,000,000 for the development of hydro-electric power at the Boulder Canyon on the Colorado River including the transmission of that power to the city. Although this sixth proposition did not receive the two-thirds vote necessary to carry it, it did get a majority.

U. S. High Tribunal Curbs Kansas Industrial Court

Taft Opinion Declares State Has No Right to Regulate Wages Not of Public Interest Character

On June 11 the United States Supreme Court rendered a unanimous decision seriously restricting the scope of the Kansas Court of Industrial Relations. In the case at issue, the secretary of the Meat Cutters' Union in January, 1921, appealed to the Industrial Court against a reduction in wages by the Charles Wolff Packing Co. A hearing was held and the court ordered that wages be advanced beyond the scale fixed by the company, asserting that an emergency existed and that higher wages were in the public interest as the plant produced food. The company resisted payment of the higher wages and the industrial court applied to the state supreme court for a mandamus to compel compliance with its order. A commissioner appointed by the state supreme court reported that the company had lost $100,000 the previous year and that the evidence did not support the claim that an emergency existed. The state supreme court overruled this report by the commissioner and issued the mandamus, whereupon the company applied to the United States Supreme Court for a writ of error, alleging its property would be taken without due process of law.

In his decision, Chief Justice Taft said:

"It [the act creating the industrial court] curtails the right of the employer on the one hand and of the employee on the other to contract about his affairs. This is part of the liberty of the individual protected by the guarantee of the due process clause of the Fourteenth Amendment. . . .

"It has never been supposed, since the adoption of the Constitution, that the business of the butcher, or the baker, the tailor, the wood chopper, the mining operator or the miner was clothed with such a public interest that the price of his product or his wages could be fixed by State regulation, . . . To say that a business is clothed with a public interest is not to import that the public may take over its entire management and run it at the expense of the owner. The extent to which regulation may reasonably go varies with different kinds of business. The regulation of rates to avoid monopoly is one thing. The regulation of wages is another.

"We think the industrial court act, in so far as it permits the fixing of wages in plaintiff in error's packing house is in conflict with the Fourteenth Amendment and deprives it of its property and liberty of contact without due process of law."

Ford Granted High Dam License

A license extending to Henry Ford the right to utilize the High Dam on the Mississippi River at St. Paul, for a period of fifty years, has been executed finally by the Federal Power Commission. The license covers the construction of a power house on the existing substructure at the St. Paul end of the dam. The power house will be equipped with four turbo-generating units, each with a capacity of 4,500 kva.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, Annual Convention, Chicago, July 11-13.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

The American Society of Civil Engineers at its meeting at New York June 13, heard a paper on the disintegration of cement in sea water, presented by William G. Atwood, Director, and A. A. Johnson, Assistant Director of the Committee on Marine Piling Investigations, National Research Council. The purpose of the paper was to place before the engineering profession a history of the study of cement for use in sea water, and an analysis of the results obtained. The paper is to be published in the August *Proceedings*. The discussion which followed the presentation of the paper was largely devoted to the effect of acid waters and fresh water on concrete rather than actual sea water.

Personal Notes

William S. Menden, who has been chief engineer of the Brooklyn Rapid Transit Co. since 1905, has been made president of the company, the name of which, upon the closing of the receivership and dismissal of the receiver, has become the Brooklyn-Manhattan Transit Co. Mr. Menden was born in Evansville, Ind., in 1868 and graduated from Rose Polytechnic Institute as a civil engineer. From 1891 to 1905 he was successively rodman, assistant engineer on construction, and chief engineer in charge of construction and maintenance, Metropolitan West Side Elevated R.R. Co., Chicago.

Ralph N. Begien, general manager of the Baltimore & Ohio R.R., Western Lines, has been appointed operating vice-president of the Chesapeake & Ohio, with headquarters at Richmond, Va. Mr. Begien's early work, after graduation from Harvard in 1897, was largely in the tropics, where he spent three years with the Nicaragua Canal Commission and one on railroad work in Ecuador. He entered the employ of the Baltimore & Ohio as assistant engineer in 1902. In 1908 he was made division engineer. Two years later Mr. Begien became assistant to the chief engineer. In 1912 he was appointed assistant general superintendent of the main-line system and later general superintendent of the Baltimore & Ohio Southwestern. He was made general manager of the B. & O. Eastern lines in 1917, having previously served the road as chief engineer.

Allen W. Stephens, of the Turner Construction Co., New York City, was awarded the honorary degree of Master of Science at this year's commencement of the University of Maine. Mr. Stephens is a graduate in civil engineering from that university and is president of the General Alumni Association.

Gerard Swope, president of the General Electric Co., was awarded the degree of Doctor of Science at Rutgers College on June 12. Dr. Irving Langmuir, assistant director of the research laboratory of the company, received the degree of Doctor of Science from Union College, Schenectady; and David B. Rushmore, consulting engineer, a D.S. degree from his alma mater, Swarthmore College. All of these men have been intensely interested in furthering scientific education in our colleges and schools and have taken a leading part in the forward looking movement of co-operation between the colleges and industry.

Charles G. Duvall, chief inspector in the Indianapolis city engineering department, will resign soon to become superintendent of construction for the Union Asphalt Paving Co.

Chesley Gray, chief engineer of the Indiana state highway commission, has been given a civil engineering degree by Rose Polytechnic Institute, Terre Haute, Ind., of which he is a graduate, the degree being granted on his professional record.

Pratt-Thompson Construction Co. announce the removal of their general offices to 114 Tenth St., Kansas City.

J. Di Stasio, formerly chief engineer of the Fougner Concrete Steel Co., and U. T. Berg, reinforced concrete specialist, announce their association as J. Di Stasio & Co., consulting engineers, New York City, specializing in reinforced-concrete structures.

Charles T. Phillips, consulting engineer, has opened offices in Los Angeles, Calif., under the firm name of the Charles T. Phillips Co., consulting engineers, having associated with him Arthur Kempston, former chief of the department of electricity in San Francisco, and Fred B. McNally, mechanical engineer, formerly of Fresno. The new firm will specialize in plans, specifications, tests for fire alarm systems, street lighting and power plants.

William S. Murray, consulting engineer, New York City, formerly consulting engineer of the New York, New Haven & Hartford R.R., received the degree of Doctor of Engineering at Lehigh University, last week, where he also delivered the alumni address.

William C. Markham, construction engineer for the Detroit street railways, has resigned to become treasurer and general manager of W. C. Markham & Co., a firm affiliated with eastern interests, for general construction work. Mr. Markham has served in the Detroit department of street railways since the beginning of municipal ownership in 1920.

Prof. W. K. Hatt, Director of the Advisory Board on Highway Research, National Research Council, has returned from Europe, and will resume his duties in Washington, D. C.

A. L. Fraser, city engineer and director of the department of public service for the city of Long Beach, Calif., has resigned, effective June 15.

John N. Edy, former chief engineer of the Montana State Highway Commission, will be the first city manager of Berkeley, Calif., and will assume office July 1 under provisions of the city's recently adopted charter.

George W. Goethals & Co., consulting engineers, New York City, has been dissolved by mutual consent of the stockholders. General Goethals continues the practice of engineering at the old address, 40 Wall St.

Henry C. Turner, president of the Turner Construction Co., of New York, was awarded the honorary degree of Doctor of Engineering on June 11 by Swarthmore College, from which he graduated with a degree of B.S. in 1893. Mr. Turner is one of the pioneers in the building of reinforced concrete in this country. He joined E. L. Ransome in 1900 and for two years was associated with him in developing the then new art of reinforced concrete. In 1902, in company with DeForest H. Dixon, also with Mr. Ransome, he formed the company of which he is president and which has built some of the largest reinforced-concrete buildings in the country. Mr. Turner was president of the American Concrete Institute for two years. He received the degree of civil engineer from Swarthmore in 1903.

Obituary

Clyde M. Carr, president for 12 years of the iron, steel and machinery firm of Joseph T. Ryerson & Son, Inc., Chicago, died June 5. On account of poor health he had been unable to take an active part in the management of the firm for the past four years and last January resigned as president, although continuing until the time of his death as a member of the board of directors. Joseph T. Ryerson succeeded Mr. Carr to the presidency. Mr. Carr became associated with the Ryerson organization in 1890.

L. B. Youngs, for 28 years head of the water department of Seattle, Wash., and for ten years chairman of the Board of Public Works, died suddenly June 10, stricken with heart failure. Mr. Youngs became head of Seattle's water and light department in 1895. When the departments were separated in 1910, he remained as superintendent of the water department, and under his supervision the department has grown to a great public utility. Mr. Youngs was born in Fulton, Kentucky, in 1859, and has resided in Seattle for 35 years.

Charles R. Seabrook, of Owen & Seabrook, Detroit, Mich., died in that city recently. Before joining this firm, Mr. Seabrook was chief engineer for H. M. Lane Co., industrial engineers, Detroit, and structural engineer for the Chile Exploration Co., Chuquicamata, Chile. He served during the War in the Air Nitrates Division of the Ordnance Department.

Dr. Louis Bell, consulting electrical engineer, authority on power transmission, and former editor of *Electrical World*, died at his Boston home June 14, aged 58. Dr. Bell, a graduate of Dartmouth, received his Ph.D. at Johns Hopkins. For many years he was with the General Electric Co. He was the author of numerous technical books.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Discuss Standardization of Concrete Mixers

To consider the possibilities of standardization in the concrete mixer field a meeting was held at Cleveland last month at which were present representatives of the Associated General Contractors of America, mixer manufacturers and engineers. It was agreed that the question of standardizing mixers should be submitted to the makers of that line of equipment. The meeting is in line with the program of the Joint Conference of Equipment Manufacturers and the A.G.C. initiated last fall when a standardization steering committee, headed by Brig.-Gen. R. C. Marshall, Jr., general manager of the contractors' association, was appointed.

At the Cleveland conference it was recommended that the entire standardization procedure be tied in officially with the American Engineering Standards Committee, and that all mixer manufacturers be invited to attend a meeting for the purpose of making recommendations and, if possible, starting the work. This meeting will, in all probability, be held in Chicago at an early date.

Plan New Research on Electric Steel Foundry Problems

The Electric Steel Founders' Research Group held a regular meeting of executives of the five electric steel foundries conducting cooperative research work, at Wernersville, Pa., May 14-17. The companies represented were the Electric Steel Co., Chicago, Fort Pitt Steel Casting Co., McKeesport, Pa., Lebanon Steel Foundry, Lebanon, Pa., Michigan Steel Casting Co., Detroit, and Sivyer Steel Casting Co., Milwaukee.

Research work being done by the members of the group to improve the quality of steel castings and increase efficiency in methods were discussed and formal reports gave the status of research investigations on facing sand mixtures, core sand mixtures, electric furnace practice, heat treatment of steel castings, production control, and porosity in castings.

Plans were made for conducting research investigations on additional steel foundry problems.

Construction Equipment Exported

Figures for March, 1923, from the U. S. Department of Commerce indicate the following exports of American construction equipment: 13 power shovels, valued at $177,091; 7 cranes, at $59,785; 23 concrete mixers, at $25,129; about 274,000 lb. of dredging machinery at $45,536; about 251,000 lb. of miscellaneous road-building equipment, at $36,251.

Of the power shovels, Japan took 6 at $89,096. Six concrete mixers at $10,310 were shipped to Mexico. Egypt paid $41,935 for miscellaneous construction equipment.

Propose Two Grades for Hard Pine and Fir Timbers

Two grades for structural timbers of Southern pine and Douglas fir have been adopted by the consulting committee on lumber standards of the National Lumber Manufacturers' Association, on the recommendation of a sub-committee. The two grades are Standard and Common. Standard is to include what has been known as merchantable long leaf in Southern pine (which itself was of different actual quality at different delivery points), and selected common in Douglas fir. Common is to include those grades designated as square edge and sound and No. 1 common in Southern pine, and No. 1 common in Douglas fir. Defect specifications as formulated by the Forest Products Laboratory for "select" grade are to be used. Working stresses are to range from 1,250 to 1,750 depending on the density of the material. These figures are for material used under shelter; material in exposed locations is to be limited to stresses 200 lb. lower.

Air Consumption of Pneumatic Tools Estimated

To aid in the selection of air-compressor outfits of the proper size, the Novo Engine Co., Lansing, Mich., has prepared the following table showing the air consumption in cubic feet of free air per minute for the various pneumatic tools commonly used in construction work.

Tool	Cu.ft. Free Air per Min.
Heavy riveting hammers	20–25
Chipping and calking hammers	15–20
Small air drills (metal or wood work)	15–20
Medium air drills (metal or wood work)	25–35
Heavy drills and reamers	35–55
Stone tools for lettering and bushing work on granite and marble	4–6
Blacksmith forges	6–10
Air paint brushes	5
Plug drills for stone quarry work	20
Rotating drills of jack-hammer type	50–70
Paving breakers	53–65
Clay diggers	35–40

In explanation of the table the company points out that while ratings for air compressors are in displacement of cubic feet of free air per minute, this is a more or less arbitrary standard in that the amount of delivered air always varies with the pressure and temperature. It is characteristic of all air compressors that they do not deliver the full amount of air they displace.

Pump, Shipped by Truck, Supplies Paver When City Water Fails

Requiring a round trip by motor truck of 400 miles between job and factory, a portable pumping plant rushed to the road contract of Reith & Riley in Kankakee, Ill., prevented a long shutdown of the work due to failure of the water supply from the city main. When this condition occurred the contractors immediately ordered a Quad 44 pumping plant from the Barnes Manufacturing Co. and in order to forestall the possibility of delay by freight shipment, sent their Reo speed wagon to the factory at Mansfield, Ohio for the pump. The equipment, weighing 5,000 lb., was loaded on the truck at Mansfield on the afternoon of May 15 and reached Kankakee, a distance of more than 200 miles, on the afternoon of the 17th. The pump was put into service the following day and since that time has been supplying water to the 21-E paving mixer used on the road contract.

Business Notes

Dorr Co. has moved to new offices in New York and opened an office in Los Angeles, Calif., in charge of Alfred T. Hastings. The company manufactures water softening and clarifying equipment.

Complete Machinery & Equipment Co., New York, has recently been organized to handle contractors' equipment. The principals in the new concern are F. H. Rothschild and B. Share, formerly superintendent of the E. George Co.

Wheeling Steel Products Co., Wheeling, W. Va., sales company for the LaBelle Iron Works, Whitaker-Glessner Co. and Wheeling Steel & Iron Co., discontinued May 1, 1923, and the Wheeling Steel Corp. is now handling all sales and operations. The Wheeling Steel Corp. assumes all existing sales obligations of the Wheeling Steel Products Co., and of the three companies above named. This action will not affect the personnel of the sales division which will remain unchanged at Wheeling and at district sales offices.

Link-Belt Co., Chicago and Philadelphia, announces that L. M. Dalton has succeeded E. J. Burnell as manager of the Boston branch office. Mr. Burnell resigned to enter business for himself.

Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., announces the following changes in personnel: Because of the increasing importance of business in the foreign countries T. E. Simpers, formerly manager of the general mill section of the industrial department, has been appointed export representative of the industrial department. This is a new position made necessary by the large size to which the foreign business of the industrial department has grown. For the present J. R. Olnhausen will have supervision over the industries formerly under the control of Mr. Simpers.

Midwest Engine Corp., Indianapolis, announces that in addition to the manufacture of its regular line of gasoline engines it will undertake the reconditioning of freight cars and railway locomotives. This work will be done in portions of the plant which have been idle since the company discontinued its war contracts.

Pelton Water Wheel Co. has acquired additional property near its present San Francisco plant and will begin extensions at once that will practically double its manufacturing facilities. A modern two-story structure 115 x 200 ft. in plan is to be built to serve as office, drafting room, pattern shop and pump assembly department.

This structure is estimated to cost about $500,000. When the several departments can be moved into it there will be made available in the old plant space which is needed for the installation of new equipment and the enlarging of the turbine erecting department.

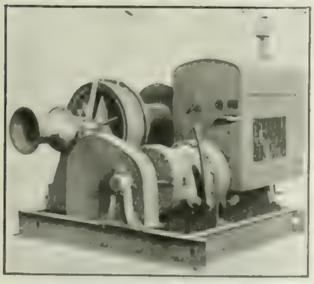
Gifford-Wood Co., manufacturer of elevating and conveying machinery, Hudson, N. Y., announces the removal of its Buffalo office to Pittsburgh, effective May 1.

Copper & Brass Research Association, New York, has just added to its membership the Engels Copper Mining Co., Gransby Consolidated Mining, Smelting & Power Co., Dallas Brass & Copper Co., Merchants & Evans Co., T. E. Conklin Brass & Copper Co., J. M. & L. A. Osborn Co., and Richards & Co., Ltd., the present membership of the association being comprised of 26 copper mining companies and 15 copper and brass fabricating and distributing companies. Information has just been received by the American association of the formation in England of a similar organization, the Copper and Brass Extended Uses Council.

Equipment and Materials

Gasoline Hoists Have Improved Thrust Apparatus

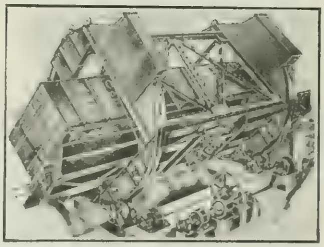
One of the features of the single- and double-drum gasoline hoisting units manufactured by the Domestic Engine & Pump Co., Shippensburg, Pa., is an improved thrust apparatus. This consists of a heavy steel screw and yoke which pushes against the hub of the drum through a thrust bearing consisting of two hardened and ground steel plates with bronze plate between. The screw also pulls the drum out of engagement by a positive movement, no spring being used to push the drum away from the friction. This design, the manufacturers point out, obviates any possibility of the friction sticking and gives the operator absolute control of the load.



The hoists are designed for a load of 2,000 lb. on a single line at 150 ft. per minute rope speed. The units are mounted on heavy frames of steel channels thus insuring rigid foundation and true alignment of engine and hoist. The brakes are of the band type with toggles to foot levers, while the drum frictions are of the cone type. To each drum shaft is attached a winch head. A lever within reach of the operator changes the engine speed so that slow or fast speeds can be obtained.

Cable-Operated Car Dumper

A new car-dumping machine for unloading coal from gondola cars has been designed by the Link Belt Co., Chicago, and the first machine is being built for a power plant at East St. Louis, Ill. The revolving cradle in which the car is placed is a structural steel frame with two trunnion rings which rest on rollers in the substructure. One of the rollers is flanged to prevent endwise shifting of the cradle. These rings are spaced so as to give supports approximately under the trucks of the car and thus minimize bending stresses. The cradle is balanced to require a minimum of power and is operated by a pair of cables. Each cable is wound on a motor-driven drum and has its ends attached to opposite sides of the trunnion ring. This arrangement dispenses with gears and racks. No end clamps are needed and the car does not have to be spotted in exact position.

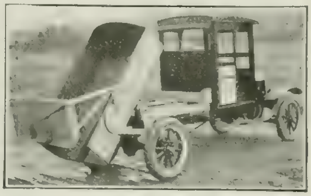


In the cradle the car rests on a deck which is supported by rollers in the main frame and tends to shift the car laterally against the dumping side of the cradle, where it is supported for its entire length. Automatic motor-driven clamps then come down to a bearing upon the car for its entire length. When the car has a bearing against the side of the dumper, a switch is engaged and the motor operating the top clamps is automatically started, applying the clamps through cable loops and a differential drive, which insures equal pressure on all clamps. This motor is stopped by means of pressure-operated limit switches which cut out the motor when a predetermined pressure is applied to the clamps. If this pressure should be decreased, as by the breaking of a lump of material between car and clamps, the motor will again be put in operation until pressure is restored. The main or rotating motor can then be operated, but if the clamps are not applied at the proper time, a limit switch will cut out the rotating motor, thus stopping the dumping operation until the clamps are again made operative. Limit switches stop the dumping at the proper time.

When the car is unloaded, the operator reverses the rotating motor. While the cradle is returning to its normal position the clamp motor is automatically reversed by a switch on the machine and the top clamps are then released by means of a counterweight. The shifting deck on which the car is supported is pushed into alignment with the fixed rails at the side of the dumper, and the empty car is pushed out by the next entering loaded car. Only one electric controller is required for all operations.

All-Service Body for 1-Ton Truck

An all-service body which can be fitted to a 1-ton truck chassis and is more particularly designed for the Ford has been placed on the market by the New York Central Iron Works Co., Hagerstown, Md. The body, known as the Crooke, measures 72 x 44 x 20 in.



and has a capacity (without surcharge) of 36½ cu.ft. It is of all-steel construction and may be attached to the chassis by six bolts without drilling. The dumping operation is effected by a hand-operated crank at either side; at no time is the load lifted. The equipment, its manufacturers claim, combines the advantages of bodies of the slow-dumping and quick-dumping type.

The body is adapted to a wide variety of uses. In handling coal the tail gate is inoperative, so that the flow of material to a chute may be controlled by a vertical sliding grate. For express purposes, such as the handling of lumber and building supplies, the tail-gate may be disconnected and thrown over to the front end of the body, producing an open-end truck. For road contract work and the handling of sand, gravel and brick the tail gate opens automatically during dumping operations, as shown in the accompanying photograph, and closes with the return of the body to its normal position. Spreading of material may be done by partially tilting the body.

Leadized Non-Corrosive Steel

Protecting steel pipes and plates against corrosion by the application of a lead coating as an integral part of the steel is a process known as "leadizing" which is being introduced by the Leadizing Co., Chicago, and is the invention of R. J. Shoemaker. The cost of the "leadized" steel is said to be little more than that of plain wrought-iron, which is often advocated on account of its high resistance to corrosion. Further, an advantage is claimed over galvanizing in that the latter gives only a surface coating which may flake off when the metal is bent or struck and which is not proof against sulphuric acid fumes, while the lead coat is homogeneous with the steel and will resist this acid.

Piping at railway shops and roundhouses, factories, mines and power plants is liable to corrosion from sulphuric acid in smoke, from the chemical action of cinders in which piping is laid in floors and yards, and from the chemical action of certain waters. In the hot treatment, the material to be coated is immersed in molten lead. In the cold treatment the lead is deposited by chemical reaction. The former method was developed while the inventor was with the Atchison, Topeka & Santa Fe Ry., and it is stated that leadized pipe buried in cinders at the Topeka shops in 1917 was in perfect condition after several years' service.

Optical Contour Projector

A projecting lamp which will project onto a screen or a measuring plate the exact contour of an object has been devised by the Bausch & Lomb Optical Co., of Rochester. The projected image is greatly enlarged, according to a description of the device by H. F. Kurtz before the Rochester Engineering Society recently. Screw threads or gear contacts may be projected upon a screen by this device and observation of the action or measurement of details carried out.

Publications from the Construction Industry

Portable Air Compressors — NOVO ENGINE CO., Lansing, Mich., in an 11-p. illustrated bulletin presents data on a variety of portable air-compressor outfits. The compressors are of the duplex, single-stage, single-acting vertical type, designed to operate against pressures up to 100 lb. per square inch. These compressed-air outfits are intended for operating rock drills, paint-spraying machines, boring machines, riveters, air hoists, and calking tools. Among the distinctive features noted by the manufacturer are the short belt drive and individual tooling systems for both engine and compressor, enabling the former to be used as an independent power plant.

Oil-Burning Equipment — COMBUSTION ENGINEERING CORP., New York, has published a new catalog which is characterized as a complete treatise on the subject of oil burning. Information is given on the properties, specifications, advantages, and supply of fuel oil, followed by a description of the Quinn oil-burner. One chapter deals with a comparison of the operating and equipment costs for oil and coal. The concluding portion of the text takes up important points in the installation of oil-burning systems and the combustion of fuel oil.

Portable and Permanent Buildings—KOLB BUILDING CO., INC., New York, devotes 64 p. in a newly published illustrated catalog to its portable and permanent buildings. While much of the information relates to residences, the company includes in its line of wooden structures, contractors' field offices, checkers' booths both for piers and freight yards, construction camp buildings, including administration buildings, restaurants, dormitories and barns. Several types of small portable all-steel storage buildings are illustrated.

Wire and Iron Fences — BUCKEYE WIRE & IRON WORKS CO., Columbus, Ohio, describes its plain and ornamental wire and iron work for fences, window grating, and elevator cages and shafts in a 31-p. illustrated catalog.

Gyratory Crushers—AUSTIN MANUFACTURING CO., Chicago, has issued a 14-p. illustrated bulletin dealing with its portable gyratory crushing and screening plants. Among the new features of this line of equipment is a portable gravel feeding conveyor, made in lengths of from 30 to 50 ft. with a belt 18 in. wide. The company's No. 4 crusher is now mounted on substantial wheel trucks and can be moved from place to place by the traction engine used to drive the crushing plant.

Water Main Cleaning—NATIONAL WATER MAIN CLEANING CO., New York, has just published a booklet listing, alphabetically, cities in which it has cleaned pipe.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

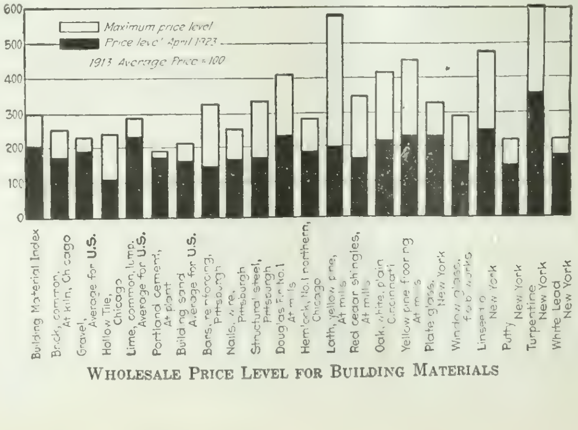
Lumber Shipments Decline

Lumber shipments from the mills during the week which ended May 19 showed a further decline, according to the weekly lumber movement review of the National Lumber Manufacturers' Association. For the week ended May 19 shipments reported from 385 mills were 237,000,000 ft., as compared with 255,000,000 ft. the previous week from 415 mills. The volume of new business accepted has been declining for some time, being 208,000,000 for 385 mills, as compared to 224,000,000 for 415 mills, —less than last year at the same time. Production, however, continues larger than last year by 21,000,000 ft. However, for the year to date shipments, orders and production are well ahead of last year, which was itself an exceptionally active year.

Owing to the extraordinarily large volume of business handled during the winter months when the lumber trade is usually lethargic, the customary succession of seasonal action and reaction in the industry has been upset this year, so that comparisons between corresponding periods of this year and last may not reflect the general state of the trade. It is likely, however, that the rising costs of building and the effort now being made to defer building activity for the purpose of stabilizing building costs, is already having some effect. Such deferment is largely, however, in the larger construction projects. Suburban and residential building activity continues with little diminishment.

Wholesale Prices of Building Materials for April, 1923

The accompanying chart shows the April, 1923, wholesale price level for building materials based on statistics gathered by the Bureau of Labor. The 1913 average price is taken as 100 on the scale and the maximum as well as the April index numbers are indicated.



WHOLESALE PRICE LEVEL FOR BUILDING MATERIALS

Southern Ry. Buys Rail to Improve Its Lines

Thirty-three thousand tons of steel rail have just been purchased by the Southern Railway System for delivery during the last six months of 1923. Included in this order are 25,500 tons of 100-lb. section and 7,500 tons of 85-lb. section rail. This brings the Southern's purchase of new steel for 1923 to 73,000 tons, 40,000 tons having been bought earlier in the year. The 100-lb. rail will be used in carrying out the program of the Southern to relay the Washington-Atlanta, Cincinnati-Chattanooga, and other lines of high traffic density with this heavy rail. The work is now in progress.

The largest share of the new order went to the Tennessee Coal, Iron & Railroad Co., which will roll 23,000 tons at its Ensley, Ala., plant; 8,000 tons were ordered from the Bethlehem Steel Co., and 2,000 tons from the Illinois Steel Co.

Portland Cement Production Shows Gain

The following statistics from tables issued by the Department of the Interior and prepared under the direction of Ernest F. Burchard, of the Geological Survey, are based mainly on reports of producers of portland cement, but in part on estimates.

During April, 1923, production totaled 11,359,000 bbl. as against 9,243,000 bbl. for the same month last year; shipments this April were 12,954,000 bbl. as against 8,592,000 bbl. in 1922; stocks on hand at the end of April, 1923, totaled 11,450,000 bbl. as against 14,470,000 bbl. for April 1922.

For the first quarter of 1923 (January, February and March) production totaled 25,669,000 bbl. as compared with 15,254,000 bbl. for the same period last year; shipments for the first quarter of 1923 were 21,708,000 bbl. as against

13,218,000 bbl. for the same period in 1922.

For the year 1922 the total production was 114,789,984 bbl. and shipments were 117,701,216 bbl.

Bookings of Steel Castings

The Department of Commerce announces that May bookings of steel castings made a slight decline from April, based on reports received by the Bureau of the Census in co-operation with the Steel Founders' Society. The bookings in May by companies representing over two-thirds of the commercial castings capacity of the United States amounted to 89,463 tons, as against 90,968 tons in April. Bookings for both railway specialties and miscellaneous castings declined.

The accompanying table shows the bookings of commercial steel castings for the past five months by 65 identical companies, with a monthly capacity of 96,900 tons.

BOOKINGS OF COMMERCIAL STEEL CASTINGS

Month 1923	Total Net Tons	Total Per Cent of Capacity	Railway Specialties Net Tons	Railway Specialties Per Cent of Capacity	Miscellaneous Castings Net Tons	Miscellaneous Castings Per Cent of Capacity
January	100,605	103 8	47,879	125.0	52,726	90.0
February	90,152	93 0	39,845	104.0	50,307	85.8
March	143,564	148 2	76,409	199.5	67,155	114.6
April	90,968	93 9	39,610	103 4	51,358	87.6
May	89,493	92.4	38,788	101.3	50,705	86.5

Steel Industry's Size Shown by Census Statistics

The Department of Commerce announces that, according to reports made to the Bureau of the Census, the value of products of establishments engaged primarily in steel production and the rolling of iron and steel products amounted to $1,481,659,000 in 1921, as compared with $2,828,902,376 in 1919 and $918,664,565 in 1914, a decrease of 48 per cent from 1919 to 1921, but an increase of 61 per cent for the seven-year period from 1914 to 1921. In 1921 reports were received from 494 establishments, a decrease of 6 from the number reporting in 1919, but an increase of 67 over those for 1914.

The decrease in the value of products has been accompanied by decreases in the number of persons employed, in the total amount paid for salaries and wages, and in the cost of materials used. In January, the month of maximum employment, 293,284 wage earners were reported; and in July, the month of minimum employment, 183,024, the minimum representing 62 per cent of the maximum. The average number of wage earners employed during the year was 235,515, as compared with 375,088 in 1919 and 248,716 in 1914.

Municipal Bond Sales for May

The aggregate of bonds disposed of by states and municipalities throughout the United States during May, according to the monthly survey of the *Commercial & Financial Chronicle*, New York, was considerably larger than during April, but when comparison is made with May of last year the tendency toward more moderate totals, noticeable the past few months, is still in evidence. The disposals in May were $91,873,006; in April, $78,131,220; and in May, 1922, $106,878,872.

Illinois made the largest contribution toward the month's total in the form of two issues of bonds aggregating $17,000,000, of which $10,000,000 was for a bonus to war veterans and the remaining $7,000,000 for road construction. The latter block was a 4-per cent issue which sold at a price of $97, giving a yield of 4.41 per cent. Among other large issues of bonds were those of $4,000,000 at Atlanta, Ga., for waterworks, schools, sewers and a viaduct all bearing 5 per cent; seven issues at Winston-Salem, N. C., aggregating $2,465,000 for public improvements;

REPRESENTATIVE PUBLIC BOND SALES DURING MAY AND JUNE, 1923

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Illinois	Roads	$7,000,000	4	97.0	4.41	May 1, 1923	1936–37	Syndicate (Guaranty Trust Co., New York and others)
Maryland	Roads	1,650,000	4½	101.57	4.30	June 15, 1923	1926–38	Alexander Brown & Sons, Baltimore, and others
County								
St. Louis, Minn	Roads	1,500,000	5	101 40	4.78	Jan. 1, 1921	1931	Syndicate (Redmond & Co., N. Y., and others)
Ramsey, Minn.	Road and bridge	1,000,000	4¾	101 44	4.60		1924–43	Syndicate (Estabrook & Co., N. Y., and others)
Abington, Pa.	School	350,000	4¼	102.596	4.05	June 1, 1924	1933–53	Janney & Co., Phila.
Baltimore, Md.	Sewage	31,000	4½	102.452	4.39	June 1, 1923	1948	J. A. W. Iglehart & Co., Baltimore
Calcasieu, La.	Navig. Channel	2,750,000	5½	100.60	5.45	Oct. 1, 1922	1923–52	Sutherlin, Barry & Co., New Orleans; Caldwell & Co., Nashville
Hancock, Ind	Road	13,860	4¾	100 04	4 74	May 15, 1923	1924 33	Peoples State Bank, Indianapolis
Greene, Ind.	Road	144,000	5	101 0	4 80	May 15, 1923	1924–33	First National Bank, Linton, Ind.
Hennepin, Minn	Road	2,000,000	4¾	101.47	4.52	June 1, 1923	1928 42	Bankers Trust Co., N. Y.
Lake, Ohio	Water	225,000	5	101.53	4.78	April 1, 1923	1925–42	Richards, Parish & Lamson, Cleveland
La Porte, Ind.	Road	82,000	5	100.97	4 80	May 15, 1923	1924 33	Fletcher American Co., Indianapolis
Rock, Wis	Road	200,000	5	102.13	4.82	June 1, 1919	1933	Harris Trust & Savings Bank, Chicago
Routt, Colo.	School	27,000	5½	103 919	5 19	June 1, 1923	1943	Janus N. Wright & Co., Denver
Wasco, Ore.	Road	200,000	5	103 10	4.59	May 15, 1923	1928 37	Ferris & Hardgrove, Spokane
Gibson, Ind.	Road	18,400	5	100 87	4 82	Apr 15, 1923	1924-33	G. L. Payne & Co., Indianapolis
Butler, Ohio	Bridge	68,956	5	100 52	4.92	May 15, 1923	1924 37	Prudden & Co., Toledo
Calhoun, [illegible]	School	60,000	5¼	100 02	5 24	Jan. 1, 1923	1924-44	Detroit Trust Co., Detroit
Asheville, N. C.	Road	310,000	5¼	104 67	4 89	Feb. 1, 1923	1933–53	Stacy & Braun, Toledo
Sussex, Del.	Road	300,000	5	103 05	4 80	Jan. 1, 1923	1931-70	Farmers Bank, Georgetown
Montgomery, Ohio	Water	40,000	5½	104.55	4 98	Apr. 1, 1923	1925–44	A. C. Allen & Co., Chicago
Township								
Dannemora, N. Y.	Road	8,000	5	101 21	4 73	Feb 1, 1923	1925 32	Geo. B. Gibbons & Co., N. Y.
Montville, Ohio	Road	23,626	6	101 75	5 62	Apr. 1, 1923	1924 31	Chagrin Falls Banking Co., Ohio
Portage, Pa.	School	100,000	4½	102 91	4 34	July 1, 1923	1933 53	Redmond & Co., Pittsburgh
Ripley, Ind	School	78,000	5	101 88	4.73	May 15, 1923	1924–38	State Bank of Carthage, Ind.
Salem, Ohio	School	30,000	5½	102.70	5.17	Apr 1, 1923	1924–43	Sidney, Spitzer & Co., Toledo
Municipality								
Atlanta, Ga.	Public works	$4,000,000	5	104 44	4 59	Jan 1, 1921	1925 51	J. H. Hilsman & Co., Atlanta; Stacy & Braun, Toledo, O.
Winston-Salem, N. C.	Streets, sewers, public works	2,465,000	4½, 5½	100 00	4½-5½	May 15 1923	1924–61	Syndicate (Harris, Forbes & Co., N. Y., and others)
Kansas City, Mo.	Water works	2,500,000	4½	102 089	4 34	July 1, 1922	1942	[illegible]
Cleveland, O.	Public works	1,970,000	4½	100 28	4 465	Mar. 1, 1923	1924 47	[illegible]
Flint, Mich.	Public works	1,875,075	4½	100 01	4 49	June 1, 1923	1924 48	[illegible]
Charleston, S. C.	School	[illegible]	5	103 33	4 76	July 15, 1923	1948	[illegible]
Chicopee, Mass.	Water and paving	[illegible]	4¼	101 517	4 16	June 1, 1923	1924 33	[illegible]
Herkimer, N. Y.	Water and sewer	[illegible]	5	103 85	4 50	June 1, 1923	1924 43	[illegible]
Jersey City, N. J.	School	2,228,000	4¾	103 47	4 44	June 1, 1923	1924-57	[illegible] Nat. City Bk., N. Y. [illegible]
Jersey City, N. J.	Gen. impv't.	[illegible]	4¾	103 29	4 44	June 1, 1923	1924-55	[illegible]
Muskegon, Mich.	Sp. impv't.	[illegible]	4½	98 16	4 89	June 1, 1923	1924–33	[illegible]
Newport, R. I.	Road	[illegible]	4½	100 06	4 40	June 1, 1923	1924 38	[illegible]
Northampton, Mass.	Sewer	20,000	4¼	100 60	4 13	June 1, 1923	1924 33	[illegible]
Portland, Ore.	Water	2,200,000	4½	100 077	4 49	July 1, 1923	1924 41	[illegible]
San Antonio, Tex.	School	[illegible]	5	102 76	4 76	July 1, 1922	1924 62	[illegible]
Jacksonville, Fla.	Street	315,000	5	101 05	4 87	May 1 1923	[illegible] 38	[illegible]
Cedarhurst, N. Y.		[illegible]	5	105 89	4 40	Mar 1, 1923	1924 48	[illegible]
Columbia, S. C.	School	[illegible]	5	103 01	4 76	June 1 1923	1928 57	[illegible]
Des Moines, Ia.	Water	[illegible]	4½	100 15	4 48	Apr. 1, 1923	1934–43	[illegible]
Omaha, Neb.	Street	600,000	4½	100 17	4 49	May 1 1923	1943	[illegible]
[illegible]	Road	[illegible]	4½	100 333	4 43	June 1 1923	1925 39	[illegible]
Bessemer City, N. C.	Street and water	[illegible]	6	102 17	5 70	May 15 1923	1926 50	[illegible]
Pottstown, Pa.	Sewer	[illegible]	4½	103 729	4 07		1931 53	[illegible]
South Pasadena, Cal.	School	[illegible]	5	102 02	4 79	June 1, 1923	1929–45	Wm. R. Staats Co., Los Angeles

$2,500,000 for water-works at Kansas City, Mo.; $2,000,000 for a sea wall at Corpus Christi, Texas; $1,970,000 at Cleveland, Ohio, and $1,875,000 at Flint, Mich.

The number of municipalities emitting permanent bonds and the number of separate issues made during May, 1923, were 541 and 373 respectively. This contrasts with 448 and 632 for April, 1923, and with 647 and 868 for May, 1922.

Of the 50 representative bond issues included in the tabulation on p. 1107, one sold at par, 47 above par, and 2 below par. The yields ranged from 4.05 to 5.07, and the rate of interest from 4 to 6 per cent.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 363 to 378, are the following:

Apartment, Chicago, Ill., to B-W Construction Co., $3,500,000.

Power development, Quebec, Canada, to Morrow and Beatty, Peterboro, Ont., $3,000,000.

Apartment, New York, N. Y., to I. W. Stemmler, Jr., Inc., $1,500,000.

Memorial, Kansas City, Mo., to Westlake Construction Co., St. Louis, $1,142,250.

Hotel, Shreveport, La., to Ault and Burden, Little Rock, Ark., $1,000,000.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 363 to 378, are the following:

Office building, New York, N. Y., for G. Backer Construction Co., $1,000,000.

Sewer, Los Angeles, Calif., for Board of Public Works, $12,000,000 bond issue.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of June 7; the next, on July 5.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.30	$4.50	$3.40	$3.55	$4.20	$3.95	$4.10	$4.25
Structural rivets, 100 lb.	4.40	5.00	4.95	3.75	4.25	5.40	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	4.25	+3.75	3.32½	3.45	3.85	3.65	4.10	4.00
Steel pipe, black, 2½ to 6 in. lap, discount	44%	52%	45%	47%	53-5%	36%	35.2@47.6%	40%	32.76
Cast-iron pipe, 6 in. and over, ton	62.50@63.50	55.00	63.00	60.20	60.50	69.00	60.00	70.00	60.00
Concreting Material:									
Cement without bags, bbl	2.70@2.80	2.85	2.25	2.20	2.39	2.84	2.71	2.90	2.25
Gravel, ¾ in., cu.yd	2.25	1.90	2.25	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd	1.25	1.24	1.95	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd	1.75	2.00	2.50	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	−64.00	42.00	53.00	58.50	—43.25	60.00	41.00	32.00	90.00
Lime, finishing, hydrated, ton	18.20	23.50	22.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	2.50	1.50	1.50	2.70	1.75	2.80	10.00
Common brick, delivered, 1,000	23.50	14.00	12.90	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.109	.115	.1032	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1573	.109	.115	.0825	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	1.16	1.24	+1.36	—1.29	1.29	1.39	1.24	.86	1.38
Common Labor:									
Common labor, union, hour	.75	.35	....	......	......	.50@.55	.55	....	.....
Common labor, non-union, hour	....	.30	.30@.50	.85	.55	.35@.50	.50	.50@.62½	+.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 81¼c.; building laborers (pick and shovel men), 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars. other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.74). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Steel prices are tending toward lower levels, with the greatest weakness in steel sheets and reinforcing bars. Quotations as low as $2.35 per 100 lb. are being offered on bars at Pittsburgh mills; the maximum, however, does not exceed $2.40. New demand for plates and shapes shows some improvement; quotations mainly at $2.50 per 100 lb., f.o.b. mill, with $2.60 asked for immediate shipments.

Warehouse prices show little change on steel, concreting materials, brick, lime and hollow tile. Linseed oil, however, advanced 1c. in Dallas and declined 8c. per gal. in Chicago, during the week which is covered by this report.

Yellow pine timbers dropped $1 per M. ft. in New York and Douglas fir, $1.50, in Minneapolis. The demand for yellow pine is weaker with orders on hand below sales. Recent rains have tied up production considerably, in cutting areas.

Maximum common labor rate in Montreal advanced to 35c. as against 30c. per hr.

New York bricklayers are still on strike, on jobs covered by the Mason Builders' Association, demanding contract of $12 per day for two years. The employers extended an offer of $11 per day for 2½ yrs., which was rejected by the unions with the resultant threat of a "lock-out" on the part of the builders. Twelve school contractors, however, signed the agreement to pay $12 per day for two years and to guarantee continuous employment to the bricklayers, during that period.

St. Louis plasterers are on strike, demanding $14 as against $12 per day. Fear is expressed that the move on the part of the plasterers will be followed by demands from other trades. The plasterers, hodcarriers and laborers have already voted to demand an increase of $1 per day.

Volume 90 New York, June 28, 1923 Number 26

Engineering News-Record

A CONSOLIDATION OF ENGINEERING NEWS, ENGINEERING RECORD, AND THE CONTRACTOR

E. J. MEHREN, *Editor* FRANK C. WIGHT, *Managing Editor*

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How One Man Landed a Job

THERE are more ways than one to use "Engineering News-Record." Here is the story of how the paper helped a construction foreman locate a job in California:

"ONE DAY, while I was working for the —— Construction Co. in Massachusetts as a concrete labor foreman, I felt like going away some place. I told the superintendent that I wanted to go away but he did not want to believe that. However, next morning, instead of going to work, I took the train for Boston.

"After two days in Boston I would have had some work but thinking that I had worked for the —— Construction Co. for about 15 years, beginning as a water boy and becoming a boss, and not wanting to go back, being ashamed to as I left there without reason, I thought I would go to Los Angeles for the winter. I telephoned the Boston office to tell them that I was leaving for Los Angeles and they asked me if I was going into motion pictures and I answered that I was going to California for a vacation, so I took the train for Los Angeles.

"WHEN I arrived at Chicago I opened my suit case and found *Engineering News-Record* and saw that they were doing more concrete work in San Francisco than in Los Angeles, so I took the train for San Francisco, and as soon as I arrived there and stepped out of the ferry building, I saw that they were building a 16-story office building. I went to see the superintendent. I told him I always had worked as boss and that I was looking for work and he told me that I could go to work at once as a stripping foreman.

"With best regards to *Engineering News-Record* that I have a very nice job, I beg to remain,

"Yours truly,
"—— ——."

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Ingeniería Internacional
Bus Transportation Electric Railway Journal
Electrical World Electrical Merchandising
Journal of Electricity and Western Industry
(Published in San Francisco)
Industrial Engineer
(Published in Chicago)
American Machinist—European Edition
(Published in London)

The annual subscription is $5 to any part of the United States, Canada, Mexico, Alaska, Hawaii, the Philippines, Porto Rico, Canal Zone, Cuba, [illegible]. Extra postage to other countries $4 (total $9 or 38 shillings). Single copy [illegible].

Change of Address: When change of address is ordered the new and the old address must be given. Notice must be received at least ten days before the change takes place. Printed in U. S. A. Copyright 1923, by McGraw-Hill Company, Inc. Published Weekly. Entered as second-class matter April 11, 1917, at the Post Office at New York under the act of March 3, 1879.

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MEAD-MORRISON

MOTOR TRUCK WINCH

hauled this 26-ton boiler more than 3 miles over winding, hilly roads, and lowered it into a pumping station.

Mead-Morrison Vertical Capstan Winches are safe, sure, silent, compact. They load, move and haul a surprising variety of loads and make money for their owners by *letting the engine do the work.*

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Multiplies Man-Power
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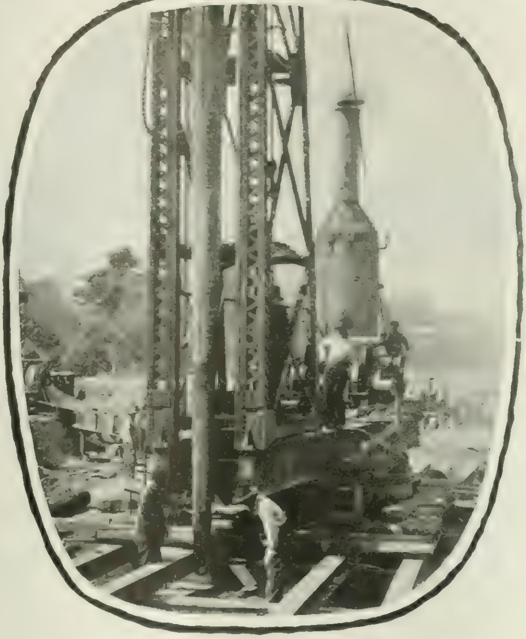

The Architect or Owner who wants to be absolutely certain that every Concrete Pile will be perfect insists on such piles being driven by the famous RAYMOND Method, using a spirally reinforced steel shell that is left in the ground.

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"A form for every pile—A pile for every purpose"

Viewing the Nation's Wealth

Uncle Sam on an inspection tour of American properties stops to examine a *Strauss bascule highway bridge* over a Western river.

"Save the surface and you save all"—Paint & Varnish

The Dutch Boy Painter:

"A 226-foot gap is spanned by those two slender arms of steel. Every square inch of that metal must be protected with plenty of red-lead paint. Otherwise, rust will get in its work of destruction. Red-lead is the surest, safest protection against corrosion."

Closed to shipping—but wide open to corrosion

UP and down these balanced levers smoothly swing. They are strong. The engineer has provided for every stress and strain.

But if this bascule construction is to *remain* strong, each square inch of steel must be protected against rust. Each square inch of steel must be kept covered with good paint.

For many years red-lead has been recognized as metal's most effective defense against corrosion. Extensive tests have been made under all possible conditions. But all research only emphasizes the rust-resisting qualities of red-lead.

Because it is pure red-lead, Dutch Boy Red-Lead supplies complete protection to all classes of metal construction and equipment. It is specified by name because of its *known* standard of quality.

Dutch Boy Red-Lead gives a tough, elastic covering that expands and contracts without cracking. It sticks tight to clean metal and does not flake off or scale. It has unusual spreading power. A given quantity will cover more surface than the same amount of most other paints.

You can get Dutch Boy Red-Lead in paste form and as a liquid ready for the brush. For shop painting and priming coats the straight, untinted red-lead should be used. The *liquid* comes also in browns, greens and black for finishing coats. The untinted *paste* can be tinted to any dark color.

Specify Dutch Boy Red-Lead by name. *There is no "or equivalent"!*

Write for Painting Helps No. 5.

NATIONAL LEAD COMPANY

New York, 111 Broadway; Boston, 131 State St.; Buffalo, 116 Oak St.; Chicago, 900 West 18th St.; Cincinnati, 659 Freeman Ave.; Cleveland, 820 West Superior Ave.; Pittsburgh, National Lead & Oil Co. of Pa., 316 Fourth Ave.; Philadelphia, John T. Lewis & Bros. Co., 437 Chestnut St.; St. Louis, 722 Chestnut St.; San Francisco, 485 California St.

Dutch Boy Red-Lead

Detail representing the construction of fireproof flooring first used in this bank building erected in 1855. Iron joists, constructed from two curved sheets and two flat strips, riveted top and bottom, rested on iron girders. Above the joists corrugated iron sheets supported a concrete filling over which was laid the wood flooring.

Three-Quarters of a Century!

THREE-QUARTERS of a century ago a broad-visioned architect specified riveted iron joists for the floors of this historic bank building. His specification originated the first light weight type of fireproof construction.

Previous to this time heavy structural steel forms had been deemed essential for permanent floors. The record of seventy-five years of service, however, has far more than justified this architect in his radical departure from former standards.

When this bank building was finally torn down to make way for a large and modern edifice, its floors were still found to be in perfect condition. The ravages of time and wear had in no way impaired or damaged them.

Science, too, within recent years has fully demonstrated the correctness of the theory upon which these floors were built—that fire-safety, durability and permanence are not dependent upon the weight and mass of the materials employed. And today thousands of buildings bear testimony to the growing popularity of this steel joist fireproof construction.

With the introduction of Truscon and National Steel Joists, the Truscon Steel Company has played a conspicuous part in the development of fireproof, permanent, yet light weight and economical flooring for all light occupancy buildings. Such flooring constitutes a saving, not alone in first cost, but in upkeep costs. It is crack-proof, vermin-proof and in every way suited to meet the ideals of present-day building.

If you are planning a home, office building, hotel apartment, store, school, etc., learn more of the safety, economy and durability of steel joist floor construction. Write today for detailed information and descriptive booklet.

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For addresses see 'phone books of principal cities.
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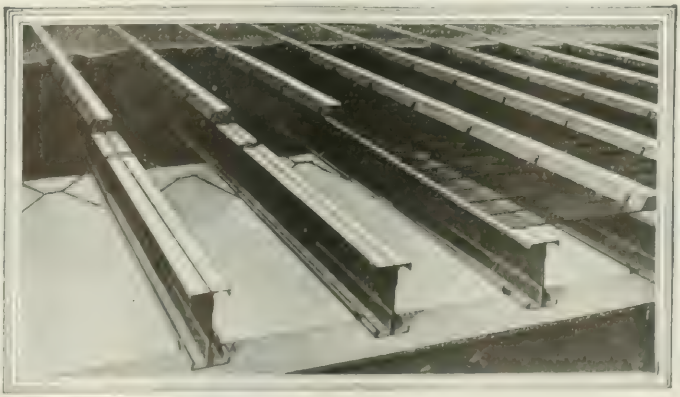
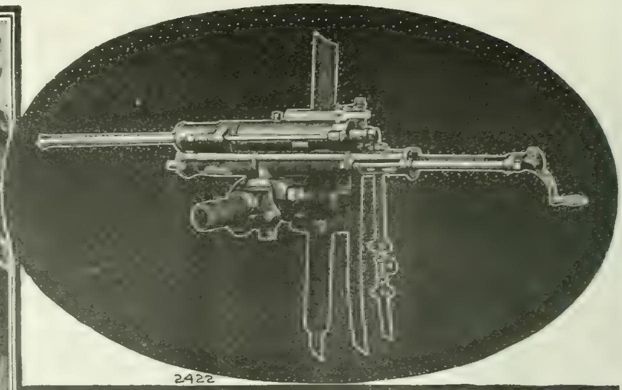
National Steel Joist Co., Massillon, Ohio

The great advance made in modern fireproofing is illustrated by this Truscon Steel Joist Floor Construction. Simple to install. Merely place the joists and apply the metal lath above for concrete and below for plastered ceilings. No [illegible] no forms, no false work — no special equipment. [illegible] everywhere for apartments, schools, stores, hotels, [illegible] floors of homes, etc.





At left—a CP-5 Rock Drill in operation. *Above—illustration showing the CP-5 Rock Drill.*

CP-5 Rock Drill — *a strictly one-man drifter*

THE CP-5 Rock Drill is a strictly one-man machine. It weighs from 35 to 60 pounds less than other heavy mounted-type drifters. It sets low in its cradle. It has no bothersome knobs. It insures quicker set-ups with less labor. It permits changing drill steel without affecting alignment. It works *with* the operator. For example, the hose stays close to the drill out of his way.

The CP-5 is proving indispensable for heavy drifting, cross-cutting and tunneling, because it combines the *speed* and *power* of heavier drifters, plus *light weight, ease of operation, durability* and *upkeep economy.*

In formations varying in hardness from slate to jasper, the CP-5 equalled the performance of 160-170-pound. drifters. This performance record was made possible by certain outstanding features fully outlined in Special Publication 697. Request *your* copy today.

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**BOYER PNEUMATIC HAMMERS · LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
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GIANT OIL AND GAS ENGINES ROCK DRILLS · COAL DRILLS**

CHICAGO CHICAGO CP PNEUMATIC **PNEUMATIC**

Rock *Drills*

Most sections have only 150 to 200 days a year of good weather suitable for outside work

Use the Shovel that WORKS EVERY GOOD DAY

"From actual experience, our own and others, we know the ERIE to be the most reliable shovel built and lowest in upkeep cost [illegible] comparison [illegible]. The ERIE [illegible] excavate more yards per hour or per day than any other shovel we have had."— [illegible] Buffalo, N. Y. (Own 3 ERIES.)

By Gerhardt F. Meyne,
Vice-Pres. Assoc. Bldg. Contractors of Illinois.
(From Engineering and Contracting.)

Lost time is the bottomless pit into which more money than can be estimated has been dumped by contractors. A day free from delays will produce twice as much as an average day. [illegible]

These contractors, and hundreds like them,

know better than to throw their money into the "lost-time" pit:

"I would advise any contractor who is in the market to buy an ERIE because it stands up. If we were to get another shovel it would be nothing but an ERIE.

"We have had our ERIE for nine months and have spent about ten dollars for repairs; most of our work is heavy grading and large cellars."—*Daniel Haupert, Haupert & Lambert, Brooklyn, N. Y.*

"The ERIE cannot be compared to any other machine that I have seen or used. Before purchasing my ERIE, I owned another shovel which I was obliged to sell because of its extremely high upkeep cost.

"Grading roads and digging sewers with the ERIE for a year and a half, my repair cost has been only $[illegible]"— [illegible] *Minn.*

"I prefer the ERIE to any other shovel on the market today, and have had experience with 7 different [illegible] in the past [illegible].

"Have [illegible] the ERIE [illegible] [illegible] foundations and loading gravel from creek bed [illegible]"— [illegible]

"We have operated our ERIE [illegible] and day for 4 months without losing more [illegible]"— [illegible]

YOUR UP-TO-DATE CONTRACTOR keeps cost records that really tell him something! He knows just how much it costs him per hour when a machine breaks down and stops his work—how much it costs in lost labor, unproductive overhead, *and loss of profits.*

That's why you see the big majority of successful contractors using ERIES. They know the dollars-and-cents value of equipment that is RELIABLE.

Up-to-date contractor wants service like this:

"One of our ERIES has been grading continuously for seven months without losing as much as two hours' total time. The ERIE is the best shovel we have ever used; it is the most reliable and has the lowest upkeep cost."—*[illegible] G. [illegible] Company, Norfolk, [illegible] [illegible] ERIES*

One letter like this means nothing: *five or six* letters like this do not mean very much. But when you read and hear HUNDREDS of such statements by contractors—all telling of this same kind of service from ERIE Shovels and Cranes—then it is wise to profit by their expERIEnce!

Actual service records prove that ERIES have only 1-3 as much repair expense, AND MAKE A CORRESPONDING SAVING IN WORKING TIME.

We will be glad to show you hundreds of letters like those at the left—written by successful contractors who have had years of experience with different shovels and cranes. Also we can send you many carefully checked records of upkeep cost.

Keep your money out of the "lost time" pit. [illegible] to "buy right." Drop us a line for the "Upkeep Cost Record Book."

ERIE STEAM SHOVEL CO., Erie, Pa., U. S. A.

Incorporated [illegible] *formerly* [illegible] Builders of [illegible] Shovels and [illegible] Cranes
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Representatives throughout the U. S. A.
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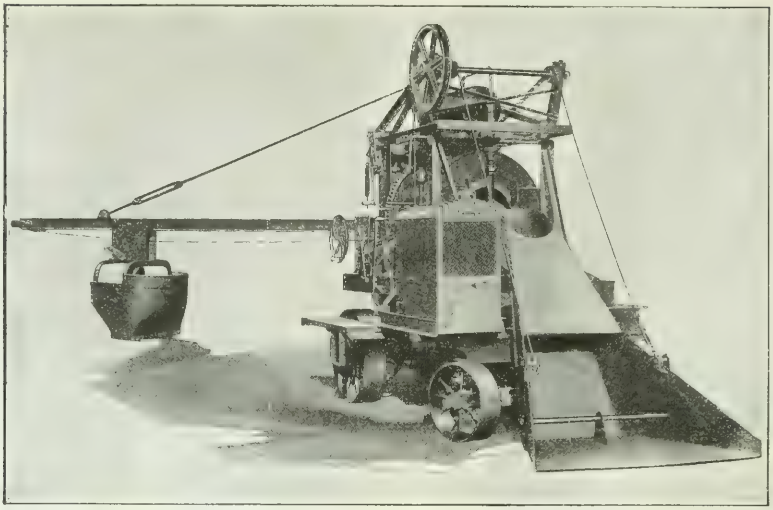
ERIE Revolving Shovels



Performance sells this Paver

for instance–

March 1922 a Southern road contractor bought a Ransome 10-E Paver. Its performance made such an impression on the contractors in his locality that inside of five months *seven* had followed his example and become Ransome owners.

And the same thing is happening this year in other parts of the country. The Ransome Paver out on the job is selling the Ransome Paver back in the plant at Dunellen. The price is right—the upkeep low, and the paver *delivers the goods.*

You'll want to get posted on this Ransome 10-E Improved Paver. We will be glad to send complete information.

5113

Without obligation on my part, please send me information on:—
Building Mixers, sizes 4-S__; 7-S__; 10-S__; 14-S__; 21-S__; 28-S__; 56-S__. Driven by Belt__, Steam__, Gasoline__, Electric__
Paving Mixers, sizes 7-E__; 10-E__; 14-E__; 21-E__. Concrete Chuting Plant for structure__ft. long by__ft. wide by__ft. high.

*NAME*____________________ *ADDRESS*____________________

Ransome 10-E PAVER

RANSOME CONCRETE MACHINERY CO.
1750 Second Street, Dunellen, N. J.

Choosing a Conveyor System

Brownhoist Builds

Apron Conveyors, Bucket Elevators, Chain Conveyors, Belt Conveyors, Locomotive Cranes, Buckets and other handling equipment.

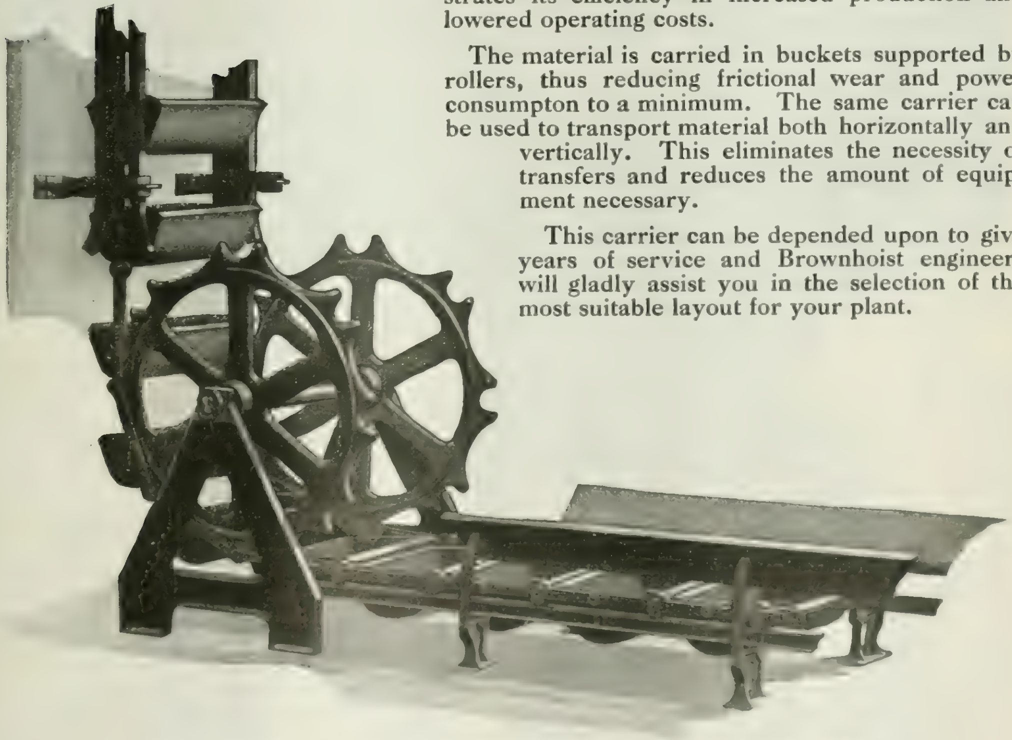
Literature on Request.

Of the utmost importance in choosing a conveyor system is the ability of the equipment to perform its work, efficiently and continuously, year after year, with low maintainence and operating cost. Shut downs for repairs must be few and far between and power consumption must be low.

The Brownhoist pivoted bucket carrier fulfills every requirement for this type of equipment unusually well. In the handling of coal, ashes, cement clinker, stone and other materials, it soon demonstrates its efficiency in increased production and lowered operating costs.

The material is carried in buckets supported by rollers, thus reducing frictional wear and power consumpton to a minimum. The same carrier can be used to transport material both horizontally and vertically. This eliminates the necessity of transfers and reduces the amount of equipment necessary.

This carrier can be depended upon to give years of service and Brownhoist engineers will gladly assist you in the selection of the most suitable layout for your plant.



The Brown Hoisting Machinery Co., *Cleveland, Ohio*

Branch Offices: New York, Chicago, Pittsburgh, San Francisco, New Orleans

BROWNHOIST

MATERIAL HANDLING EQUIPMENT

Like Looking at the Sun

If you were to look into one of the great rotary kilns in a cement mill, you would see only a glare of light so intense that it would be like looking at the noon-day sun. For a few moments after, you would be unable to see anything.

But borrow the workman's colored goggles to protect your eyes, and peer through the peep-hole again. Then you will see a tornado of coal—of gas or spraying oil—bursting into a sheet of sun-white flame. Into the other end of the kiln flow the finely ground limestone and clay—the materials for cement.

In their three-hour journey through this inferno, the materials undergo many changes. Moisture and gases are driven off as the rotation of the kiln tumbles the materials about, subjecting them to gradually increasing heat until the sun-white flame half melts the powder and it rolls into glass-hard clinker. This clinker, an entirely new chemical compound, when pulverized becomes portland cement.

Scientific control marks every stage of the burning process. Producing the required 2,500 to 3,000 degrees Fahrenheit of heat consumes great quantities of fuel—30 pounds of coal, or its equivalent, for each 94-pound sack of cement.

For the whole cement-making process, the consumption of coal is approximately 50 pounds a sack—more than half a ton of coal to a ton of cement.

PORTLAND CEMENT ASSOCIATION

A National Organization
to Improve and Extend the Uses of Concrete

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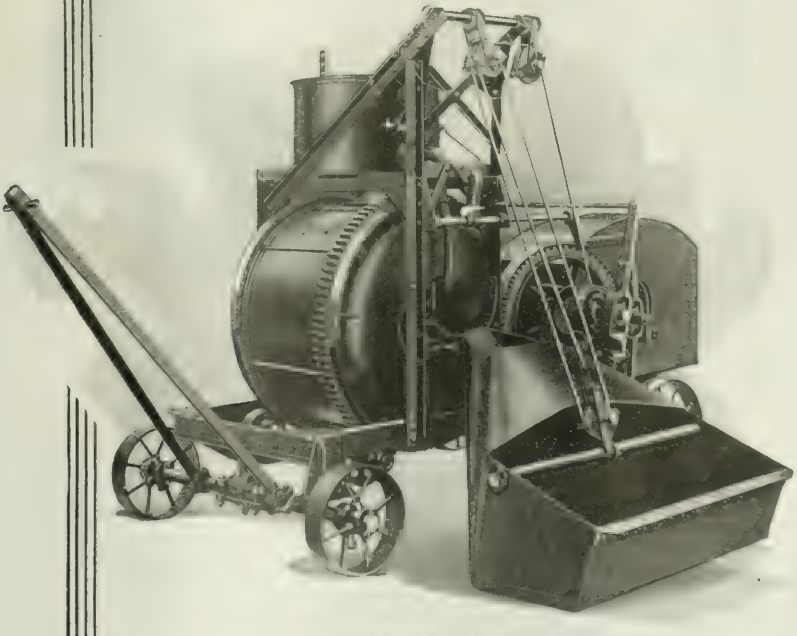
THE MIXER YOU HAVE WAITED FOR

AUSTIN MACHINERY
"MOVES THE EARTH—MIXES THE CONCRETE"

THE AUSTIN DRUM MIXER



The Austin Drum Mixer with Side Loader

There is a difference in these Austin Drums though they may resemble other drum type mixers. This difference is in the mixing action and the unusual enduring qualities. In place of the usual "V" spreaders and short blades we use long blades. In charging the mixer these blades carry the material away from the charging side almost instantaneously. This provides fast charging and prevents clogging. While mixing, the blades aid in carrying the material up and dropping onto the discharge spout. The inverted spout throws the material back to the charging side of the mixer. This induces a mixing action, supplemented by a remixing action that shortens the time required to secure a thoroughly mixed batch.

The result is more batches per hour, more jobs per season and greater profit at the completion of the job. [illegible]

AUSTIN MACHINERY CORPORATION
[illegible] Dorr Street
Toledo, Ohio

AUSTIN BUILT CONTRACTORS' EQUIPMENT
CUBE MIXERS [illegible] MIXERS CUBE PAVERS DRUM PAVERS ASPHALT PLANTS TRENCH MACHINES TRENCH WIDENERS DITCHERS BACKFILLERS DRAGLINES CRANES SHOVELS [illegible] CLAMSHELLS WAGON LOADERS SUBGRADERS CONCRETE ROAD TAMPER AND FINISHER

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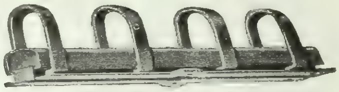
DAYTON No. 5
Malleable Iron

"Y" SOCKET
Malleable Iron



SLOTTED INSERT
Pressed Steel
12-in., 18-in., 24-in., 36-in.

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- BAR-TYS
- EASEL-CHAIRS
- SLAB BAR-SPACERS
- BEAM BAR-SPACERS
- HY-CHAIRS
- X-TENSION CLIPS
- CURB-BARS
- STAIR-TREADS
- WALL-TYS

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42 Broadway, New York

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Sales Agencies with Stocks in other Principal Cities

A Haiss Truck Loader

Is a Flexible Piece of Equipment

For Loading Trucks at Siding

Digging and Loading in Sand or Gravel Bank.

Loading at Quarry Stockpile.

Loading in Material Yards.

Loading to truck, car or truck-tractor at roadside storage.

Making final subgrade cut.

Removing old surfacing.

When you buy a Haiss Truck Loader you are not tying up money in a one-purpose machine. You can apply its economies on any one of a number of jobs.

The big job is stockpile loading—$1\frac{1}{2}$ cu. yd. per minute and no truck time lost. Speedy work but only $\frac{1}{4}$ the cost of hand shoveling.

Remember it is not merely a bucket loader—it digs, not as a steam shovel or for steam shovel work, but entirely practical in sand or light earth, or where old macadam surface has been scarified and scraped into windrows.

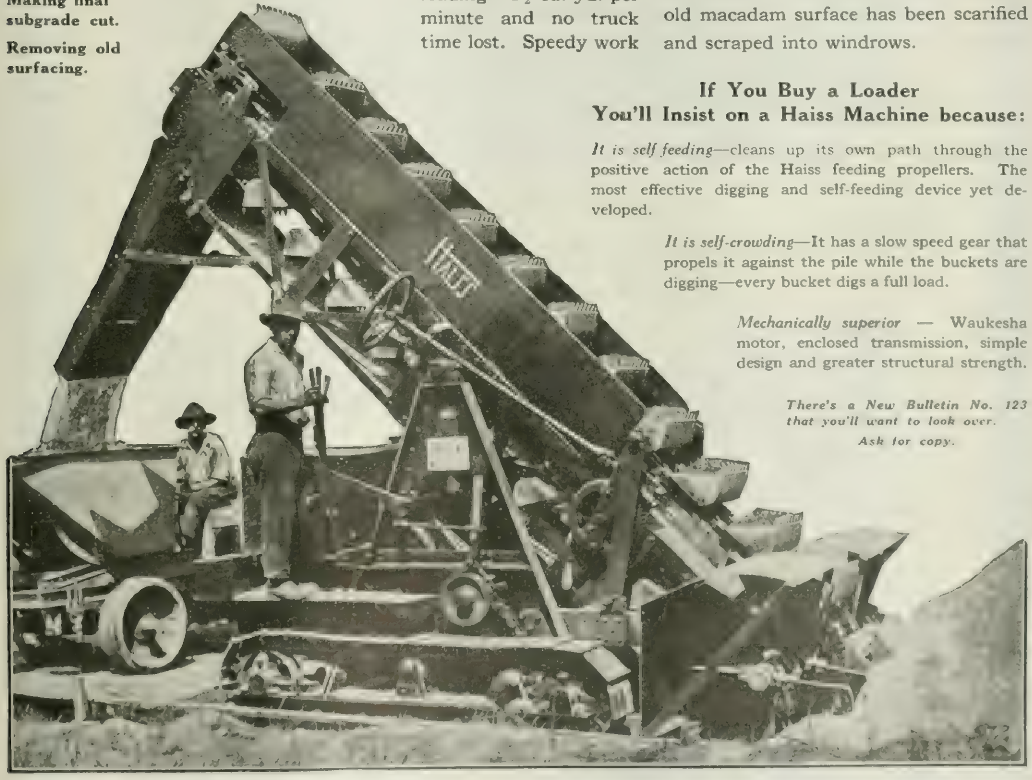
If You Buy a Loader You'll Insist on a Haiss Machine because:

It is self feeding—cleans up its own path through the positive action of the Haiss feeding propellers. The most effective digging and self-feeding device yet developed.

It is self-crowding—It has a slow speed gear that propels it against the pile while the buckets are digging—every bucket digs a full load.

Mechanically superior — Waukesha motor, enclosed transmission, simple design and greater structural strength.

There's a New Bulletin No. 123 that you'll want to look over. Ask for copy.

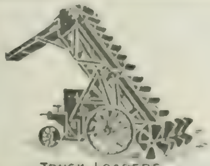


The Geo. Haiss Mfg. Company, Inc., 140th St. and Rider Ave., New York

Established 1892

Representatives throughout the world

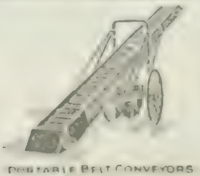
[illegible]

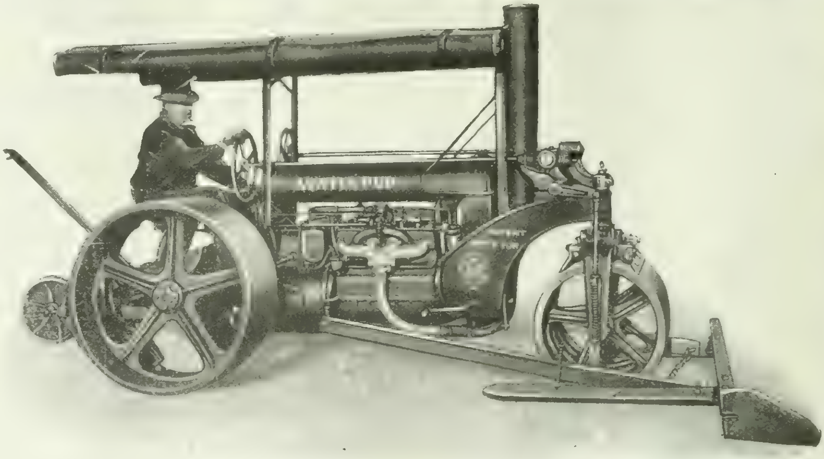


HAISS

MATERIALS HANDLING EQUIPMENT

CLAM SHELL BUCKETS





The Pup Complete with Maintainer and Scarifier

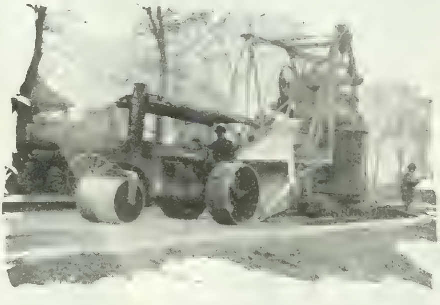
The Austin Pup

Weight: 3, 3½ or 4 tons

THE AUSTIN PUP is the undoubted sensation of the road building and maintenance fields. Exhibited for the first time at the Chicago Good Roads Show in January, where it attracted far more than its proportionate share of attention, it has already become one of the most popular tools with contractors and public officials of all classes from State to Township and City to Village. The reason for such universal popularity is not hard to discover; the Pup adapts itself perfectly to a surprisingly wide range of work and clearly surpasses older methods in every instance, as is shown by the following excerpts from a few of the letters we have received from enthusiastic users.

C. M. Upham, State Highway Engineer of North Carolina, writes that "The Austin Pup Roller that we are utilizing in our experimental work is giving exceptionally good results. We are also using the Pup Roller in rolling surface stone on bituminous macadam maintenance. We find that this machine is very handy in working out many of these details."

From Ritchie & Ramsey, Topeka, Kansas, Contractors, we learn that "The Pup has more than lived up to our fondest expectations. Frank Bills, who has always been our roller man, and who has operated about every piece of machinery that a street or road contractor could possibly use, states that the Pup, from a standpoint of economy in operation, simplicity of design and diversity of uses to which it can be put, exceeds every piece of contractor's machinery he has ever seen."



Rolling Subgrade

PRICE AND SERVICE are two of the Pup's most attractive features. By utilizing the Fordson tractor to furnish the motive power, we have taken advantage of Ford's costs which are below anything known in the world because he builds his goods by the hundreds of thousands; and the first cost of the Pup is, therefore, considerably below what it would be if we were to build it complete. An arrangement has also been made whereby the Ford Motor Company, of Detroit, pays the local Ford dealer, in the territory where the Pup is delivered, a commission on the Fordson part of the outfit, so the Pup owner receives dealer service and prompt deliveries of Fordson parts from the Ford dealer in addition to the service maintained by our numerous warehouses and service stations.

Planing a Rough Mountain Road

Roller and Road Maintainer

Furnished With or Without Maintainer and Scarifier Attachments

WEST VIRGINIA adds this testimony: "The pictures are of the Pup working on one of the hardest propositions I think I ever saw in West Virginia. The ruts on the road were anywhere from one foot to eighteen inches in depth, but the little Pup waded right in and sure did plane the road down. One of the tax-payers passing by while the machine was working remarked that it was worth more than any other road machine he ever saw on any work; that all the work that they had done with the road grader this year was wasted money. Made four trips over a little more than a mile of road and reclaimed it from practically an impassable piece of road to one over which autos could drive with comfort, with about six hours work."

F. E. Ross, City Engineer of Jefferson, Mo., says that "The Pup has been in use almost every working day since we received it and is giving the best of satisfaction.

"It has abundance of power. We have used it on grades as high as 12 per cent and have never had to use low gear. We took the roller to the city park to roll the golf links. On the way to the park it had to climb a 20 per cent grade on a gravel road. As the grade was so steep that the roller would spin its wheels, we put a few lugs on each wheel, put the machine in high gear and went over the top.

"Before buying the roller we had all patches tamped. The tamping was the most expensive part of the repair work, wore the men out and took about three-fourths of their time. Since we received the roller, the same crew is doing about four times as much work as before, is doing 100 per cent better work, and at a saving sufficient to more than pay for the roller this season."

A special circular tells the [illegible] of the Pup Roller and Road Maintainer, and its [illegible].
Write for a copy today.

The Austin-Western Road Machinery Co.

Factories
and
Home Office
Chicago

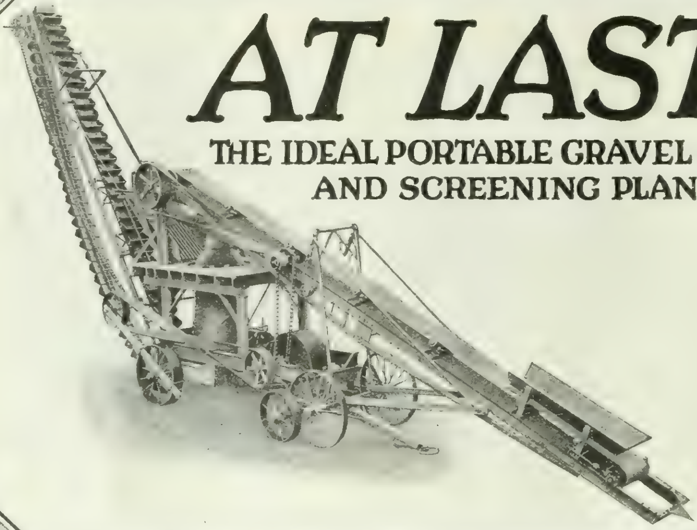
THE AUSTIN-WESTERN LINE
IT SERVES YOU RIGHT

Warehouses
and
Service Stations
in all
Principal Cities

On Patchwork

AT LAST!

THE IDEAL PORTABLE GRAVEL CRUSHING AND SCREENING PLANT



GRAVEL is brought from the pit in wagons, drags or fresnos, and dumped through a trap directly upon the conveyor, which in turn deposits the material upon a grizzly screen. The undersized material drops through the bars of the grizzly upon a chute leading directly to the elevator, while the oversize rolls down the bars into the crusher.

Nos. 2, 3 and 4 Austin Gyratory Crushers can be mounted on trucks and furnished with rigid or folding elevators of the required lengths, and gravel conveyors ranging in length from 30 feet to 50 feet. Optional equipment includes a revolving screen mounted on a portable bin.

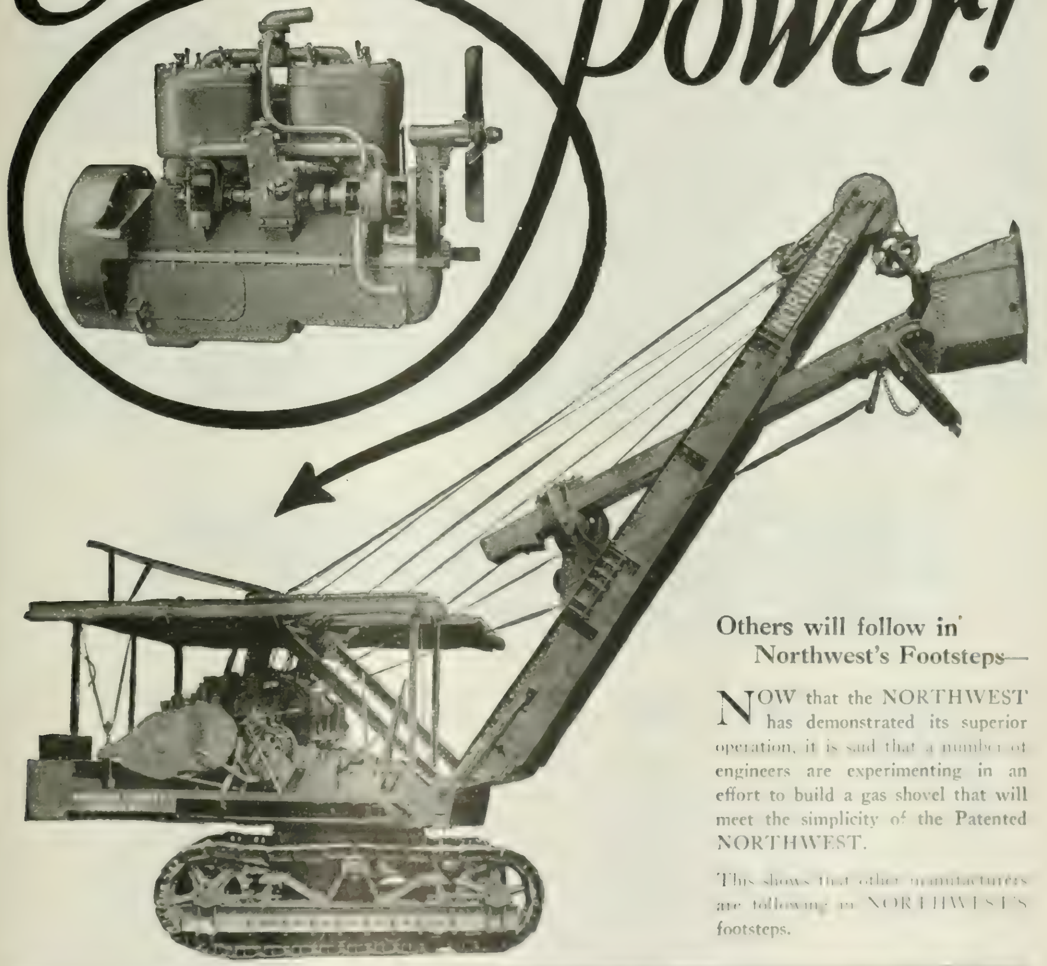
While moving from place to place, the elevator folds down over the crusher; the conveyor is disconnected from the crusher, and its lower end attached to a truck or wagon.

(*A special bulletin describing these portable plants in detail is just off the press. We would like to send you a copy. Ask for Portable Gyratory Crusher Bulletin "H"*)

AUSTIN MANUFACTURING CO.

New York · CHICAGO · San Francisco

Gasoline Power!



Others will follow in Northwest's Footsteps—

NOW that the NORTHWEST has demonstrated its superior operation, it is said that a number of engineers are experimenting in an effort to build a gas shovel that will meet the simplicity of the Patented NORTHWEST.

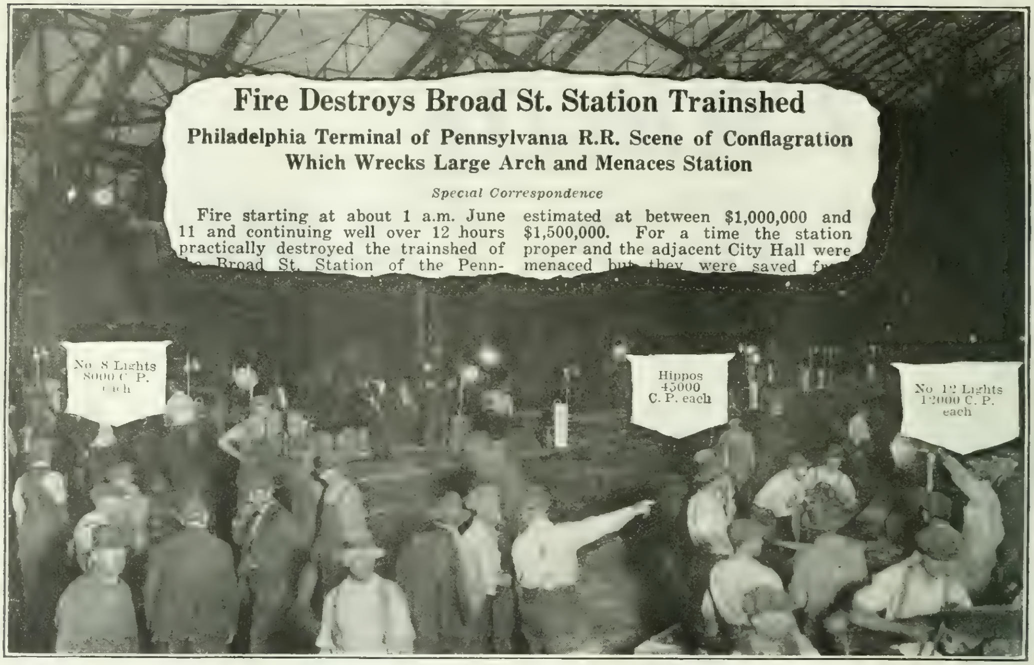
This shows that other manufacturers are following in NORTHWEST'S footsteps.

NORTHWEST ENGINEERING CO.
1227 Steger Building, CHICAGO

NORTHWEST

CRANE
DRAGLINE
SHOVEL

Gas or Electric



Fire Destroys Broad St. Station Trainshed

Philadelphia Terminal of Pennsylvania R.R. Scene of Conflagration Which Wrecks Large Arch and Menaces Station

Special Correspondence

Fire starting at about 1 a.m. June 11 and continuing well over 12 hours practically destroyed the trainshed of Broad St. Station of the Penn-

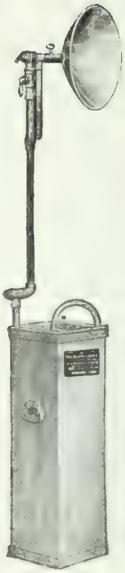
estimated at between $1,000,000 and $1,500,000. For a time the station proper and the adjacent City Hall were menaced but they were saved

THE MILBURN LIGHT

On the job in Philadelphia!

The ruins of the Broad Street Station trainshed had not quit smoking before numbers of Milburn Lights were on the job with the clean-up gang! Fifty Milburn lights were ordered at 2 p. m. (afternoon of the fire) and were on the job *that night*. Note the *batteries* of Milburns in the photo above. New platform construction work was begun at once—and the Milburn Lights helped to speed up the work. Here is another and striking instance of the dependability, quick-set up and efficiency of Milburn Lights—they are the lights to call upon in everyday work or in the big emergency. Operate on any kind of Carbide.

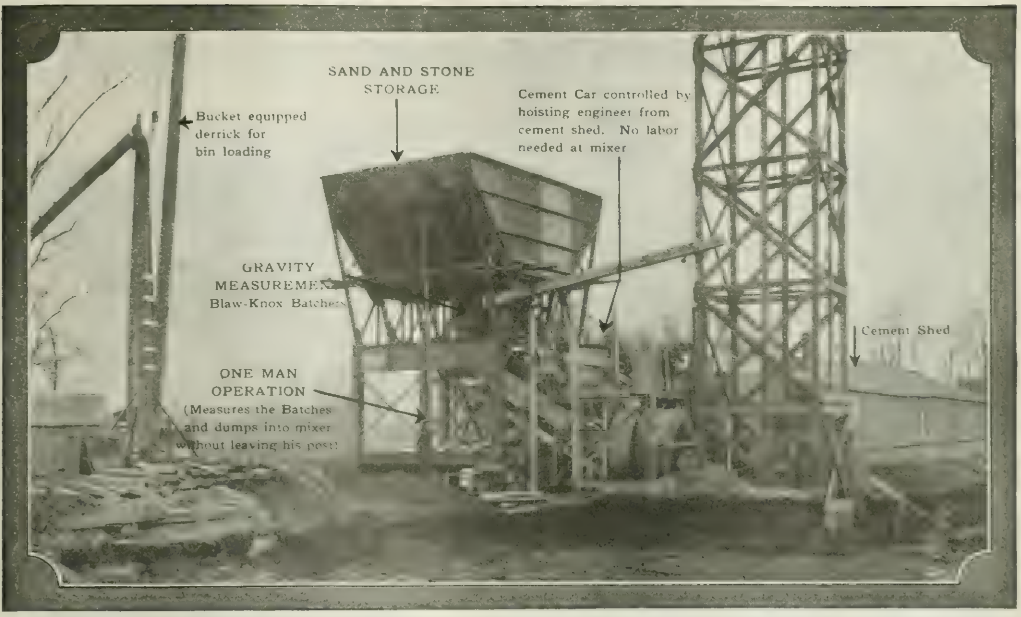
Send for Circular 21, or order a light on trial.
Warehoused everywhere



No. 8, over 8,000 candlepower. Burns 12 hours on 8 lb. of carbide. Costs 3c per hour

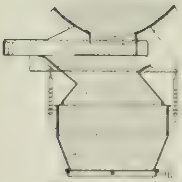
P. S.—The "Milburn Combination CUT-WELD Torch" is also being used on the job of dismantling the twisted steel frame-work.

The Alexander Milburn Company
1416-1428 W. Baltimore St.
Baltimore, Md.


SAND AND STONE STORAGE
Bucket equipped derrick for bin loading
Cement Car controlled by hoisting engineer from cement shed. No labor needed at mixer
GRAVITY MEASUREMENT Blaw-Knox Batchers
ONE MAN OPERATION (Measures the Batches and dumps into mixer without leaving his post)
Cement Shed

The Same Good Quality *of* Concrete

from Foundation to Roof



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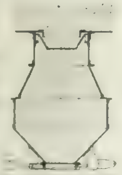

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Uniform concrete—every batch exactly alike—automatically proportioned *to the cubic inch* by a BATCHERPLANT.

Labor-saving—*one man* strikes off and dumps accurately measured batches of sand and stone as fast as the mixer can handle them.

As the foundation for a central mixing and distributing system the all-steel BATCHERPLANT costs less to install; costs less to operate; is more accurate—and will speed up the pouring of your concrete to a far greater extent than any other device for storing and measuring. The BATCHERPLANT has 100% salvage value, and can be used on job after job.

Tell us about *your* job—we'll help you lay out your mixing and distributing system.

Blaw-Knox Road Building Equipment
Road Forms
Universal Forms
Truck Turntables
Batcherplants
Handy Houses
Clamshell Buckets
Cement Handling and Loading System

BLAW-KNOX COMPANY
601 Farmer's Bank Bldg., Pittsburgh, Pa.
New York Baltimore Birmingham Chicago Detroit
London, Eng

BLAW-KNOX Batcherplant

Conveyors like this, built with rugged Rex Chain, are aiding in the production of Buick, Dodge Brothers, Ford, Nash, Paige, Studebaker and many other motor cars

Doing more work with less effort

Though facing a *decreasing* supply of labor the industries of this country now are being called on to satisfy an *increasing* demand for their products. Forced to make more units with fewer human hands, thousands of plants are meeting the issue through a broader use of labor-conserving methods and equipment. Conveyors built with Rex Chain are playing an important part in this new order of the day. Saving time and effort in the moving of materials from operation to operation, they are releasing labor for those tasks which must be done by hand, and are insuring larger outputs at lower cost. Probably there are places in your plant where Rex Chain, in conveyors or drives, can effect vital economies. Our engineers can show you how.

This powerful and long-lasting Rex Chabelco Steel Chain is delivering equal satisfaction in conveying materials and in driving rolls, drums, oil-well drills, screens, construction machinery and other equipment

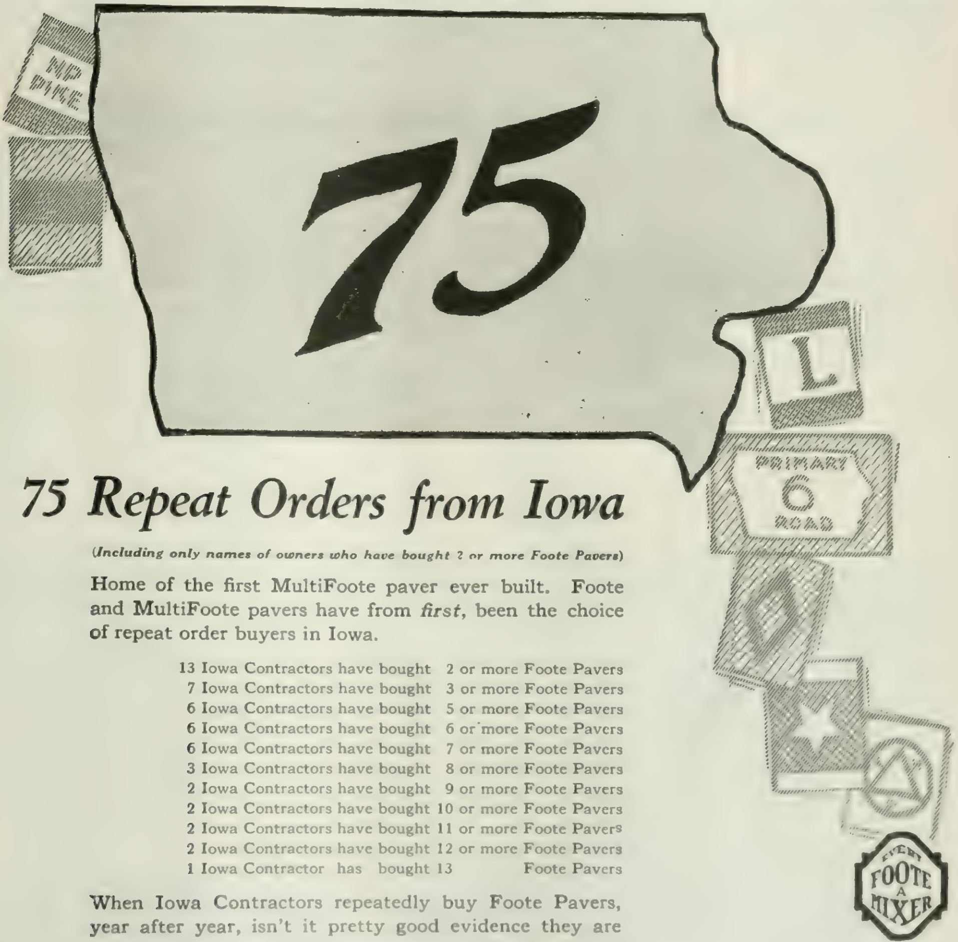
CHAIN BELT COMPANY, MILWAUKEE

Branch Offices and Representatives in Principal Cities in the United States and Abroad

Rex Sprockets, Rex Conveyors, Rex Concrete Mixers and Pavers, Rex Traveling Water Screens

Iowa—A Repeat Order State

No. 6 of a series of 10 Repeat Order States



75 Repeat Orders from Iowa

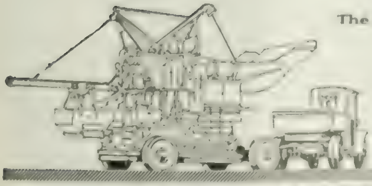
(Including only names of owners who have bought 2 or more Foote Pavers)

Home of the first MultiFoote paver ever built. Foote and MultiFoote pavers have from *first*, been the choice of repeat order buyers in Iowa.

13 Iowa Contractors have bought 2 or more Foote Pavers
7 Iowa Contractors have bought 3 or more Foote Pavers
6 Iowa Contractors have bought 5 or more Foote Pavers
6 Iowa Contractors have bought 6 or more Foote Pavers
6 Iowa Contractors have bought 7 or more Foote Pavers
3 Iowa Contractors have bought 8 or more Foote Pavers
2 Iowa Contractors have bought 9 or more Foote Pavers
2 Iowa Contractors have bought 10 or more Foote Pavers
2 Iowa Contractors have bought 11 or more Foote Pavers
2 Iowa Contractors have bought 12 or more Foote Pavers
1 Iowa Contractor has bought 13 Foote Pavers

When Iowa Contractors repeatedly buy Foote Pavers, year after year, isn't it pretty good evidence they are satisfied that Foote performance cannot be duplicated by any other paving mixer on the market?

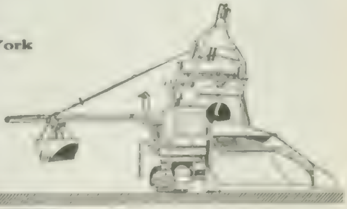
Just Steady Footage—day in and day out—season after season—on job after job—that's why *more than 65% of all our sales are repeat orders.*



The Foote Company, Inc., Nunda, New York

[illegible]

[illegible] **on the job.** [illegible] **Foote Transport Trailer** [illegible] **to the job.** [illegible]



Quicker to the Job ROAD **MULTI FOOTE** PAVER ***Faster on the Job***

TRADE MARK REGISTERED

KOEHRING

Easy Flowing Concrete

EASY flowing, easy spouting concrete begins with the mixing action. The plasticity that means easy flowing without excess of water depends on the thorough coating of every fragment of stone and grain of sand with cement. Then cement acts as a lubricant — the concrete is plastic, easy flowing, easy to work — a real factor in lower costs.

The Koehring re-mixing action prevents segregation of aggregate according to size — sends every grain of sand and cement, every fragment of stone through the mixing process for re-mixing. The result is perfect uniformity of concrete from the first to last shovelful of every batch, and a plastic, free flowing concrete that spouts and "works" to great advantage.

This, together with the Koehring *"Heavy Duty"* construction which means long, trouble-free service life, gives the Koehring owner an extra profit margin on every season's work.

Write for Catalog C 8

KOEHRING COMPANY
Manufacturers of concrete mixers, cranes, draglines, shovels
MILWAUKEE, WIS.

Sales offices and service warehouses in all principal cities.

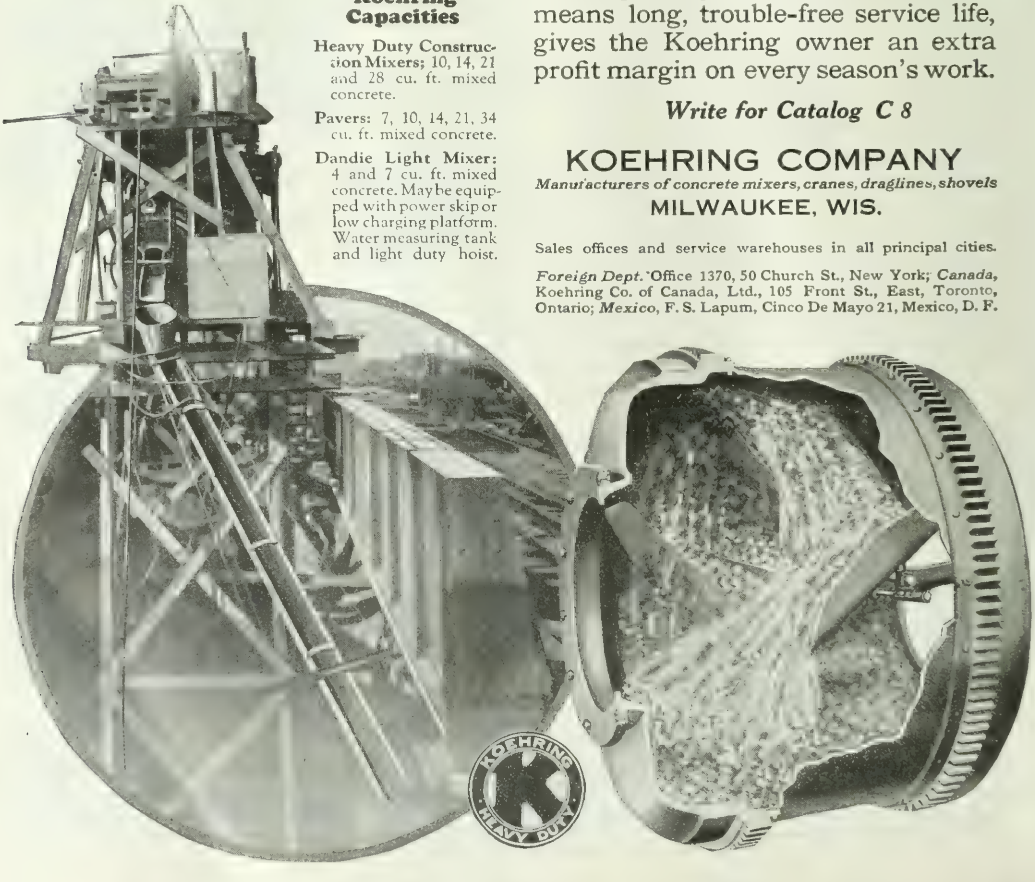
Foreign Dept. Office 1370, 50 Church St., New York; *Canada*, Koehring Co. of Canada, Ltd., 105 Front St., East, Toronto, Ontario; *Mexico*, F. S. Lapum, Cinco De Mayo 21, Mexico, D. F.

Koehring Capacities

Heavy Duty Construction Mixers; 10, 14, 21 and 28 cu. ft. mixed concrete.

Pavers: 7, 10, 14, 21, 34 cu. ft. mixed concrete.

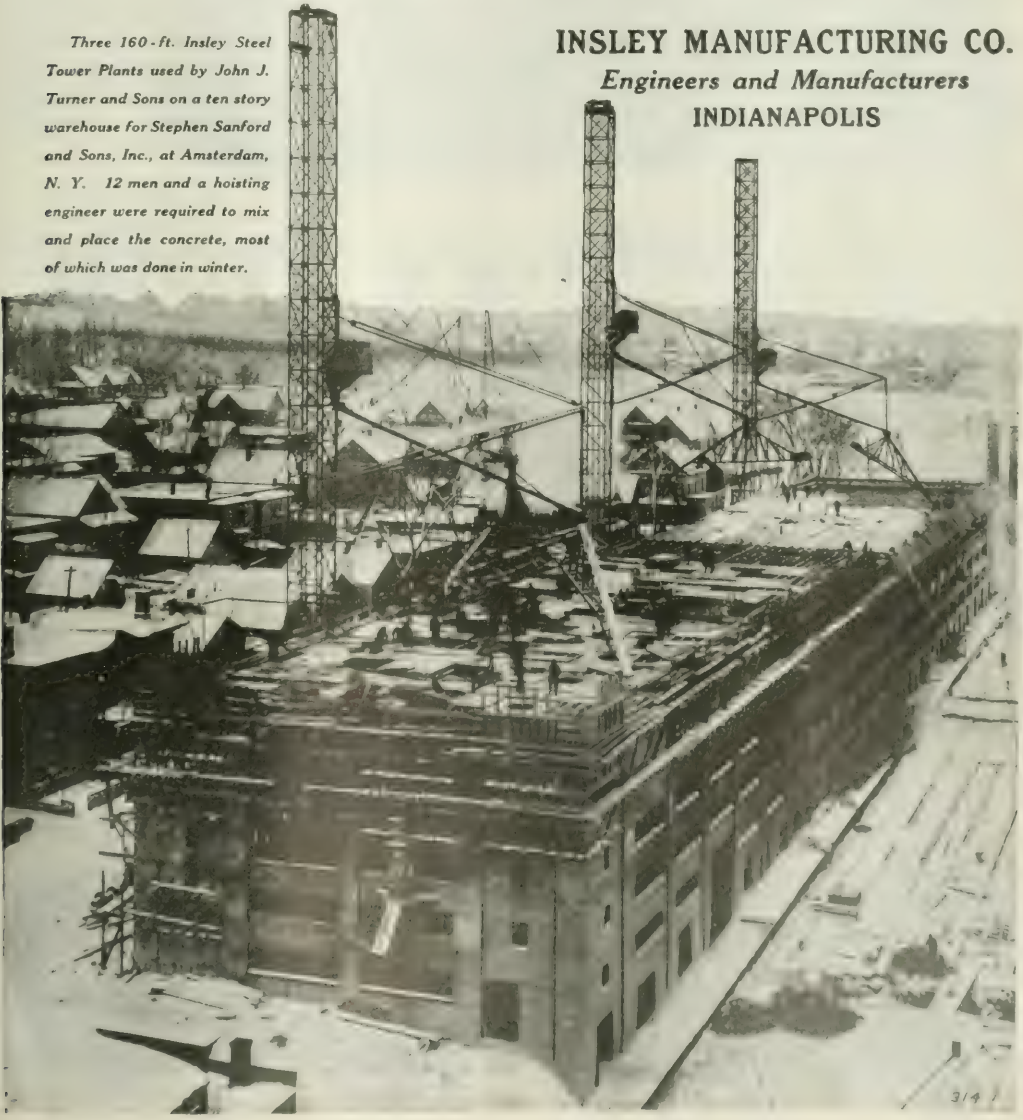
Dandie Light Mixer: 4 and 7 cu. ft. mixed concrete. May be equipped with power skip or low charging platform. Water measuring tank and light duty hoist.



Insley Concrete Placing Equipment

"We are confident that the Insley design of Boom and Counterweight Chutes, and Sliding Frame, is the best that can be had," is the opinion of John J. Turner and Sons of Amsterdam, N. Y. "Stoppages for shifting chutes are entirely done away with."

There are large numbers of contractors who have had similar experiences with INSLEY CONCRETE PLACING EQUIPMENT, whether it be on a 13,000 cu. yd. job as is shown by this illustration, using a multiple tower plant, or a small job of a few hundred yards requiring a MAST HOIST PLANT. Let us show you how the special features of Insley design save you money.



Three 160-ft. Insley Steel Tower Plants used by John J. Turner and Sons on a ten story warehouse for Stephen Sanford and Sons, Inc., at Amsterdam, N. Y. 12 men and a hoisting engineer were required to mix and place the concrete, most of which was done in winter.

INSLEY MANUFACTURING CO.
Engineers and Manufacturers
INDIANAPOLIS

"Save the surface and you save all Paint & Varnish"

More Profit *with* DU-LITE

The White That's Always White

R

Copyright 1923 by
E. I. du Pont de Nemours
and Company

Du Pont Prescription Paint Service covers every requirement of the construction industry. There is a du Pont Paint or Varnish for every type of surface.

- Bridges
- Buildings
- Structural Steel of every description
- Railroad Structures
- Warehouses
- Standpipes
- Tanks and Towers
- Steel Stacks
- Storage Bins
- Hoppers, Etc.

Write us describing your requirements

1793 · BORN WITH THE REPUBLIC · 1802
DU PONT
PAINTS AND VARNISHES

No need to tell you that the acceptance of any construction job depends to a large extent on the finished appearance. It is particularly important that the interior be finished to give maximum light reflection — thus insuring to your client more profits through increased production.

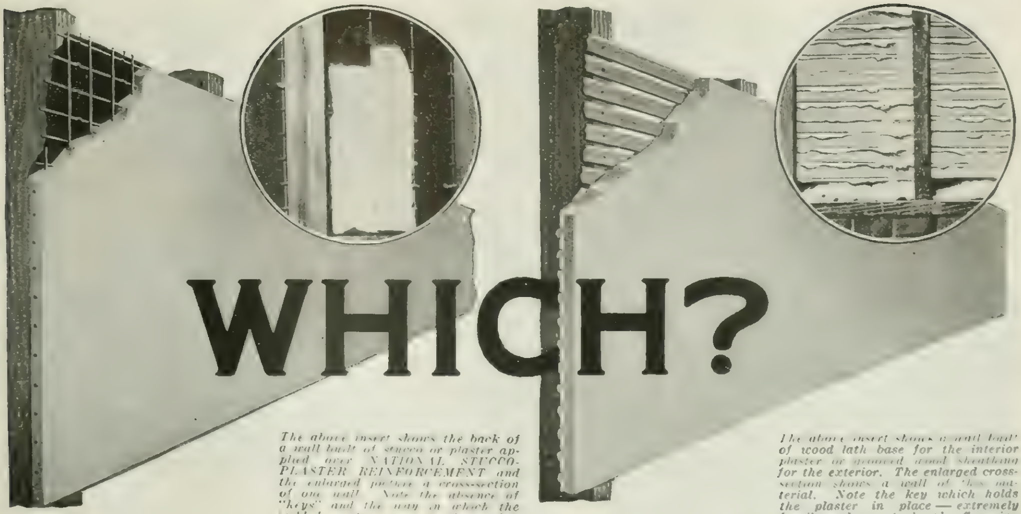
Realizing this, du Pont Chemical Engineers, in their problem of providing paints for the construction industry, have developed an interior white paint that

Sets a New Standard in Quality

With this Improved Du-Lite you can fully satisfy your client from the standpoint of light-reflection, and its use will mean more profits to you through its greater covering power, and easier working properties.

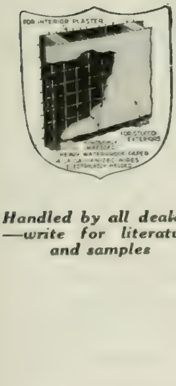
Engineers, contractors and plant superintendents may obtain free a copy of "Principles and Practices of Upkeep Painting"—a practical handbook covering every painting problem—on receipt of signed request on their business stationery. To others the price is $2.00 per copy. Write Dept. B.

E. I. du Pont de Nemours & Co., Inc.
35th St. and Gray's Ferry Road
PHILADELPHIA, PA.
Chicago Varnish Works, 2100 Elston Ave., Chicago, Ill.
Everett Station, No. 49, Boston, Mass.



The above insert shows the back of a wall built of stucco or plaster applied over NATIONAL STUCCO-PLASTER REINFORCEMENT and the enlarged picture a cross-section of one wall. Note the absence of "keys" and the way in which the welded reinforcement is thoroughly embedded in the plaster and stucco; thus assuring a reinforced job.

The above insert shows a wall built of wood lath base for the interior plaster or grooved wood sheathing for the exterior. The enlarged cross-section shows a wall of this material. Note the key which holds the plaster in place — extremely fragile and easy to break off, owing to the expansion and contraction of the wood bases.



Handled by all dealers —write for literature and samples

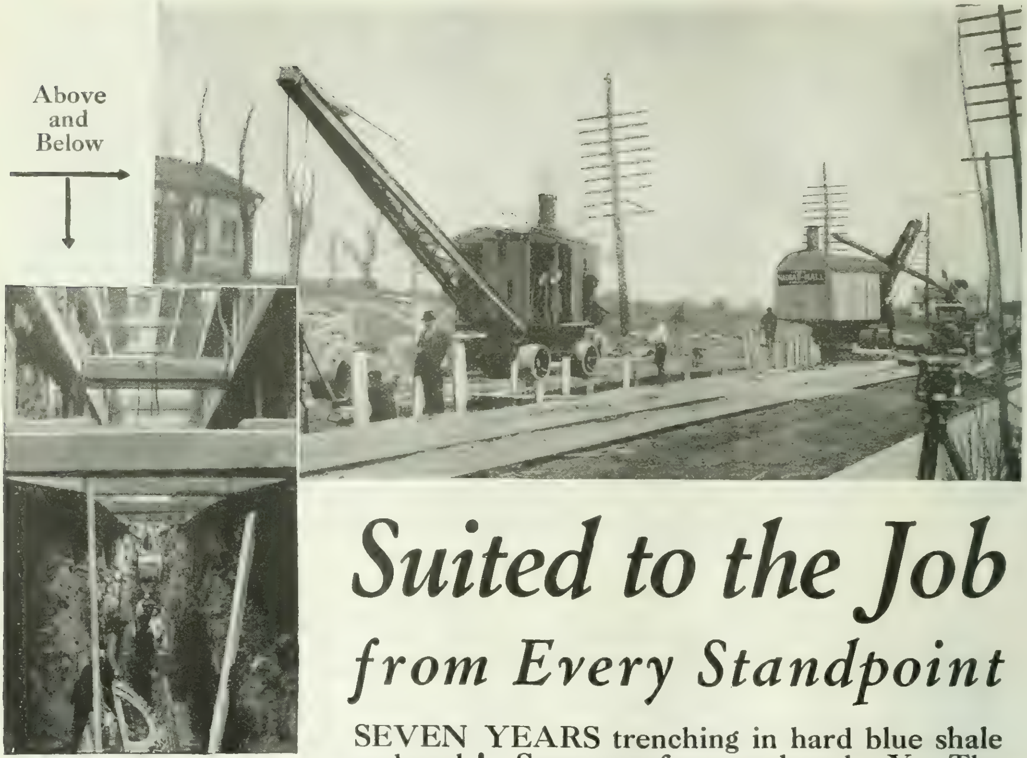
Which would you rather have—exterior walls reinforced with NATIONAL STUCCO-PLASTER REINFORCEMENT (galvanized) at the same or less cost with the assurance of permanency . . . . interior walls, partitions and ceilings, reinforced with NATIONAL STUCCO-PLASTER REINFORCEMENT (galvanized) at a slight increase over the cost of wood lath, thereby insuring the plaster against cracks and lath marks, and making it possible to put decorations on the walls and ceilings without fear of discoloration. . . . . or—those types of lath which have been commonly used and resulted in the cracking and falling off of the stucco and plaster, due to expansion and contraction and breaking off of the "keys."

Again we ask "WHICH?"

When you build, insist on having NATIONAL STUCCO-PLASTER REINFORCEMENT

National Steel Fabric Company
(Subsidiary of Pittsburgh Steel Company)
700 Union Arcade Pittsburgh, Pa.

NATIONAL STEEL FABRIC CO
Subsidiary of PITTSBURGH STEEL CO
UNION ARCADE BUILDING PITTSBURGH, U.S.A.



Suited to the Job

from Every Standpoint

The A-1 Thew

"Our first Thew shovel, a Type A-1, was purchased in 1915. We have used it solely for trench excavation, mostly hard blue shale and rock. This machine has gone through some real hard work and has stood up splendidly. We are pleased with both machines and feel that they have given us full satisfaction. Your service has been first class.

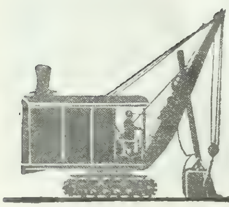
THE HADDAD-MALL CO.
931 Schofield Building
Cleveland, Ohio

SEVEN YEARS trenching in hard blue shale and rock! Some test for any shovel. Yet The Haddad-Mall Company have recently made it "another Thew" because they know they can depend on it.

This job is representative of what they expect from their shovels. Two and one-half miles of trench averaging 23 feet deep; 50 to 75 feet completed each day. "Completed" means digging, laying two sewer lines and filling.

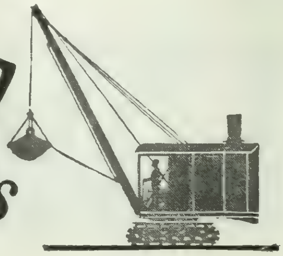
Shovels that will do this are worth getting acquainted with. Write for Bulletin 113 and find out some more facts about the Type A-1 Thew.

THE THEW SHOVEL CO., LORAIN, O.

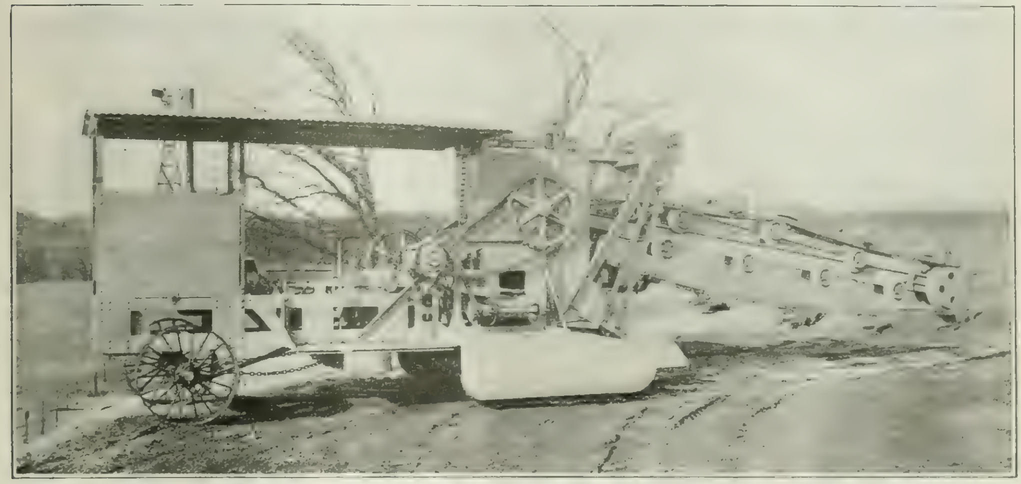


Thew

Power Shovels



PARSONS



WE don't know who built the first trench excavator—it may have been King Tut—but we do know who builds the *best* one on the market today—it's called the

PARSONS MODEL 30

It cuts 12 feet deep and 30 inches wide and for work of this size the new Model 30 is the sturdiest, fastest, longest lived, easiest operated, most mabile and best paying machine ever built. That's a fact.

Think about these points—direct drive—12 foot wheel base—Parsons quality heat treated electric steel castings —overlapping steel treads on Parco Traction—traction drive through sliding and worn gears—patented endless chain crowding device—45 H.P. heavy duty engine—main reverse and worm gears in oil tight housings.

Wire us or write for a representative to call.

THE PARSONS COMPANY
NEWTON, IOWA, U. S. A.

Kansas City, 1737 Walnut St. New York, 115 Centre St. Chicago 11 S. La Salle St.
Louisville [illegible]
Seattle Baltimore [illegible]

MUSSENS LIMITED, SOLE DISTRIBUTORS IN CANADA
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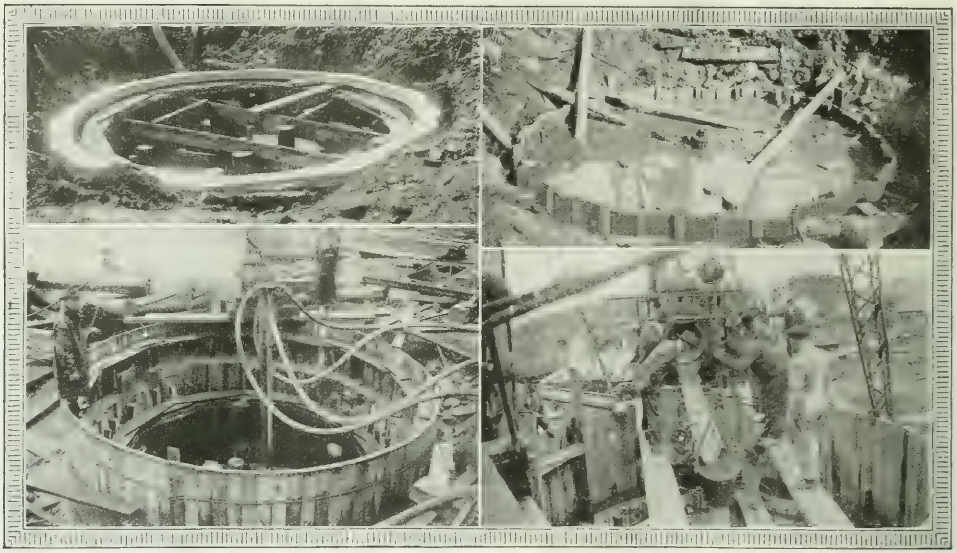
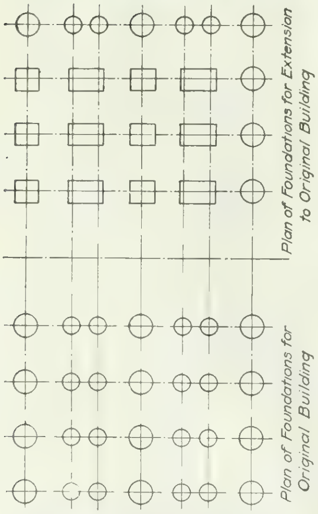


Top—Bottom template for foundation cylinder in place; piling after driving, showing center pile for locating driving mast
Bottom—Driven cylinder with top wooden form and concrete ring brace in position, also sand ejector in operation; filling cylinder with concrete

Installing the


Plan of Foundations for Extension to Original Building
Plan of Foundations for Original Building

Plan of foundations of Plant of Philadelphia Electric Company, showing extent of recent addition

for Delaware Station Philadelphia Electric

The Delaware Station Power House of the Philadelphia Electric Company is located on low-lying, wet land, previously used as a shipyard.

The first installation consisted of twenty-eight piers, each approximately 14 feet in diameter, and constructed within permanent cylindrical open caissons. Each caisson was composed of 42 pieces of Lackawanna $12\frac{3}{4}$in. x $\frac{3}{8}$in. straight-web section in 32-foot lengths.

The steel sheet piling was assembled by means of cable way around two templates, one at ground level, the second at a height above ground of two-thirds the length of the steel, thus insuring accurate size of cylinder and plumbness of steel. After setting and closing the cylinder, the piling sections were driven short distances in succession down to bed rock, that is the piling was entirely driven before excavation was started.

In this way the piling of the cylinders was driven quickly and without interruption. Likewise the excavation of the material proceeded rapidly and without interruption, and the whole foundation job was accomplished with very satisfactory economy.

BETHLEHEM

Five cylinders being driven at once. Note the plumbness of the Lackawanna Steel Sheet Piling
John T. Windram, Architect; Stone and Webster, Builders, The Philadelphia Electric Co., Engineers

foundation piers

Power House of the Company—

One of the circular caissons showing six sets of bracing rings in position. Bottom at elevation about −45

When an addition to the Delaware Station was started in 1922, the general method that had proved so successful for the first foundations was adopted for the additional foundations. Open caissons, excavated in the dry and braced with circular steel rings, were used, with Lackawanna Piling in 40 and 45-foot lengths.

Economy and efficiency is obtained in foundation, pier, bulkhead and similar work by the use of Lackawanna Piling. Our piling engineer's experience covers hundreds of jobs, and they are ready to help on your piling problems.

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A "Jackhamer" is the rock drill for all-around work. No contractor's equipment is complete without, at least, one of these machines.

One man can operate and work the "Jackhamer." He can run the drill wherever he can get a foot hold, and drill holes at any angle. The "Jackhamer" rotates its drill steel and cleans the hole of the cuttings.

For road construction—grading, quarrying ditching, trench digging—or for building excavation, tunnelling, block hole work, etc., use the "Jackhamer."

And, for furnishing air to your "Jackhamer" Drills use an I-R Portable Compressor—a compact, complete, easily moved air compressor plant on wheels, built primarily for the contractor.

Bulletin 4046 contains a detail description of the construction of the "Jackhamer" and of the work which it can do. Send for a copy now.

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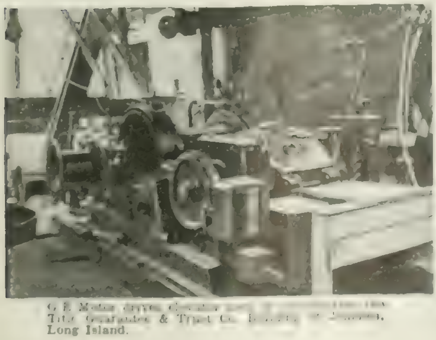
G-E Motors drive air compressors used in excavating for the Equitable Society Building, New York City.

G-E Motor drives hoist used in erecting the Home Insurance Building, New York City.



G-E Motor drives [illegible] Title Guarantee & Trust Co. [illegible], Long Island.

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RESEARCH TESTS DESIGN EQUIPMENT

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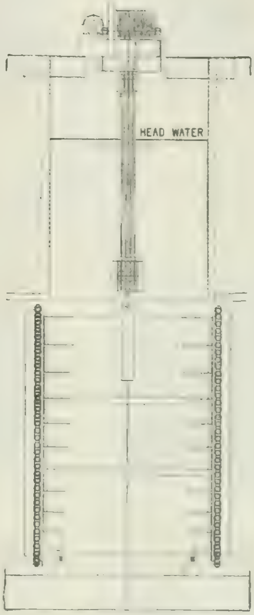
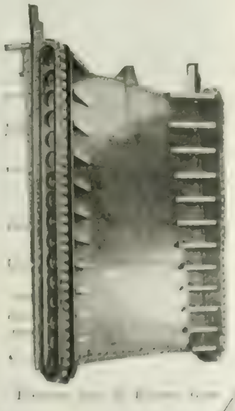
are seated by the action of gravity and the water pressure behind them, *the seat being inclined to the movement of the gate.* Adjustment screws at the lower end of the gate eliminate all sliding friction.

They have given years of efficient service. They are in operation in the United States and Canada, and many additional installations are being made throughout the country.

They are adaptable for penstocks, locks, flash-boards, flood control or any situation where sliding gates are used.





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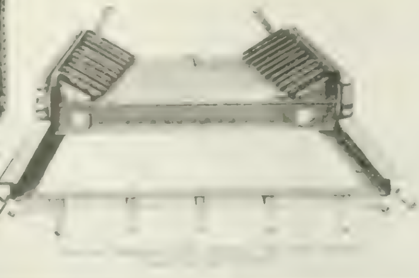

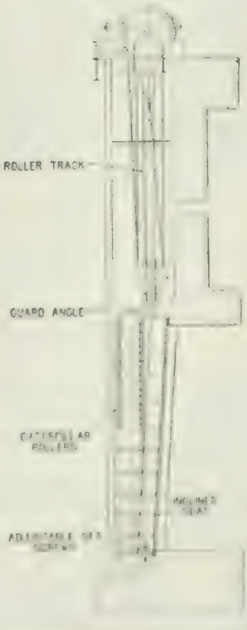

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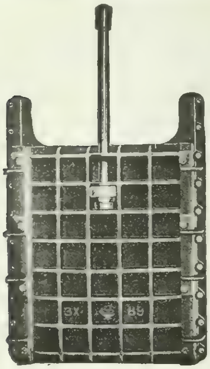
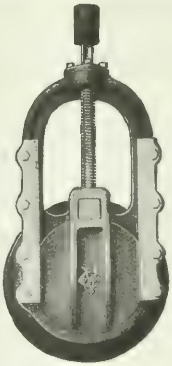
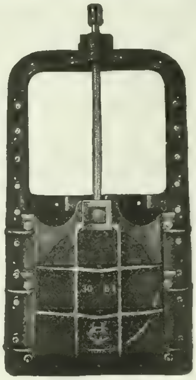
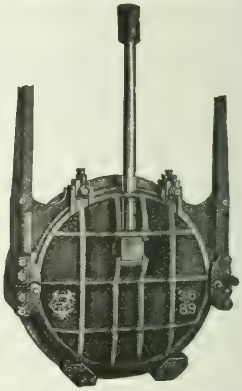




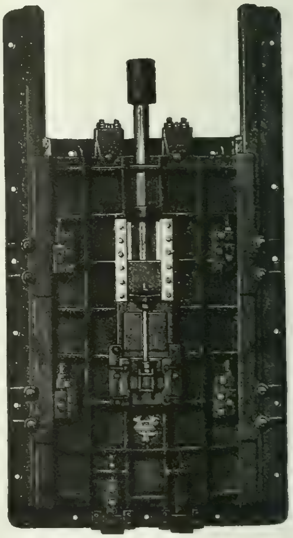




A few of our many Standard designs

Each one of these Sluice Gates has been carefully designed and built in every detail of metal and construction, for its particular purpose. Standard patterns and advanced method keep production costs at minimum.

Our experience in this field covers the production of Waste Gates, Controlling Gates, Inlet and Outlet Gates, Distributing Gates, etc., etc. These cuts illustrate a few of our many standard designs.



The Chapman Catalog

We have issued a catalog of more than 300 pages that is practically a "textbook" on the latest Sluice Gate Practice and all related mechanism. We will be glad to forward you a copy with our compliments, upon request.

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VALVES

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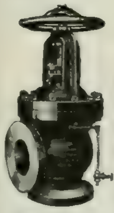
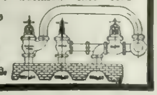
Pat. Automatic Double Cushioned Triple Acting Non-Return Valves



Angle Globe or Elbow Pattern

1. Prevent shut-downs due to reversal of steam flow.
2. Instantly close and isolate a boiler when a tube bursts.
3. Cut off steam flow from every boiler instantly when a steam pipe ruptures.
4. Automatically cut a boiler into line.
5. Prevent backflow into cold boiler
6. The only valves that can be tested in service.



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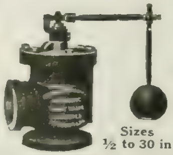
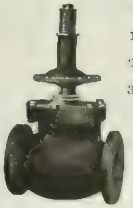
1. Automatically Maintain Uniform Water Levels in Tanks, Standpipes, etc.
2. Instantly Adjusted to Operate Quickly or Slowly.
3. Floats Swivel to any Angle—Most Satisfactory Float Valves Known.
4. No Metal-to-Metal Seats — No Water, Hammer or Shock
5. Cushioned by Water and Air.



Sizes ½ to 30 in.

GOLDEN-ANDERSON
Pat. Cushioned Water Relief Valves

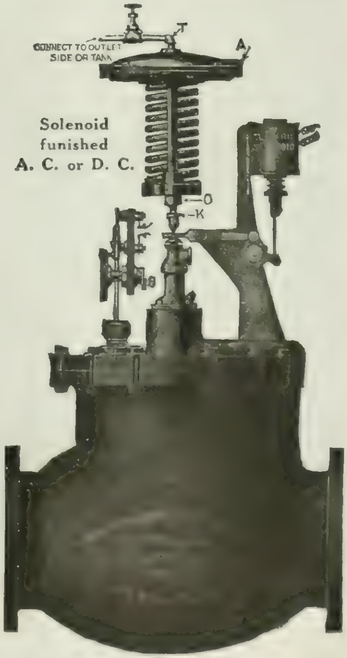


1. Automatically relieve excess pressure.
2. Prevent stress, strain and bursting of mains.
3. Correct mechanical construction.
4. Perfect air and water, cushioning.
5. No metal-to-metal seats. No hammering or shocks.
6. Angle and globe pattern. Sizes 3 to 30 in

"No Metal-to-Metal Seats"

Pumps Motor-driven? Use Golden-Anderson

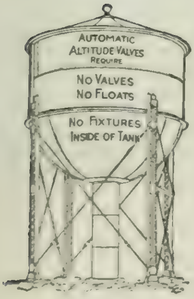
Patented Automatic Cushioned "Stop-Starter Electric" Controlling Altitude Valves



Solenoid funished A. C. or D. C.

Sizes to 30 in.

These valves will "cut in" or "cut out" one or more driven pumps. Actuated by the fall or rise of water level in stand-pipes, tanks or reservoirs. Control pumps automatically from distant points if desired. By maintaining a constant water level, they stop water waste due to overflow, and also all unnecessary pumping. For high or low pressure. Air and water cushioned. No floats or fixtures. No water hammer or shock. No metal to metal seats. Solenoid furnished for alternating or direct current. Especially adapted for railroads, water works and industrial plants.



"No Floats or Fixtures"
"No Water Hammer or Shock"

Golden-Anderson Valve Specialty Co., 1202 Fulton Bldg., Pittsburgh, Pa.

Absolute Guarantee

GOLDEN-ANDERSON
Pat. Cushioned Electric Water Service Valves

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2. Open or close by electricity from [illegible] [illegible] or [illegible]. Also close by hand
3. No waste of electricity. Current is on only few seconds
4. Cushioned in opening and closing.
5. No water hammer shock [illegible] or chattering

"Hosts of References"

GOLDEN-ANDERSON
Pat. Automatic Cushioned Water Pressure Regulating Valves

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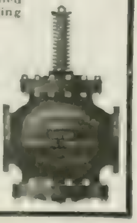
2. [illegible]
3. [illegible]



GOLDEN-ANDERSON
Pat. Automatic Double Cushioned Check Valves

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2. For High or Low Pressure.
3. [illegible]
4. [illegible]
5. [illegible]

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Makers of the Largest Sluice and Gate Valves in America

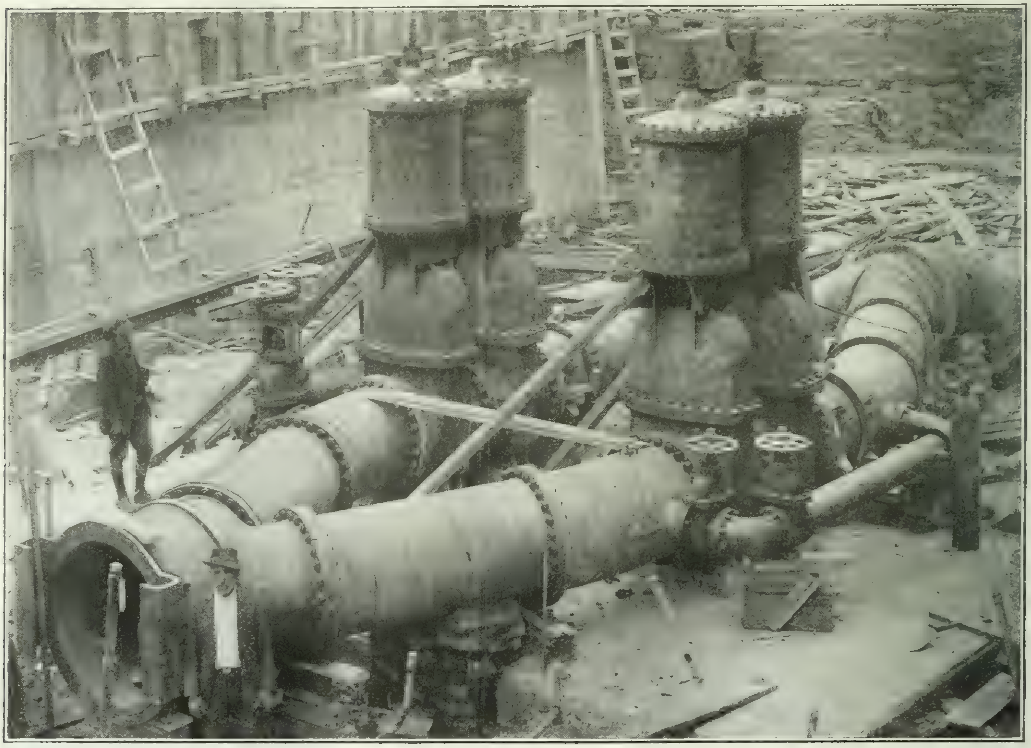

Photo Courtesy N. Y. Board of Water Supply

WE FURNISHED the four **30-in. Solid Bronze** Gate Valves (with solid bronze hydraulic cylinders) and the 8-in. and 12-in. Gate Valves also shown (which are solid bronze) and the solid bronze 30-in. Pipes in the foreground, for the New York Board of Water Supply, Gilboa Dam.

This system of piping and valves provides the Blow-off and Steam Control.

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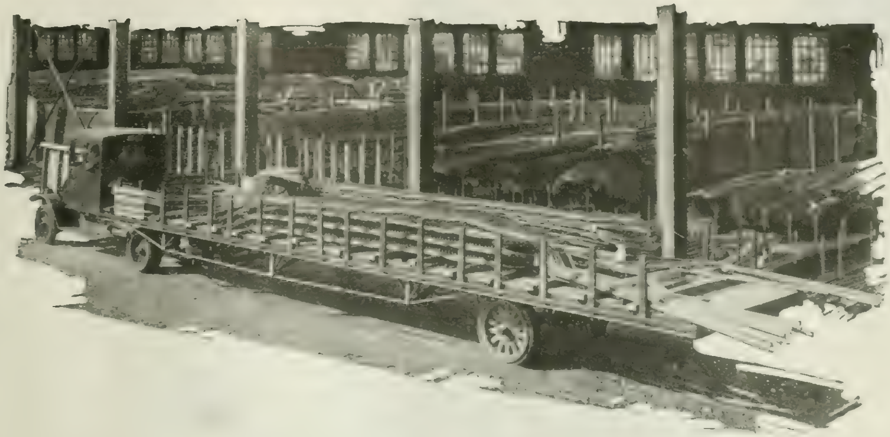

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Our large stock of steel on hand together with our complete equipment for bending, making spirals and special pieces, enables us to make quick shipment of the complete material—cut, bent, bundled and tagged, ready for the forms.

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JOSEPH T. RYERSON & SON INC.
ESTABLISHED 1842

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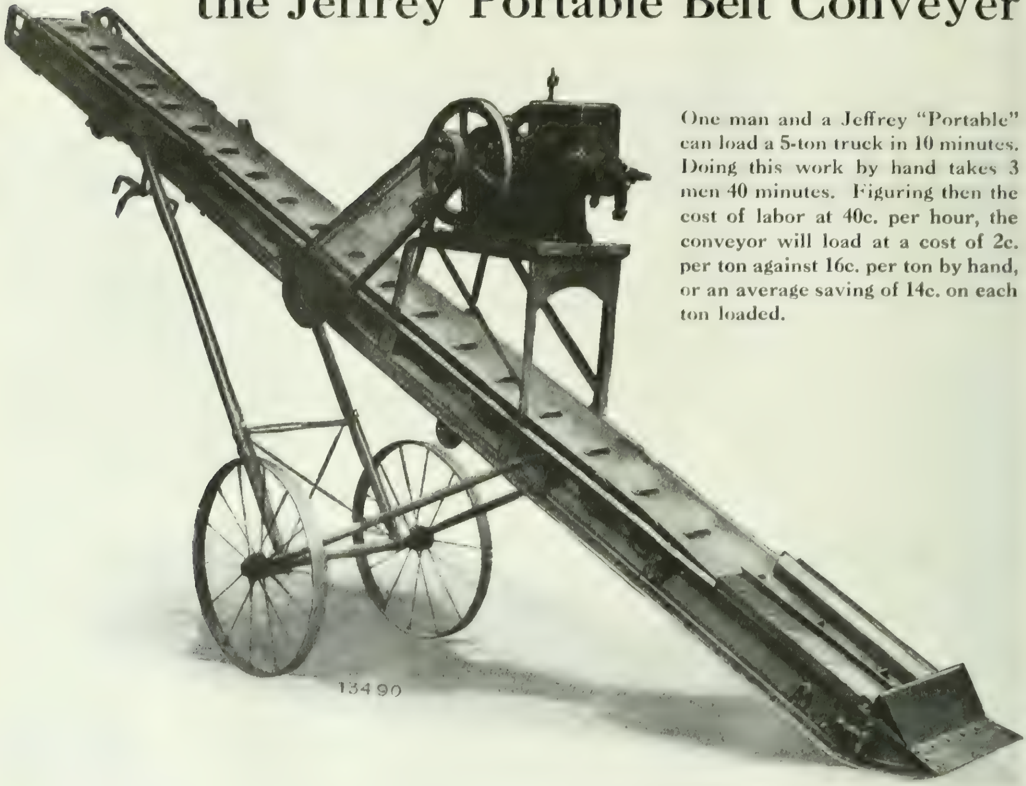

One man and a Jeffrey "Portable" can load a 5-ton truck in 10 minutes. Doing this work by hand takes 3 men 40 minutes. Figuring then the cost of labor at 40c. per hour, the conveyor will load at a cost of 2c. per ton against 16c. per ton by hand, or an average saving of 14c. on each ton loaded.

A Few of the Important Features:

Easily operated Worm and Wheel Raising and Lowering Device automatically locks conveyer in any position.

Troughed Belt carries gritty material without injury to belt.

Strong sharp nose can be readily thrust into pile.

Steel Guard Plates protect lower strand of belt.

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Because of the unusual interest over the entire country for information about gas welded pipe joints the Linde Company has prepared a booklet which should be of interest to every large user of piping.

A copy of "How Welded Joints Solved Pipe Line Troubles," may be secured upon request from our nearest District Sales Office.

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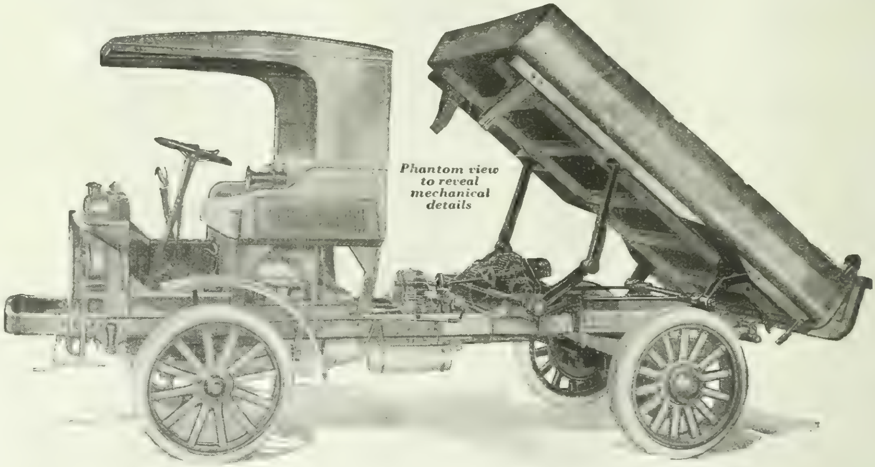

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

Volume 90 — NEW YORK, JUNE 28, 1923 — Number 26

Leviathan—Queen of the Seas

TO TAKE a ship, the largest in the world in tonnage, which had lain at anchor for over three years, and which never in her nine years had made a normal voyage, and so to re-equip her and re-design her that she becomes the fastest liner afloat is a feat worthy of notice. That is what American naval engineers have done to the "Leviathan." When the old "Vaterland" made last week the 25-hr. run of 687 nautical miles—an average of 27.48 knots—she broke the record held by the "Mauretania" by 11 miles and 0.44 knots. The world's largest ship is also the fastest and she becomes so by the work of the American engineers who entirely changed the driving power with which the Germans were never able to approach the speed just made. The "Leviathan" is not the entire American merchant marine but she is the queen ship of the fleet. It behooves Americans, especially those who bewail our lost prestige on the seas, to patronize her and her sister ships.

More Bridge Floor Fires

NEW evidence of the reality and seriousness of the fire hazard in wooden bridge floors continues to accumulate. Three destructive bridge fires have just been added to the record, as reported in the current week's news. The loss in any such fire is large enough to warrant careful attention to the fire hazard at the time of construction. Development of adequate fire-protective construction will doubtless require time. A useful beginning, however, was made a year ago through the work of a special co-operative committee which reported on the subject after detailed study. The report, published in *Engineering News-Record* of Nov. 9, 1922, lays particular emphasis on the value of firestops, a device that has hitherto found only occasional use. That it is a worth-while protection may be judged from the account of the recent Stevens Point fire, which repeats the story of many former fires in the matter of rapid longitudinal spread of the flames along the bottom of the floor, under the stimulus of an evident longitudinal chimney effect. In the absence of access openings through the floor such a fire, once started, is virtually beyond control. The simple and cheap expedients of firestops and access openings are capable of saving most of the loss caused by bridge floor fires.

Fundamentally Wrong

EVERY aspect of the conflict between the Pennsylvania R.R. and the Railroad Labor Board, which came to a climax in the formal rebuke of the railroad company last week, is unfortunate. Primarily it is unfortunate that the labor board is not provided with power to enforce its decisions even though as in this case the wisdom of its finding is to be questioned. Without such power it will soon become useless. In fact it may already be useless for now there is no reason why the labor organizations should not follow the example of the Pennsylvania. In the second place it is unfortunate that the labor board let the case come to this climax knowing, as it must have, that it lacked the power of enforcement. The question at issue was a debatable one; the law does not specifically state what form the employee representation shall take, and consequently need not have been made an issue as long as the actual dispute between the Pennsylvania and its employees was on a fair way to settlement. And finally it is unfortunate that the railroad company defied the labor board even though it considered the findings fundamentally wrong. If they were wrong the case could have been reopened and the Pennsylvania could have gone into the court with clean hands, and could, moreover, have looked to its employees to abide by the board's findings in some future time when the situation might be reversed. Now it can do neither. We believe that the principle for which the Pennsylvania was fighting is right, but that its method of conducting the fight is wrong. If the great corporations openly defy this administrative tribunal how can they or the country expect individuals or minor organizations to respect it.

Connecticut Still Vacillates

THE vacillation and delay in the adoption of a policy and method for water pollution control in Connecticut, noted in these columns in 1921, has been continued by the action of the 1923 legislature. The result is postponement of action for two more years and an apparent further befogging of the main points at issue. The governor acted wisely in vetoing the emasculated bill outlined in our news section, since it virtually let go scot free industrial plants located in cities and might have handicapped if not ruined the so-called "country" mills and factories, as well as any others discharging their wastes directly into streams instead of into public sewers. Too much stress seems to be laid by the governor upon the public health aspects of the bill in view of the fact that, as he states, public water supplies are protected by existing laws.

Highway Department Turnover

IN an average session of three months the legislatures of our states have more or less completely overturned fourteen highway departments. This is about 30 per cent turnover—a figure fairly comparable in size with those which are turning gray the hair of contractors and other employers of labor. Of course such a turnover in highway administration is not recorded every year. Last winter was open season for highway departments and the political pot-hunters were active. It is not however the percentage of turnover that is significant, but the fact that state governors and legislators and even the voters who pay the bills regard with entire complaisance the disrupting of a business organization of the magnitude of a state department of highways.

The 14 states which have changed partly or wholly their highway executives and managers are each doing an annual business of between $5,000,000 and $10,000,000 in road construction and maintenance. If a similar turnover should occur in private businesses of corresponding magnitude bankers and business associations would take a high hand in correcting a situation regarded as dangerous to industrial and commercial existence. There is evidently a vast need that the public should be made to realize that their highway departments are immense business organizations of a highly specialized character doing an annual business which surpasses in money value all but a few nation-wide private enterprises. Changes in personnel, often, and even drastic reorganization, occasionally, are required in highway departments, as in other business organizations, but neither popular impulse nor political expediency should be the inspiration for such action. Both were large influences in this year's changes.

Human Nature and Tunnel Driving

DRIVING tunnels isn't all machine work; a knowledge of human nature helps. Out on the Pacific Coast recently in one of the latest power tunnels a new drill better fitted than the old ones to drill the 20-ft. and deeper holes demanded by the new large rock sections was set up alongside the standard drills. Despite the fact that the drill had been tested out in this particular heading by the foreman and shown to work well, the crews did not get good results with it. It was too heavy, they said, and there was no denying the fact that it was often out of order. Too often, in fact, for such a substantially built device. Strangely enough, too, foreign material, such as pieces of file, was generally found in the mechanism when it was turned in as "out of order." The superintendent did not quit, however. He merely withdrew the drill from this particular heading, waited until the incident was no longer in the limelight and then "stored" the drill in the tool house at a heading where the lightest drills on the job were in use. Gossip about such matters gets around a camp quickly and soon after the drill arrived a driller on his way in to his work stopped at this tool house and asked to see "that —— —— drill those fellers at adit 3 couldn't make work." He looked it over carefully and then called to his helper, "Come on, we take this one in." With the larger and more effective tool the two men completed their drilling thirty five minutes ahead of the others and then walked out of the tunnel *taking the drill with them*. After this, prejudice against the new type of drill was no longer a menace; instead a demand for it sprung up and within six months it was used exclusively throughout the entire project and was giving entire satisfaction with a more rapid rate of progress than was possible before.

Municipal Construction and Money-Costs

THE rise in construction costs and in the interest or yield rate for bonds is a double handicap on municipal improvements. The construction-cost index for June is 220.7 against 166.62 for June, 1922, and 273.8 for the peak of June, 1920, or it is 32 per cent higher than a year ago, 121 per cent above the 1913 level and only 19 per cent under the peak. The cities have, therefore, to pay more for the work they require. At the same time the interest or yield rate on municipal and state bonds has been going up in the last few months. For the week ending June 15 the yield rate on bonds offered by 16 states and municipalities was 4½ or higher for seven issues, while in only one instance was the yield rate as low as 4 (Troy, N. Y. 1 to 20-year 4¼'s selling at 4). The actual interest rates were 5 per cent or more for 8 of the 16 offerings and below 4½ for only 1 of the 16 lots. Earlier this year interest rates of under 4½ and yield rates of about or under 4 were frequent. Were it not for the fact that many of these bond issues are offered to finance improvements to which there have been commitments not readily put aside, the unfavorable market for materials, labor and money would cause a sharper and more immediate decline in the volume of construction work than has yet been the case. If present construction- and money-costs keep on the up grade the need for municipal improvements and consequently the lag is bound to increase. Eventually much of it will be met although some projects are bound to die. Under such conditions there is more need than ever for wise discrimination between the work that should be undertaken, regardless of unfavorable conditions, and that which without undue sacrifice may be postponed to a more auspicious time.

A Disheartening Dismissal

NO MOVE ever made has been more destructive of the morale of the engineer in the federal service than the peremptory ousting of Arthur P. Davis as director of the United States Reclamation Service. For forty years Mr. Davis has faithfully served the government and through regular and deserved promotion had risen to become the executive head of a bureau of more distinctly engineering character than any other of similar size under civilian control, a bureau, moreover, which engineers have successfully administered since its initiation. And yet he is removed without explanation and with no opportunity for defense, to meet the needs of what must be regarded as purely partisan politics. The administration cannot well escape the charge of debauching the government service in the interests of self perpetuation.

The incident has two sides, that of Mr. Davis himself, with its implication as to all other engineers in the government, and the larger one of the administration of government engineering bureaus, with its implications regarding a department of public works. As for Mr. Davis he will be able now to enter a consulting practice which has long awaited him at a compensation much greater than he has heretofore enjoyed, taking with him the respect of his professional associates to compensate him somewhat for his reflections on the ungratefulness of republics. His fellow engineers in the government know, however, that one of the compensations they have felt they enjoyed in public employ, the security which is supposed to make up for the numerous superior attractions of private employ, is at the mercy of any political superior who chooses to override the civil service laws by the simple subterfuge of abolishing the office. This knowledge cannot help but increase the already great difficulty of providing competent engineers for the work the government has to do.

What is in the mind of the Secretary of the Interior in this dismissal it is not permitted us to know. He takes refuge in the sole statement that he prefers to have reclamation work in charge of a business man rather than an engineer, but in order to avoid the necessity of showing wherein the engineering control has been unsatisfactory he abolishes the office of director and substitutes a new one of commissioner, thus depriving the automatically removed director of a hearing on his dismissal. And to succeed this engineer who has grown up in the service, one of the most competent men in both the science and business of reclamation in the world, the secretary—a doctor of medicine whose life work has been the conduct of an asylum for the mentally deficient—appoints a not too successful country banker who has been a governor of Idaho. Is there any reason why the charge should not lie that the administration politicians want to have the leverage of the Reclamation Fund to use where it will do the most good? If Mr. Davis was incompetent he is entitled to know in what particulars; if the engineering control of an engineering activity has been a failure the engineers of this country are entitled to know wherein that failure lay and how a so-called business administration made up of doctors and politicians is to be superior.

The engineers who have been favoring a federal department of public works must be profoundly depressed by this incident. It has been their contention—and it has been the contention of this journal—that the engineering operations of the government must be administered by engineers who could be remote from political interference and thus free to devote to the government the full measure of their professional service. Dr. Work has shown how difficult it will be to keep the politicians out of government engineering. He has made some who are opposed to the military system of public works feel that the stability of that system is a virtue as well as a defect. It may be deadening to initiative and inducive of arbitrary class distinction but it does prevent political control.

Training for Leadership

LAST week at Ithaca the Society for the Promotion of Engineering Education carried as a slogan at the masthead of the program the brave words—"Training for Leadership." Around that slogan the program was built, starting with an address by the dean of the college where the meeting was held and ending later in the week with an after dinner speech by the president of the society. In between, the rôle of the engineer as a leader in industry, business, transportation and public service were discussed by specialists in those lines of endeavor. It is no secret that these addresses, all well prepared, some eloquent and all thoughtful, left the hearers cold—not to the desirability, or even inevitability, of the engineer assuming a leader's part in the world's affairs, but to the possibility of so training him in his undergraduate days as to insure for him such a part.

There is an old story of a little boy who when asked what he was going to do when he grew up answered, "I'm going into the millionaire business." So too the advertising pages of certain magazines are filled with instructions how to earn fabulous weekly incomes or to dominate one's fellows merely by following some prescribed system available at so much per course or per week. To set out avowedly to train engineering students so that they become leaders of men savors too much of a little boy's vague ambition or of a charlatan's easy road to success. The engineering teachers realized this and they emphasized it.

This does not mean that the engineering teachers, any more than the bulk of the profession, question for a minute the world's need for the leadership that the engineering type of mind can give. As Dean Kimball so well pointed out the military leader, who ruled by force, has passed away; the legal leader, who rules by precedent must similarly succumb to the revolutionary developments and discoveries that render precedent useless as a rule for future guidance not only in the material but even more in the social and spiritual; there remains the scientific leader, who is guided by fact and fact alone but who possesses that one essential of the imaginative spirit, the willingness, nay more, the anxiety to believe that anything is possible. The engineer, who gives the skeleton of science a corporeal existence and breathes into it life, must step forward out of the crowd into the forefront of the world.

How then can the embryo engineer be trained to take this leading place? By specifically guiding him individually toward leadership; by consciously directing his course of study to that end? Hardly. Leaders are born not made. Few privates carry the marshall's baton in their mental knapsack. To take the mass of the human material presenting itself for an engineering education and to attempt to mold it toward the one end of directing the affairs of this world would be to grievously overestimate the importance of training and, more than that, of the engineer's place in the world. All the educator can do is to formulate as well as he can those qualities of thought and practice which characterize the engineering type of mind and methods, qualities that the changing character of the world make ever more necessary for the conduct of the world, and then endeavor so to instruct the student that he will go forth endowed, within his own limitations, with those qualities. If he knows the laws of nature, can by reasoned processes apply those laws to specific cases and can persuade other men that his application is not only correct but profitable, he will have the essentials of leadership. The remainder of the way lies in himself and the teacher can do little more than point it out.

One paragraph in an address at Ithaca by W. E. Wickenden, of the American Telephone & Telegraph Co., is a clear expression of this thought. "There are some things which colleges can do to a higher degree than any other institution. They can train men to think logically, to study effectively, to investigate with discrimination, to plan intelligently, to work systematically, to express themselves with clarity and vigor, to appreciate and enjoy things of beauty and to pass valid judgments on their own work and that of others. There are some things which colleges can do to a less complete degree, such as training men to know other men's minds, to estimate human relations, to co-operate with their fellows, to strike a just balance between details and general relations and to decide issues on the basis of evidence, even when it is not wholly conclusive. There are other services which they can render in degrees which vary widely with the individual's capacity for response, such as to stimulate the imagination, to clarify the ethical sense, to develop self-confidence and the willingness to assume the consequences of one's own decisions, to recognize ability and to delegate responsibility."

It was with full recognition of these possibilities and limitations that the engineering teachers regarded the slogan at last week's meeting. If they continue to recognize them in their work of teaching, the slogan has its value as a beacon to steer by. It is far from being a complete chart of the voyage.

Ontario Provincial Railway Extending to Hudson Bay

New 190-Mile Line to Encourage Settlement and Develop Mineral and Power Resources—Airplanes Check Surveys—Construction Methods—Electrification

WITH a port on James Bay (Hudson Bay) for its objective, but with the main purpose of opening up new country for settlement and mineral development, the Temiskaming & Northern Ontario Ry. is building a 70-mile extension north from its present terminal at Cochrane, Ont., as the first section of a 190-mile line to Moose Factory at the south end of James Bay. It is expected that contracts for the construction of the remainder of the line will be awarded this summer. Special features noted in this article are the exploration and location survey work, use of airplanes to check ordinary surveys, construction methods and equipment, water power development and the recommended electrification of the present main line. Views of the work and the country are shown in Figs. 1 and 2, and Fig. 3 is a map of the new line.

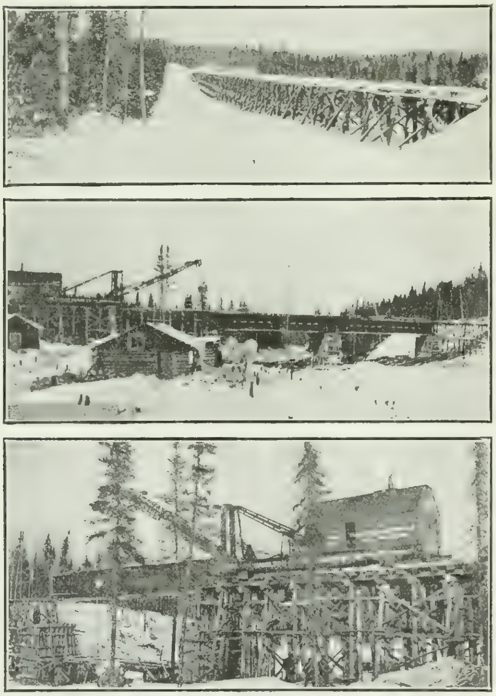


FIG. 1—BRIDGE AT SUCKER CREEK; T. & N. O. RY.
Top; temporary structure, with trestle approach to be filled later. Middle and bottom; placing two 85-ft. spans on concrete piers, Mile 20.3.

Government Railway Project—This railway was built by and is both owned and operated by the province of Ontario, under the control of a commission appointed by the Provincial Government. In 1902 the Province commenced the construction of a colonization railway northward from North Bay, on the Canadian Pacific Ry., to New Liskeard at the head of Lake Temiskaming. For about a thousand miles through Ontario the transcontinental line of the Canadian Pacific Ry. crosses the south face of the great "pre-Cambrian shield," which extends from the Great Lakes northward to Arctic waters, and is the largest and most important physiographic feature of Canada. This area had been commonly thought to have no economic resources, other than its rapidly diminishing pine and spruce forests, and it was quite unpopulated, except for sparse settlements along the Canadian Pacific Ry. The provincial railway was primarily projected to open to settlement large areas of fertile clay land that lie between Lake Temiskaming and James Bay, and form what is now known as the northern Ontario clay belt.

About two years later the Dominion Government undertook the construction of the National Transcontinental Ry. between Quebec and Winnipeg. The route of this railway across the Province of Ontario lay entirely in the drainage area of the rivers draining into Hudson Bay, and in a large part through the above clay belt. The Provinical railway was later extended northward to meet the Dominion railway, reaching the connecting point at Cochrane in 1908, thus facilitating the construction of the new Transcontinental line eastward and westward from this point.

At that time it was expected that the Temiskaming & Northern Ontario Ry. would be a connecting link between the Grand Trunk Ry. and the proposed Grand Trunk Pacific Ry., for a route from Toronto to Winnipeg and the Pacific Coast. But owing to war conditions and the Grand Trunk's loss of control of its Pacific extension this plan never became operative. At present the Grand Trunk, the National Transcontinental and the Grand Trunk Pacific are all absorbed in the government system of the Canadian National Railways.

Although the Temiskaming & Northern Ontario Ry. has remained as a local line it has served the development purpose for which it was originally projected. A great area of the clay belt is being cleared and put under cultivation, pulp and paper mills have been established, numerous hydro-electric installations have been made and the construction of the railway has led to the discovery and development of silver and gold mines of international repute. In fact, it is said that with the construction of this railway the frontier of Ontario was moved about 250 miles further north. When the National Transcontinental Ry. was projected, running westward across the northern and practically unknown part of Ontario, it was shown that it would open up a great territory of good but hitherto inaccessible country north of the "height of land." With the new railway now being extended north from this line to James Bay another strip of land will be made accessible and the frontier moved still further northward.

The winters are long and cold, with a minimum temperature of 30 to 35 deg. below zero, and there is snow on the ground for at least five months of the year. The summers are short, usually hot and dry, but the nights are cool. There are only about two months without frost.

Mineral Resources—As to the mineral developments in this region, Dr. C. V. Corless, director and manager of the Mond Nickel Co., in an address before the Canadian Club of Toronto, stated that probably the greatest advantage of the extension of the Provincial railway will be in rendering the shores of James Bay and Hudson Bay and the tributary rivers accessible to explorers and prospectors for four or five months of the year. The Hudson Bay Ry., in Manitoba, will have a similar effect when completed. He predicted the discovery of great mineral wealth in this newly opened territory. Referring to the five great groups of mines already found on the southern fringe of the pre-Cambrian shield (Lake Superior iron, Michigan copper, Sudbury nickel, Cobalt silver and Porcupine gold) Dr. Corless said: "These five fabulously rich mining areas with numerous other minor discoveries, some of which may develop into very important mines, are all situated in a small part of the pre-Cambrian shield, the part we have very incompletely examined merely because it was accessible. The remainder of this vast shield is similar in glaciation and geological formation. Further, where prospectors have secured a new point of attack, as near The Pas, in Manitoba, made accessible by the Hudson Bay Ry., they have discovered valuable mineral deposits."

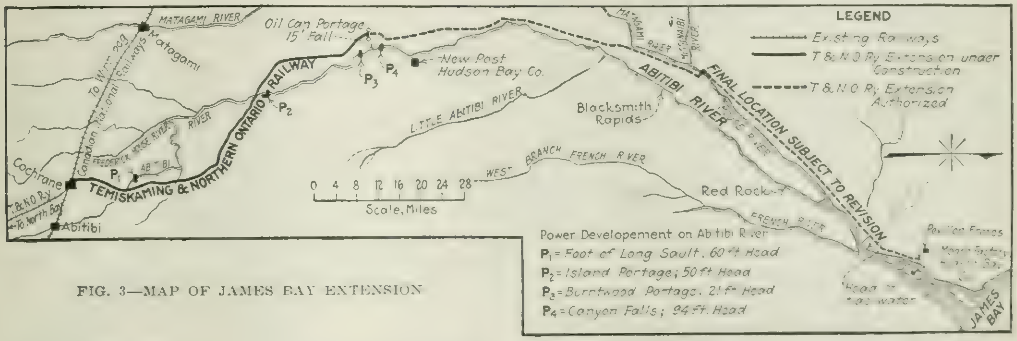


FIG. 3—MAP OF JAMES BAY EXTENSION

Exploratory Work—Exploration surveys north of Cochrane have been carried on intermittently for several years. Little was known of this territory except along the larger rivers, of which traverse surveys had been made. Traveling by canoe routes was relatively easy, but the forests on either side were practically impassable. During these early surveys information was collected respecting the timber, soil, water powers and mineral resources. An examination was also made of all possible harbors on the south side of James Bay.

It was found that there would be no serious construction difficulties to determine the location of the extension. The problem was, therefore, the location of a route that would best serve to develop the intervening territory, and that would reach a terminal on tidewater at which a harbor could be developed to meet the requirements of whatever navigation should offer. The mouth of the Moose River proved to be the most desirable site for a harbor, with the terminal located on the west bank of the river opposite Moose Factory, which is an old Hudson Bay Co. post on an island in an estuary of the river. It is anticipated that the construction of a railway to Moose Factory will create considerable interest in James Bay and Hudson Bay, and that during the navigation season of five months a considerable amount of coastwise shipping will be carried on. From a geological standpoint the prospects of finding valuable minerals along the shores of Hudson Bay are very favorable, but as the bay is practically inaccessible very little prospecting has been done. In selecting the route from Cochrane to Moose Factory the most direct line has not been followed, but it is believed that the route as adopted will open a large area to settlement and will better serve to promote the establishment of pulp and paper mills on the Moose River and its tributaries.

Ordinary and Airplane Surveys—Initial surveys were carried on by methods usually followed in northern Canada, the only means of transportation being canoes in summer, and toboggans and dog teams in winter. Subsequent to the completion of the exploratory surveys and the selection of a route, the Laurentide Air Service, Limited, established an air station near Cochrane, at which a number of modern seaplanes are available for commercial flying, and the railway engineers have made some use of the machines.

These seaplanes were not available when the exploratory and reconnaissance surveys were made, but it is considered that they can be used to advantage in making exploratory surveys in unmapped country. After the completion of the reconnaissance surveys the engineers used the seaplanes to a slight extent to check up results of their previous surveys. It has been the experience on this work, however, that aerial surveys cannot take the place of preliminary instrumental surveys, since the topography of the country is such that the slope of the river valleys, etc., cannot be determined with sufficient accuracy without levels from trial lines. On the other hand, the flights made have served to check the information which was obtained by more laborious methods.

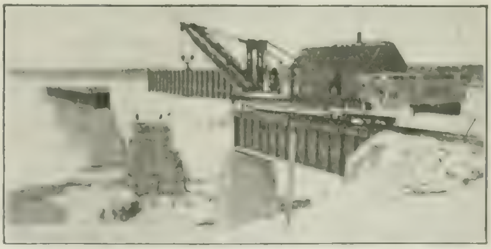
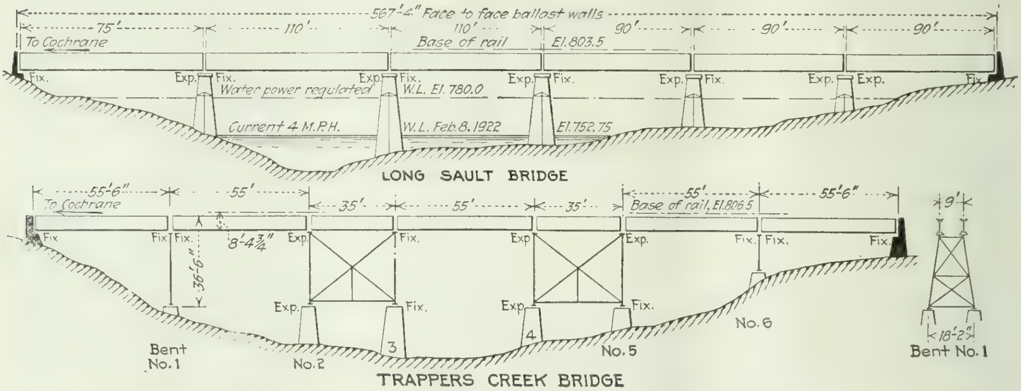


FIG. 2—PLACING 110-FT. SPAN, ABITIBI RIVER BRIDGE
March 20, 1922. Note double boom derrick car. Spans on the far bank were erected before the temporary trestle [illegible]

Final location surveys are now being completed to Moose Factory by two survey parties. Each party consists of a chief of party, transitman, leveler, topographer, two rodmen, two chainmen, four to six axmen, cook, cookee and two to four packers or canoemen. A transport party is responsible for transportation of supplies to main caches, from which the location parties draw when required. The entire operation is in charge of a chief locating engineer who co-ordinates the work of the various parties.

In connection with the location surveys, topographic surveys have been made of the water-powers on the Abitibi River (see Fig. 3) in order to determine clearances for structures crossing the Abitibi and its tributaries. In all cases these structures are being designed so that they will not restrict the future development of water-power sites (see Fig. 4). Information obtained from the hydrographic surveys was used also in connection with the studies for the electrification of the railway, which has been recommended for the main line and two important branches, as noted later.



LONG SAULT BRIDGE

TRAPPERS CREEK BRIDGE

FIG. 4—TYPICAL BRIDGE AND VIADUCT CONSTRUCTION

Construction Work—On the first 70-mile section of the James Bay extension the work is comparatively light, the grading averaging about 14,000 cu.yd. per mile. About 40 per cent of the fill material is from cuts and the balance from borrow pits. The limit of free haul is 500 ft. Maximum grades are 0.4 per cent southbound and 0.6 per cent northbound, with a maximum curvature of four degrees. Roadbed width is 18 ft. on fills and 24 ft. in cuts. The location profile showed no solid rock, but a small quantity has been encountered in some of the deeper cuts. All clearing has been done on the 99-ft. right-of-way, this work being handled generally by the stationmen preparatory to the work of grading.

Side borrowing is done usually by stationmen, using wheelbarrows for making the fills. In some places where the land is drier than usual, scrapers have been used to make embankments from side ditches. Line cuttings are generally taken out by pick and shovel, the material being removed in narrow-gage dump cars hauled by horses. Two steam shovels are in operation, both with 2½-yd. dippers. One is being used for ballast and the other for filling dump-car trains.

The contractor's equipment is of standard gage, except that small narrow-gage cars are used in taking out line cuts. Owing to the nature of the country it is difficult to move steam shovels ahead of the standard-gage track. Air-operated dump cars of 16-yd. capacity are used for making fills, the number of cars per train varying from six to twelve. Temporary trestles made from round timber, on piles where necessary, are used in making embankments with these trains. At the end of April, track had been laid to Mile 44.4, where foundations for a large bridge across the Abitibi River were being constructed. The grading between this bridge and the end of the contract at Mile 70, was fairly well covered.

There has been comparatively little trouble from sliding cuts, but the bottoms of a few cuts have been very soft, necessitating cross logging to hold up the track. Nor has there been excessive settlement of fills, except in one cut at Mile 5 where a 14-ft. embankment had to be carried across a marsh. As a rule the embankments are not originally made above grade line to allow for settlement. There is naturally some slight settlement, but this is taken up later by using train hauled material, which is generally sand, providing better drainage than the material usually found in line cuts. It has not been necessary to use cross logging under the embankments on account of swamps.

Structures and Track—All structures are of permanent construction. The smaller culverts are of reinforced-concrete pipe, except in a few cases where corrugated metal pipe is used on account of greater facility of transportation. The larger culverts are of a flat-top type built of reinforced concrete. In the deep clay of glacial origin pile foundations are necessary for most of the structures. Spruce suitable for piling is generally found adjacent to the right-of-way. The larger creeks have deep ravines and these are crossed by steel trestles, the clay banks of the creeks not being sufficiently stable to permit the construction of large culverts or high abutments.

Typical bridge work is shown in Figs. 1, 2, 4 and 5. The largest structure is the crossing of the Abitibi River, Mile 44.4, which has a 220-ft. deck truss center span and plate girder flanking spans on concrete piers, with steel trestle approaches. All structures are designed for Cooper's E-60 loading and in accordance with the Canadian Engineering Standards Specifications. Trouble was experienced in unwatering pier 2 of the Abitibi River bridge at the Long Sault, Mile 11.3, and in order to avoid delay to tracklaying a temporary

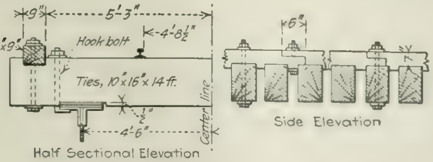


FIG. 5—DETAILS OF BRIDGE DECK

structure was erected between piers 1 and 3. During the winter, when tracklying was suspended, this temporary structure was removed and the two 110-ft. spans were placed, as shown in Fig. 2.

Bridge decks, Fig. 6, have ties spaced about 14 in. c. to c. with 8x9-in. guard timbers boxed or dapped over the ties. To prevent breaking of the ribs between the daps, four 3-in. nails are driven in each rib before the timber is dapped. These timbers are spliced either over or between the ties, as shown, according to the length of the timbers. Since gravel and cement for bridge foundations had to be brought in by rail, temporary trestles were built at several structures in order to avoid delay. The temporary trestle of the Sucker Creek bridge, Fig. 1, will be filled.

Track is being laid with 80-lb. rails of A. S. C. E. section, laid to break joint and spliced with heat-treated angle bars. Fig. 6 shows a Roberts tracklaying machine at work on a muskeg or swamp fill. The ties are of local jack pine, untreated, with 18 ties per 33-ft. rail length. Pit gravel is used for ballast and is 10 in. deep under the ties. Passing sidings 3,000 ft. long are provided at intervals of six miles and the turnouts have No. 11 frogs. The location of stations will depend on settlement. Woven-wire 52-in. fencing for the right-of-way is attached to 8-ft. cedar posts, placed 16½ to 33 ft. apart.

Swastika-Kirkland Branch—In order to assist the development of the Kirkland Lake gold mining area, about five miles east of Swastika (on the existing main line south of Cochrane), a branch line is being built eastward along this mineralized zone. It is intended to build about twenty-five miles this summer, and probably the line will be extended ten miles further to the interprovincial boundary. Preliminary surveys are now being made. This will be built as a comparatively cheap branch line, using 10-degree curves and 2 per cent grades where necessary. By using these maximum grades and curves, the grading quantities will be only about 15,000 cu.yd. per mile, about evenly divided between rock and sand. There will be no structures of importance.

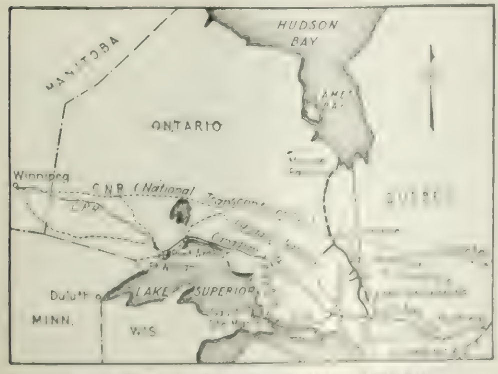


FIG. 7—KEY MAP OF NORTHERN ONTARIO

Electrification—In connection with this railway it is of particular interest to note that after careful study electric traction was recommended in 1922 as economical for the 250-mile main line from North Bay to Cochrane and for the two branches to Porcupine and Iroquois Falls, 33 and 7 miles respectively. Power could be developed at hydro-electric plants along the line and on the basis of using 3,000-volt direct current it was estimated that the reduction in operating expenses would be materially greater than the interest charge on the investment. Although the amount of traffic is less than is usually considered necessary for economical operation by electricity, this condition is said to be more than counterbalanced by the power cost. Thus, coal for the locomotives averaged $9.50 per ton in 1921, while it is estimated that current can be generated and delivered to the trolley wire for not more than ¾c. per kw.-hr. The total cost of equipment, exclusive of generating plants, is estimated at $11,215,000.

Immediate electrification was not recommended, it being considered that further investigation should be made, especially as to hydro-electric installations, and that complete plans and specifications should be prepared first so that definite bids for the work can be invited.

FIG. 6—TRACKLAYING MACHINE ON MUSKEG FILL

Engineers and Contractors—For the 70-mile section now under construction the general contractors are Grant, Smith & Co. & McDonnell, Vancouver, B. C., who have sublet the clearing and grading to Noehren & Mannix, of Calgary, Alberta, and the concrete masonry to C. D. French & Co., of Montreal, Que. Steel bridge work, including erection, has been let to the Hamilton Bridge Works Co., Hamilton, Ont. It is expected to have this section completed in October, 1923, at an approximate cost of $3,500,000. Final location surveys are being made for the remainder of the extension to Moose Factory, and the contract for this construction will probably be let about August, 1923.

The Temiskaming & Northern Ontario Ry. is under the jurisdiction of a commission appointed by the Provincial Government, with Geo. W. Lee as chairman. The engineering staff consists of S. B. Clement, chief engineer; W. R. Maher, chief locating engineer; A. L. McDougall, division engineer in charge of construction, and A. A. McRoberts, assistant engineer in charge of design of structures. The investigation and report on electrification was made by Mr. Clement in conjunction with J. G. Kerry, Toronto, consulting engineer for the Commission.

Further Tests on Concrete-Encased Steel Floor Joists

STRENGTH TESTS of concrete-encased steel beams reported in *Engineering News-Record* of May 3, p. 800, were extended in subsequent tests to higher loads and to vibratory loads, and the observed stresses were compared with calculated stresses on the basis of reinforced-concrete action of the composite structure. The results, recently reported by Profs. H. M. Mackay, Peter Gillespie, and C. Leluau to the steel fabricators' section of the Canadian Manufacturers' Association, are held to indicate that in such encased-beam construction the concrete and steel act together to form a composite beam, which may be designed by the usual reinforced-concrete T-beam theory; that this action may be utilized to effect a considerable economy in floor design; and that the limits of bond stress between concrete and steel which should be observed in such design require further tests to determine them. The experimenters also report that it is advantageous to provide for continuity at the ends of the beams by reinforcement passing through the top of the slab, that the shear reinforcement provided by the webs of the beams will tend to eliminate failure from diagonal tension, and that these encased beams are in a more favorable position than reinforced-concrete beams because of the fact that the concrete carries no stress from dead-load.

Previous Tests—As reported the live-load was carried up to 220 lb. per square foot which was double the design live-load for a stress of 16,000 lb. per square inch in the beams; the panels were 15 x 16 ft. in size, of which a slab area 10 ft. wide and 16 ft. long carried by two 10-in. 22.4-lb. I-beams spanning 16 ft. and spaced 5 ft. apart was subjected to load. In the further tests the live-load was carried up to 365 lb. per square foot, or 3½ times the design live-load or more than twice the design total load. This increased the live-load flange stress in the steel from 7,600 lb. per square inch to 14,750 lb. per square inch, and made the total flange stress (dead plus live) 21,500 lb. per square inch. Slight haircracking in the lower portions of the beam encasement, one or two cracks extending to near the bottom of the slab, appeared during the higher stages of loading. The test was discontinued because it proved impracticable to place more load on the panel. Comparison of the measured steel stresses with those computed by calculation of the structure as a reinforced-concrete assemblage showed the observed results to lie between those calculated for the case of full tension in the concrete and the case of no tension in the concrete; in the latter case a part of the slab was counted as acting with the beam encasement to give T-beam action, this slab width extending four times the slab thickness to either side of the beam encasement. In the lower stages of loading the results agreed closely with those for the case of tension in the concrete, while in the upper stages of loading the results diverged more and more toward the other basis of calculation.

Before carrying out the tests under increased load, the panels were loaded with a concrete mixer of gross weight 10,400 lb., and this mixer, containing a 500-lb. charge of stone and operated by compressed air, was run "at a good speed" for two days. Its weight produced bending moments corresponding to those of a uniform live-load of 115 lb. per square foot. Strain-gage and deflection readings taken before and after the running of the mixer checked the weight of the mixer but indicated no vibration effect, and some slight haircracks that had been noticed in the previous tests showed no further extension, "although the amount of vibration produced would have been quite excessive in a building."

Truck Load Limits Reduced by New California Law

THE MAXIMUM load that may be carried by motor vehicles operating on improved state or county roads in California was reduced by the recent legislature in that state. Heretofore the limit for vehicle and load has been 30,000 lb.; this is reduced to 22,000 lb., effective Aug. 31, 1923, but vehicles weighing 10,000 lb. or more which are registered prior to Aug. 31, 1923, may operate with 24,000 lb. gross until Dec. 31, 1926.

Cities and counties may by ordinance increase the permissible weights but may not reduce except on unimproved roads, on bridges or for emergency. The maximum permissible weight per inch width of tire channel base is fixed at 700 lb. and the total gross weight for 6- or 8-wheel vehicles is set at 34,000 lb. Only one trailer may be used, whether laden or unladen. Body widths are limited to 96 in. over all, but cities or counties may increase this. The limiting speeds are established as follows:

Gross Weight	Maximum Speed
9,000 lb. but less than 12,000	25 miles per hour
13,000 lb. but less than 22,000	15 miles per hour
Over 22,000 lb.	10 miles per hour

Trucks or trailers constructed to carry 4 tons of load are limited to 15 miles per hour, laden or unladen.

Taxes and fees will be as follows: For each motor vehicle, trailer or semi-trailer, registration fee, $3; for the first set of license plates $5, each additional set $3.

Motor vehicles, trailers and semi-trailers equipped with solid tires will pay a weight tax on the following basis:

Unladen Weights	Tax
Under 3,000 lb.	$10.00
3,000 and under 6,000 lb.	20.00
6,000 and under 10,000 lb.	30.00
10,000 lb. or more	40.00

Pneumatic-tire vehicles pay one-half the foregoing weight tax and vehicles weighing less than 3,000 lb. and with cushion tires are considered as equipped with pneumatic tires. A gasoline tax of 2 cents per gallon goes into effect Sept. 30, 1923.

Leasing Engine Terminal Plants

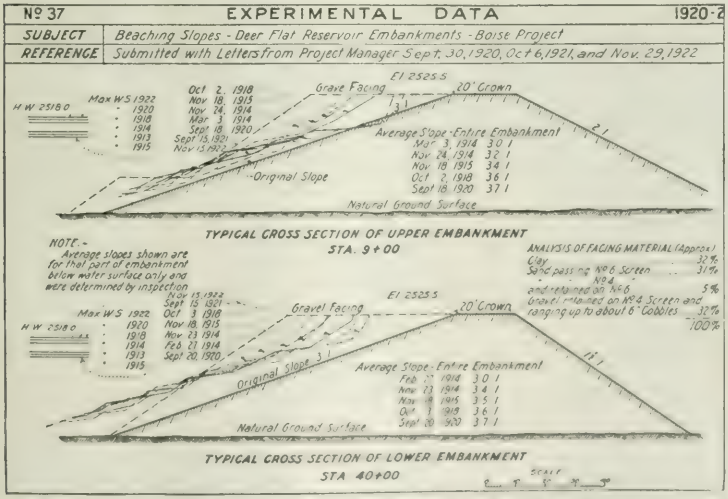
Modern facilities at engine terminals are needed in many cases where the railways are unable to finance such needed improvements. To meet this condition the National Boiler Washing Co., Chicago, has arranged to install its plants and special apparatus on the basis of payment by rental, the plan being somewhat similar to that of car equipment trusts. Payments are to be made on monthly notes and the plant will remain the property of the contracting company until the railway makes the final payment on the lease. The plan is similar to that of car equipment trusts, but the cars carry their own mortgage while the terminal equipment is put on mortgaged property. While the plant is being paid for it is an operating charge, but after all the lease notes have been paid the railroad can take title to the property and put it into capital account at its depreciated value.

Observations on Beaching Slopes on Reservoir Embankment

Abstract of Paper by C. A. Bissell, Engineer, U. S. Reclamation Service, in March "Reclamation Record"

FOR eight years cross-sections have been taken of the Deer Flat reservoir embankment of the Boise Project of the U. S. Reclamation Service to determine beaching slopes. Originally, the finished slopes were purposely much in excess of the present ones, but profiles for the last two years indicate they are now practically stable.

The reservoir is formed by taking advantage of a natural depression in the hills and closing the gaps by earthfill dams. The length of the upper dam is 4,000 ft. and of the lower one 7,200 ft. The former has a maximum height of 70 ft. and the latter 40 ft. The area of the reservoir is 9,800 acres and its greatest length, almost squarely facing the lower embankment, is nine miles. At the time of construction the extensive area and exposed position of the lake indicated that at times the wave action would be strong and that protection was accordingly important. No rock was to be found in the vicinity of either embankment and the distance from railroad connections made the importation of rock from a distance very expensive. The same conditions made the cost of concrete high and pavement with this material would also have been expensive. The importance of the question was emphasized by the great extent of the water slope in each embankment and it was finally concluded to try the experiment of protecting these slopes by an excess quantity of coarse gravel.



BLEACHING SLOPES OF UPPER AND LOWER DEER FLAT DAMS
Reproduced from *Reclamation Record*, March, 1923

After finishing the dam to the lines required by the drawings, with 3 to 1 water slope and 20-ft. top width, the equipment on the ground was employed in widening the top by dumping from cars on the water slope the coarsest material available, moving the tracks outward as the top width of the embankment increased. The material was composed of water-worn sand and gravel, varying from cobbles of 50-lb. weight through all the intermediate sizes to very fine sand, the proportion of coarse material varying some but not much. In this way the upper embankment received about 95,000 cu.yd. of extra material which was deposited on the water slope, taking its natural angle of repose and widening the top of the embankment to a width varying from 51 to 67 ft. A larger quantity was [illegible] on the lower embankment as this is much longer. It required about 226,000 cu.yd. of material.

Cross-sections have been taken periodically, beginning in 1914, to determine the slopes to which this gravel had washed down. A recent letter from J. B. Bond, project manager, states that cross-sections taken last fall show no material changes over 1921 conditions, the difference being so slight that they would not show up on cross-sections of the scale of the drawing.

In 1922 Deer Flat Reservoir was filled to its maximum designed capacity on April 20 and was held at that stage until May 5, after which date it was gradually drawn down.

At the time of construction it was estimated that it would be possible to repeat the process of gravel reinforcement at least twice before reaching the cost of paving the entire water slope. It seems certain that this never will be required. At the lower embankment the advent of the railway since the embankment was constructed opens the possibility of employing either rock or concrete at some future date should further operations appear to be required. The present indications are that considerable economy is likely to be accomplished over the cost of paving the embankment slopes by the usual methods at time of construction.

Sixty Long Timber Columns Tested

RESULTS of tests of 60 columns of Southern yellow pine and coast type Douglas fir, 12x12 in. x 24 ft. long, have just been reported by the Forest Products Laboratory, Madison, Wis. These tests are part of a much longer test series, intend to extend over a four-year period, covering both green and air-dried material, summer-cut and winter-cut, of various grades from clear and dense to defective and light-weight. The columns so far tested include 40 of Southern yellow pine, most of them true long-leaf pine, and 20 of Douglas fir. The length was chosen to give a true long column, that is, one which would fail by buckling without exceeding the elastic limit of the material; shorter columns cut from the larger ones are to be tested later. In all three groups composing the set of 60 columns, the average of the ultimate (maximum) load of the several columns was 95 to 96 per cent of the Euler load computed from the constants of the column and its modulus of elasticity, the latter having been obtained in a preliminary bending test. The columns were tested "under what may be considered pin-end conditions." In the three series the lowest and highest failure loads were 201,500 and 432,600 lb.; 187,900 and 418,400 lb.; and 182,000 and 406,300 lb. The last figure is based on 19 columns, the twentieth having been found to have a defect that required its exclusion from the series. The tests have been interpreted as indicating "that there is little, if any, difference in the long-column strength of the two species," namely, Southern yellow pine and Douglas fir.

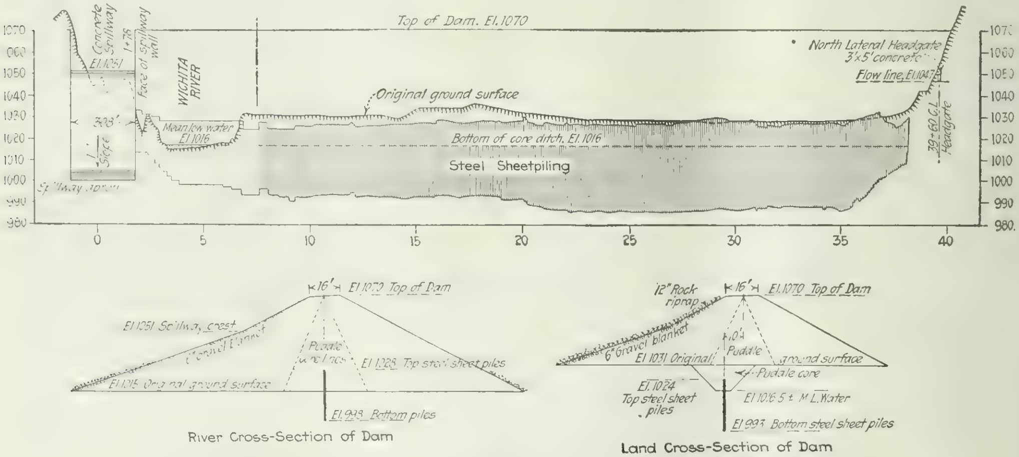
Results of 2x2-in. columns cut from the large timbers showed failure loads proportional to their stiffness moduli, indicating "that knots in themselves do not greatly affect the column strength."

Earth Dam Built by Flooding Dry Fill

Depth of Dry Fill Successfully Compacted by Flooding Was Remarkable Feature of Diversion Dam for Water Supply and Irrigation at Wichita Falls, Texas

By Albert S. Fry
Morgan Engineering Co., Memphis, Tenn.

A POROUS earth, easily soaked, made the flooding method particularly advantageous for constructing the smaller of the two earth dams for the irrigation and water supply development near Wichita Falls, Texas (*Engineering News-Record*, June 21, p. 1080). It is thought that in building this dam greater depths of fill were consolidated by flooding than in any previous operation. Fills 3 ft. deep were successfully consolidated and dried out ready for the succeeding lift of embankment in from seven to twelve days.



River Cross-Section of Dam

Land Cross-Section of Dam

DIVERSION DAM, WICHITA FALLS WATER SUPPLY AND IRRIGATION DEVELOPMENT

As described in the preceding article the main storage dam of the development works is supplemented by a smaller diversion dam. While this will be a costly structure when completed, the topography of the country is such that it was more economical to build both a storage dam and a diversion dam than it was either to build a storage dam at the site of the present diversion dam or to construct an irrigation canal extending 15 miles from the storage dam to the site of the diversion dam. Under the plan which was adopted, the diversion dam will raise the level of the water about 20 ft. above the valley floor to the elevation of the intake into the main irrigation canal which carries the water to the agricultural lands and to Wichita Falls.

Construction—Construction of the diversion dam began in January, 1922. The cutoff trench was excavated 10 ft. upstream from the center line of the dam by a walking dragline machine. Material from the trench was deposited in both toes of the dam. The excavation extended an average depth of 15 ft. to low water level in the river, which was nearly the same elevation as the river bed. In the bottom of the trench, a row of steel sheet piling, weighing 35 lb. per square foot, was driven to refusal into the underlying shale. The top of the piling extended a minimum distance of 8 ft. above the bottom of the trench. The longest piling driven was 43 ft.

Before backfilling the trench with clay puddle, it was pumped full of water from the river. Material from a borrowpit on the downstream side of the dam was loaded into dump wagons by a tractor and elevating grader. Two dump wagons were connected together and were drawn by tractors. The first method used was to dump the wagons at the edge of the cutoff trench but this method was abandoned because of the difficulty in getting the material into the trench. By the second method the material was dumped at the downstream toe of the dam and moved by a dragline excavator into the trench. This method proved satisfactory. The earth from the trench which had been put into the toes of the dam was leveled down to a height of about 4 ft. and the dragline moved along on this material in refilling the cutoff trench. In depositing the material, the bucket was dumped near the edge of the trench so that the tendency would be for the heavier particles to deposit along the side of the trench and the very fine material to deposit in the center and along each side of the piling, thus taking as much advantage as possible of the hydraulic grading of the material.

For a distance of about 700 ft. at the beginning of the work, after the material from the cutoff trench had been leveled down to a height of about 4 ft. above the general surface, the puddle core was extended up to this level in the same manner as that used in refilling the trench. However, on account of the cost of puddling, this method was discontinued for the remainder of the dam and the puddle was carried up only to the original ground surface and the fill up to the 4-ft. level

FLOODING THE EMBANKMENT IN SECTIONS 300 FT. LONG
Settling 3-ft. fills under water pumped in after deposition by teams and wagons. Material has 45 per cent voids and dries quickly.

was made in the same manner as the fill for the remainder of the dam.

Originally it was intended to roll and sprinkle the earth embankment but it was found that the material was adaptable to the use of settling under water and this method has been used. Material for the embankment is being taken from borrow pits both up and downstream from the dam, hauled on to the dam and placed in lifts about 3 ft. deep. After about 100,000 cu.yd. of material had been placed by the dragline machine rehandling the material into the embankment, after it had been dumped at the toes from wagons, the method was discontinued and the remainder of the dam is being built by teams and dump wagons.

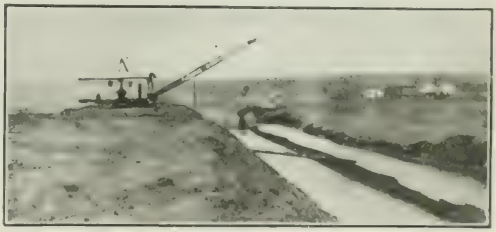
In each lift the embankment is separated into sections about 300 ft. long by small levees along the sides and across the embankment. These sections are flooded with sufficient water pumped from the river to cover the fills with a pool 1 ft. deep. This amount of water is ordinarily sufficient to saturate the material thoroughly, but in case it is not more water is pumped on later. The time for the entire lift to become saturated varies according to conditions. Where the material was placed in the embankment by the dragline excavator, the earth where the dragline traveled was packed so hard that it required from 4 to 8 days for complete saturation. Where the fill is made by teams or tractors and wagons, the time of saturation is reduced to 3 or 4 days. When tests show that saturation is complete, the pool is drained, and the material dries out in from 3 to 8 days, depending largely on the temperature, so that the next lift can be placed.

It is planned to top out the dam with teams just as the present valley section is being built, except that the flooding method will probably be discontinued above the elevation of the spillway and the material which is too dry to compact suitably by team travel will be sprinkled.

The material available for this dam is very favorable to the flooding method of construction, as it contains about 45 per cent of voids, therefore saturates readily and dries out in a short enough time so that the work is not delayed waiting for the fill to become firm enough to work upon. The economy of this method of construction depends on the character of the soil as to whether or not it will become saturated easily. Heavy soils which do not saturate readily require the fill to be placed in thin layers. In other places where the Morgan Engineering Co. has used this method of construction, material has been placed in layers of only 12 or 18 in. Where such low lifts are necessary, the unit cost of the embankment is increased and other methods of construction may be more economical. On the diversion dam, however, the soil was adaptable to lifts of as much as 3 ft. and accordingly the flooding method offered an economical way to construct the embankment.

The rock riprap has not yet been placed on the diversion dam, but particular care will be taken in laying the stones and all of the openings between the stones will be hammered and rammed full of spalls with a sledge down to the gravel blanket. It is believed that by taking these extra precautions in placing the riprap, the comparatively thin layer (6 in.) of riprap adopted will be more satisfactory than a thicker layer with the rocks merely dumped on to the face of the dam. The riprap constructed in this manner will be so nearly solid that very little if any material will be sucked out by wave action through the interstices between the stones.

Spillway—The concrete spillway section of the diversion dam is located in the side of the hill at the south end of the dam. It was necessary to set this section over into the hill in order to secure a good foundation at a reasonable depth for the heavy concrete overflow section. The headgates and intake to the main irrigation canal are located just above the south end of the spillway and the intake structure will be joined to the spillway. An approach channel to the spillway through the side of the hill and a channel below the spillway to lead the water from the stilling pool back into the river channel are being excavated.

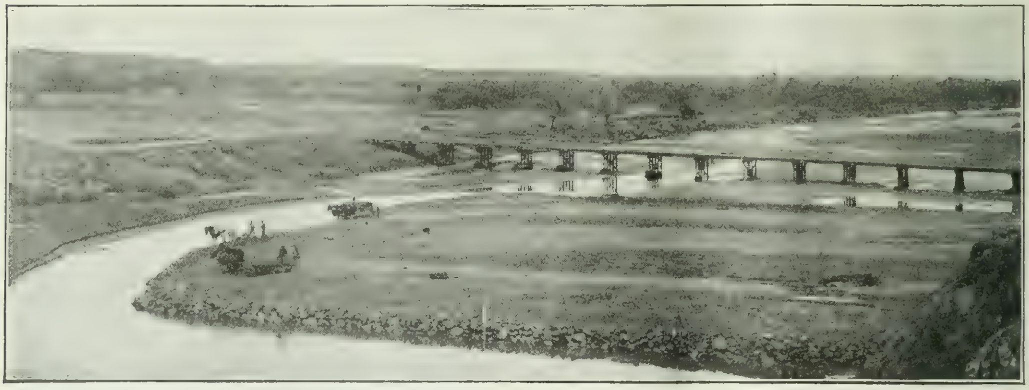


BACKFILLING CUTOFF TRENCH WITH DRAGLINE
After the trench was dug piling was driven down the center extending 8 ft. above the bottom of the trench and water was pumped in. The backfill was placed in water.

Excavated material is being placed in the river channel beginning at the south bank and crowding out to the north, leaving a part of the old channel at the north side of the present channel about 75 ft. wide to carry the flow of the river. The material across the channel is being placed in the toes of the dam, leaving a trench in between the toes which finally will be filled with puddle. Steel sheet piling will then be driven through the puddle across the channel. There will be some surplus material from the excavation for the spillway and the intake works in addition to that required in the embankment across the river. This surplus will be hauled across the river channel on a pile trestle and placed in the earth section of the embankment just north of the river channel.

Clay Blanket—In order to protect the restricted section of river channel from washing excessively during such floods as may occur, a 3-ft. blanket of clay has been placed on the sandy bottom of the river bed. On the downstream toe of this clay blanket, riprap 15 or 20 ft. wide has been placed extending along the bed of the river. A timber flume 60 ft. wide and 50 ft. long with suitable cutoff and wing-walls at the entrance will afford additional protection to the river channel gap. At the downstream end of the flume, a plank mattress securely wired to the lower end of the flume with the downstream edge free to move up and down as the sand is scoured out will prevent destructive action at the outlet. This mattress is in sections 10 ft. wide and 15 ft. long, wired securely together. The flume will have a depth of 5 or 6 ft.

The construction of the storage dam was sufficiently advanced by March 1, 1923, so that ordinary floods could be controlled by allowing the water to store above the constructed portion of the dam and thereby prevent damage to the diversion dam from such floods. The temporary flume constructed across the restricted section of the river channel will carry the water which comes in from the drainage area between the two dams without danger to the works. Should an unusually large flood occur which would require the opening of the conduits in the storage dam to the point where they would pass a large volume of water, the temporary flume would not be sufficient and there world be risk of losing part of the embankment at the diversion dam. Under the contract this risk is assumed by the contractor.



FILLING IN RIVER CHANNEL AT DIVERSION DAM

To prevent scouring of the narrowed channel during floods the sand and gravel in the river bottom were blanketed with clay.

Berlin Sewage Farms in Use Fifty Years

Sewage farming is still used in Berlin, according to a letter from Dr. Ruths of the city administration. The only change since the irrigation fields were put in use in 1873 has been the enlargement of the settling tanks so that nearly all the suspended matter in the sewage is removed before the sewage is applied to the land. This makes possible a higher rate of sewage application than before as well as the continuous use of the fields. The effluent from the irrigated areas, says Dr. Ruths, is perfectly clear and increases the fish population of the river into which it is discharged. Distribution is by open ditches. Sandy soil, once sparsely covered with grasses or trees, now produces fruit, vegetables or, if in grass, five or six crops of hay annually. The volume of sewage pumped to the sewage farms is about 500,000 cu.m. daily (132 m.g.d.). The area irrigated is some 11,000 hectares (27,000 acres).

Elastic Modulus of Sand Foundation Measured in Holland

TESTS of the elastic modulus of the foundation material were necessary for the safe and economical design of a very large tide lock about to be built at Ymuiden, where the Amsterdam Canal enters the North Sea. The results were recently reported by M. Wolterbeek, of the public-works department of Holland; an abstract is given by A. Bijls in *Le Génie Civil* of May 26. Proper calculation of the bending moment in the floor of the lock requires a knowledge of the elastic reaction of the sub-soil. This reaction was taken as proportional to the vertical deformation, but for the numerical calculations it was necessary to determine the modulus of the soil, or the load per square inch per inch of depression. This quantity was determined by measurement on the bottom of a shallow pit exposing undisturbed, saturated sand (below groundwater level). A square bearing block was placed on the floor of this pit, carrying a loading platform confined by post guides on either side. Bearing blocks of various sizes were used in different tests, the length of side ranging from 4 in. to 28 in. (areas 100, 500, 1,000, 2,500, and 5,000 square centimeters). A marked lag in the deformation was observed, both in loading and in unloading. It was assumed, however, that any depression remaining 24 hours after unloading was permanent, and by this criterion the total depression in each instance was divided into elastic and permanent. For a load of 5½ lb. per square inch or 800 lb. per square foot, the permanent deformation was less for the large than for the small bearing blocks, while the elastic compression increased quite decidedly with the size of bearing block, amounting to 0.08 mm., 0.20, 0.29, 0.58 and 1.34 mm., respectively, for the five sizes of block. The modulus of elasticity correspondingly decreased from 1,730 lb. per square inch per inch for the small block to 102 lb. for the largest block.

Panama Canal Transits

The rapid increase in the United States intercoastal trade is shown by a comparison of the record of Panama Canal transits for the month of April for the past four years: 1920, 7 vessels; 1921, 19; 1922, 24; and 1923, 95 vessels.

Road Surfaces and Motor Transport

International Congress at Seville, Spain, Considers Six Questions Equally Divided Between Surfacing Methods and Highway Transport Practice

(*Special Correspondence*)

PRIMARILY the discussions of the International Road Congress which was held May 6 to 13 at Seville, Spain, were concerned with the needed changes in road construction to meet the increasing burden of automobile traffic. There were six questions submitted to reporters, as follows:

1. Surfacing of roads with concrete.
2. Use of bitumen and asphalt for surfacing.
3. Laying of tramway-rails on the various kinds of road surface.
4. The development of motor transport.
5. General traffic regulations.
6. The problem of traffic on congested roads and streets of towns.

Preprints were furnished to the delegates, containing reports from 13 countries and from 149 persons of whom 81 were residents of the United States. The method of operation of these congresses is: A number of individual reports from competent reporters are received from the various countries. These are then referred to a general reporter, who, through custom, is a native of the country in which the congress is held. The general reporter then summarizes the individual reports and draws conclusions in so far as these seem to be justified. These conclusions are then put before the congress for discussion and action.

The conclusions are taken up in caucus by delegates from the nations. In this case the French delegation had prepared conclusions which in many cases were entirely rewritten from the conclusions of the Spanish reporters. The French conclusions formed the basis of discussion by the English caucus, and finally the conclusions as modified were presented to the final meeting of the congress and adopted. The delegates from the United States had no official standing, and were invited to share in the English caucus.

With respect to the conclusions, the following is noticed: First, in drawing up conclusions which will apply to the colonial possessions of France in Morocco, to Paris, London, and the United States, the form must be very general, and would appear to be mainly a citation of the obvious. In the second place, delegations from the Latin countries appear to regard these conclusions as very important, since they could be taken to be directive of action by those who had power to regulate the construction and use of roads in their respective countries.

Again, the Latin nations concluded that subsidies should be granted to automobile transport, which is entirely opposed to the views of the United States. In fact, in Italy, where the railroads are under governmental ownership and regulation, subsidies are granted to motor transport lines which of course are only established to fill the needs of passenger transport for isolated districts which do not [illegible] transportation or are not served by the railroad. The government grants a concession for the operation of such lines by private persons, and meets the deficit in the operation. Similarly, the Italian government has granted a concession for the construction and operation by private persons of a road exclusively for automobiles from Milan to the Italian Lakes. The French railroads operate passenger bus service over the highways. In fact, the acute controversies arising in the United States between the leaders of thought in the railway and highway fields do not seem to have arisen on the continent. Indeed, it may be remarked that the recent measurements of highway traffic in New England show that only a small portion of traffic is really competitive, and instances again the necessity of informing oneself before feeling.

A traveler, desiring to appraise highway development in Europe, or to reach conclusions from the experiences of these countries in highway transport, must make up his mind to devote considerable time to examination, and to learn the reasons for the conflicting reports, as, for instance, the relative economy of the tramway and motor bus operation in the cities of England. The economic conditions and the habits of the people are so different from those of the United States that care must be exercised in transferring principles and practices in either direction. The United States has been forced to build new roads to carry the remarkable burden of automobile traffic, and has the wealth to finance these constructions. The continental nations have roads well located, well drained and with solid road-beds, but not the economic conditions with which to face a widespread extension of motor transport. However, in some places, the increase of motor vehicle movement corresponds with that in the United States. The problem in the continent is distinctly one of surfacing existing roads.

While the conclusions of the congress are very general, yet the engineers of these countries will find in the reports a body of useful information.

Deliberations of the Congress—The congress was held in two sections, the first dealing with resurfacing of roads was attended by approximately 200 persons; the second dealing with more general phases of highway transport, was attended by approximately 50 persons. Approximately 600 persons in all were in attendance. The usual difficulties of international congresses were experienced in the time lost in translating remarks into two other languages than that of the speaker; and at this particular congress there was considerable lack of formality of debate. As in many other meetings of associations, considerable energy appears to be misused in the formulation of the obvious. There is also a common tendency to frame ideas into conclusions without respect to the data of experience and experiments. The vast body of experimental data available to the road engineers of the United States does not seem to have been known by the European engineers.

Entertainment—The very hospitable local committee had provided for the delegates an interesting program of entertainments characteristic of Andalusia. The organ recital in that most glorious of all cathdrals, the Seville Cathedral, will linger long in the memory of the delegates. After the congress an excursion was provided to Granada and Cordova.

Question 1. Surfacing of Roads with Concrete—In the continent the desire to obtain a cheap construction that will be more resistant to heavy modern traffic has led to various forms of construction in which stone blocks or broken stone are bound together with lean or rich mixtures. For instance, the Cornet system in Belgium uses a binder of ten parts of slag, two parts of slaked lime and one of cement. The road is constructed of two layers of broken stone between which a layer of mortar is interposed. The first layer of stone is leveled and rolled, and a bed of mortar, approximately 1½ in. thick, is laid. Then a second layer of stone is spread and also rolled. The operation is expected to fill the voids in the stone road with mortar.

Recourse is also had in France and Italy to special patented products such as "Rhoubenite" and "Soliditit." Rhoubenite is an invention of a Belgian engineer, R. Houben, who endeavored to obtain an impermeable concrete by incorporating saw-dust impregnated with a special mixture of tar and bitumen, thus producing a powder which is mixed in a proportion of about 60 liters to 400 kilos of cement. The powder is added to the concrete mixer. After a few turns of the mixer, the concrete is carried in trucks to the site of the work. This Rhoubenite was used first in 1912 on the road from Brussels to Namur.

In all, some 72 installations of various forms of roads bound together with cement are reported from Belgium from 1910 to 1920, and 18 of these are of so-called Rhoubenite.

In Italy two trials of Portland cement concrete for roads were made in 1911. During 1914, 1915 and 1916, some ten concrete road constructions were reported in Italy. The esplanade in front of the central station in Milan is reported as in excellent condition after eight years' wear under rubber-tired wheels. Other roads in Milan, supporting traffic of an industrial type, are rapidly deteriorating, but are reported to have been executed in a very imperfect manner. Italians have made use of the system called "Soliditit," first in 1913 in a tunnel under the Quirinal, but without success.

Two concrete facings were made in 1920 and 1921 on a highway supporting a traffic of more than 3,000 vehicles per day. One of these roads which was flat and very damp, contains many cracks and deep ruts. The surface of the other, a 45 per cent grade, remains in good condition. At the Octroi gate on this last road, where the wheels must follow two narrow tracks, a wear of 2 cm. has been measured.

The Italian engineers stress the importance of a solid foundation under concrete slabs, so there may be continuous support; and also advise against the construction of two-course concrete roads.

In Holland, 1920, authorization was given to construct concrete facings for a length of 150 m., divided into three sections of 50 m. each: first, a section of 1:2:4 gravel concrete; second a two-course construction with a lean base; third, reinforced-concrete pavement of a mix of 1:1½:3. The work was installed in the spring of 1921. On the national highway between Amsterdam and Amersfoort the construction seems to have been conducted under careful management, and was opened to traffic after a period of one month. The first section, after 10 months' use, had to be reconstructed with asphalt blocks, and the second section showed enough wear to inconvenience the traffic; the third, reinforced section, has shown no signs of disaggregation. No difference is noticed in the amount of cracking between the reinforced and non-reinforced part of the roadway.

The reports from nine English engineers were incorporated in a report by Alfred Dryland of Middlesex County, England, summarizing their experience with concrete pavements during the last four or five years. A number of experimental installations of concrete roads have also been made in Spanish countries.

The congress concluded that cement concrete for carriage ways formed of materials of good quality and suitably proportioned, built on sound and well-drained foundations, are capable, if the work is carefully executed, of withstanding considerable traffic of heavy vehicles fitted with rubber tires, but that further investigations are required as to the effect of traffic consisting of a large portion of steel-tired vehicles. A mix of 1:2:3½ was recommended. One of the American delegates expressed his opinion that concrete pavements might be constructed of much leaner concrete, possibly 1:3:6. The congress mentioned the use of special cements as justifying the adoption of different proportions. It did not appear advisable to express an opinion as to whether reinforced concrete should be employed in preference to mass concrete, and thorough studies were recommended. The question of providing expansion joints against the effect of various temperatures and humidity was also to be studied. Interesting results have already been obtained following the adoption of a resurfacing method whereby a matrix of sand and lime is added to the macadam during or subsequent to the laying.

Question 2. Surfacing Roads with Bitumen and Asphalt—There has been a much more extended experience in the use of asphalt than in the use of concrete. There are approximately 105 miles of highways faced with bituminous materials in France. Experience with bituminous surfaces on national roads in France extends from 1912 to 1922. Those previous to 1918 were largely experimental, although certain roads constructed in 1913 have withstood a heavy burden of traffic in good shape. An experiment by Michelin is quoted as showing 25 per cent decrease in cost of rolling traction on bituminous roads from those of macadam roads. The French reporter says that the life of the heavily traveled macadam roads in the Seine-et-Oise Department is about one year, and that the cost of the bituminous surface is recovered within three years.

A French reporter lays the cause of the waves in bituminous surfaces to the action of the roller, and suggests a ramming machine as a substitute for the roller.

The English reporters refer to many miles of main roads on which two-coat asphalt surfacing has been laid directly on the existing macadam roadbed. Rock asphalt is found in many places throughout the continent, principally in Switzerland, France, Germany and Sicily. After being reduced to a powder it is spread on the road surfaces and compressed. The percentage of bitumen varies from 6 per cent to 16 per cent. The desirable proportion for working in Great Britain is found to be about 10 and 11 per cent. The rock is mined and shipped in lumps by steamers. When it arrives at the works it is broken into medium-sized fragments and subsequently ground in pulverizing mills. After being heated it is transported, at a temperature of 340 deg. F., to the road, where it is raked and rammed to the necessary thickness of approximately 2 in., then laid on a cement concrete base. In Great Britain the use of rock asphalt is limited mainly to city streets. Italy has used rock asphalt extensively, the production being 106,000 tons in 1920. In 1849 a road in Switzerland was surfaced with this powdered asphalt rock. In 1860 this material was used for the first time in Zurich where now two-thirds of the total area of the streets is of compressed asphalt surfacing. It is reported that this material is too slippery for roads with steep grades. The limit of grade is 2½ per cent, whereas rolled asphalt can be used up to 4 per cent, according to the Swiss report.

The conclusions of the congress with respect to bituminous and asphalt surfacing were very general. It was recommended that research work should proceed, to determine the cause of corrugations and the means by which they could be avoided.

Question 3. Laying Tramway-Rails on Road Surfaces—The subject of laying tramway-rails on various kinds of road surfaces engaged the serious attention of the congress. It seemed odd to Americans to learn that rails may be laid directly on natural soil of gravel or sand, but a conclusion of this kind is no doubt written to cover conditions in the colonial territory such as Morocco. An interesting construction used by Mr. Brodie at Liverpool is to interpose a bed of pitch between the rail and the concrete foundation as the only fastening. The rail is raised clear of the surface, when practically set, and supported on hard wooden pieces of the same length as the width of the base of the rail, so that the rail is set in position true to line and level. These wooden pieces do not exceed ¾ in. in thickness. Temporary lines of sand or chippings are then laid just clear of the edges of the base of the rail, and a tempered mixture of pitch and oil, to which an equal bulk of hot sand has been added and thoroughly mixed in, both being at a temperature of about 300 deg. F., is then poured into the space between the upper side of the concrete and the under side of the rail until it comes up slightly over the upper side of the base, and completely surrounds and fixes in position the wooden packing pieces. When the mixture cools, the temporary lines of sand or chippings, which acted as small dams to retain the liquid pitch mixture, are removed. The mixture when cool sets to a semi-plastic consistency, and takes a firm grip both of the rail and the concrete, and forms an excellent bond, keeping the rail in exact position, so that no movement of the rail is permitted, and shutting out absolutely the possibility of water finding its way down between the rail and the concrete.

The method when carried out thoroughly, has done away with the trouble from rising sets or displaced paving alongside the rail in tramway streets.

The hold which a satisfactory [illegible] has on the concrete and the rail is well seen when moving the rail for reconstruction purposes. In such cases it becomes necessary to use heavy levers and bars to bring the rail off its bed, and when the joint is broken it will be found that in some portion of the length of the rail the pitch mixture parts from the rail surface while in others the mixture parts from the concrete and often brings away with it any weak portion of the concrete.

The reports upon this question are of exceptional interest and value. The live discussion of the problems of tramway rails on roads will recall the conference on paving held at the Engineers' Club in Philadelphia some few months ago.

A number of reports were received on the topic "Progress Made in Modern Mechanical Appliances Used in the Construction of Roads." Ten reports were received from the United States, one from France and one from Great Britain.

Question 4. The Development of Motor Transport—The fourth question was the development of motor transport, upon which reports were received from Spain, United States, France, Great Britain, Italy, Netherlands, Switzerland and Czechoslovakia.

In France the number of automobiles in 1920 was 231,074, as follows:

Passenger vehicles	public	20,812	
	private	132,759	
	Total		153,571
Lorries	public	6,364	
	private	71,139	
	Total		77,503
	Grand total		231,074

There were five times as many motor buses in 1920 as in 1913. In 1921 the number of motor vehicles which paid taxes, outside of the three departments, was 287,182, of which 92,730 were heavy vehicles. France has one motor vehicle for each 160 inhabitants; Switzerland one for every 151 inhabitants; and Great Britain one for each 110 inhabitants. France subsidizes motor transport lines capable of transporting at least 20 passengers each way per day, 500 kilos of luggage and 2,000 kilos of goods.

It is considered in France, as in Italy, that the economic conditions will prevent the creation of new railway lines, and that automobile transport, which can be rapidly installed and at a still approachable outlay, must supply the needs for increased transport. There were 164 subsidized motor transport lines in 1921. Many lines have been abandoned by the first contractors, concerning which the French reporters remark that:

> The cause lies more often in that, tempted by the bait of promised subventions, and knowing little about the limitations, maintenance and renewing expenses required for a well established automobile business, having underestimated, if not completely omitted these items, amortization charges on the capital, contractors badly advised undertake engagements which are too onerous and which they very soon find themselves unable to keep. May we express the wish that the Public Authorities warn them against their own impulse and only grant subventions to these contractors or companies having sufficient technical and financial capacities to carry out satisfactorily the services they offer to ensure.

The French reporter gives relative costs of motor transport in 1910 and 1922, and remarks that the whole business of the motor transport situation is dominated by the question of fuel. He discusses the use of the mixed carburant, a mixture of equal parts of alcohol and benzol.

The English reporter speaks of the decay of road transportation after 1850, consequent upon the building of railroads. By 1906 the traffic of the country had commenced to flow once more over the roads. In 1914 the advance of motor transport was steady until the war, when road transport increased rapidly because of the limitation of the capacity of the railroads. The freeing of motor vehicles from war service attracted a number of drivers to this work, who, being untrained in careful business methods, undertook rates which, while meeting the actual cost incurred and providing a living wage, were insufficient to assure the upkeep of the vehicle and equipment over a long series of years. Meanwhile the railways had been allowed to fall into poor condition. According to the English reporter, the deficiency of the railway rather than the merit of motor transport was the cause of the rapid growth of road traffic, and not until there is free play allowed to economic operating conditions will the question of the advantage or disadvantage of the two forms of conveyance for the two classes of traffic be determined.

A number of instances are quoted of the experience of merchants in hauling various commodities to London by motor trucks, to an economic advantage. The reporter remarks that there are always reasons for the use of the roads other than that of comparative costs. The average haul on the railroads in Great Britain was 50 miles against 186 miles in the United States, in the year 1920.

As in certain portions of the United States, unrestricted competition between motor bus lines has led to unfortunate results, recognized by the motor truck operators themselves who are now desirous of control by public service corporations. The English reporter speaks of the influence of roads in changing the location of cities and the drifting of factories to the surrounding rural areas, which brings forward problems in country planning.

In Italy there is a scarcity of railroads, and automobiles have become a necessary auxiliary of service, with fixed rates and time-tables, in bringing movement and life to the most distant and inaccessible inhabited places, delivering entire regions from their isolation. Motor bus lines are subsidized by the government. In 1905 there was a single subsidized automobile line; in 1921, 631 lines, with a total length of 23,910 kilometers. A number of lines covering 25,000 kilometers are not subsidized, but are under the control of the state, which settles questions of competition and regulates their operation relative to the subsidized lines. Lines destined exclusively for the transportation of goods are run without financial assistance from the state. The reporter concludes that rules serving as a basis of subsidized passenger service could not be applied to goods service, since motor vehicles should never travel empty, which would be the case if fixed time-tables and hours were imposed upon these freight carriers. It is hoped in Italy that better co-ordination between these goods carriers and railway services may be established, so that there will be a single movement from distant points to house-door in an interior town. In 1901 the state imposed heavy burdens on such motor transport companies. In 1904 the principle of subsidizing such roads was established. The motor service suffered so heavily during the war that special efforts were made by the state to encourage the resumption of the highway motor bus traffic by increased subsidies, increased payment for postal service, and in supplying petrol at a special price.

Up to 1914 very few attempts were made to use the motor truck for the transportation of goods, but after the war and the freeing of the immense stock of motor trucks, the road transport of goods increased. The number of motor vehicles in Italy in 1921 was estimated as 100,000, one for every 350 inhabitants. Costs of motor car service are extensively quoted in the report.

The Italian government grants a reduction in traffic tax for automobiles furnished with pneumatic tires. A test is reported at Milan of a good tarred road showing a unit consumption of petrol to be 26.7 grams per ton-kilometer total weight, and 42 grams per ton-kilometer of useful capacity. On an ordinary macadam road in moderately good condition, the consumption was 76.5 grams per ton-kilometer total weight, and 146 grams per ton-kilometer of useful capacity, about three times excess.

It is to be noted that the Italian government has granted a concession for the construction of a highway exclusively for automobiles, from Milan to the Italian Lakes. Tolls are to be charged, based on weight and power of the vehicle.

In Switzerland there is an extensive use of motor buses. The passenger cars increased 560 per cent from 1910 to 1922, and the trucks 1676 per cent. Since the last year of the war, 1918, passenger cars have increased 1.3 times and trucks 2.5 times. In 1904 the postal administration added the first motor truck to its service, and a passenger bus line was installed the preceding year. In 1921 there were 51 licensed automobile services. The principle of subsidy obtains in Switzerland where 20 concerns receive assistance from the states or from municipalities. The private concerns carry passengers in large, open touring cars, running from the larger towns. They are considered to be competitors of the railroads. The reporter from Switzerland gives valuable data on the cost of passenger car and motor truck service.

One conclusion of the Congress with respect to the development of motor transport stated that, where railways and tramways cannot penetrate, traffic should proceed by the highways and be encouraged by the governments, if necessary, by granting subsidies sufficient to insure their existence and in proportion to the service they are called upon to render. Research was recommended into the economical sources of energy. The motor vehicles must be adapted to the roads, so as to diminish the effect of rapid running or heavy traffic; as for instance, including tires, method of suspension and braking.

Question 5. General Traffic Regulations—General traffic regulations have received considerable attention in Europe, and formed the subject of an International Congress in Paris in October, 1921. Exceptions were made for farm vehicles traveling for short distances on the road. The continental regulations are based on the principle that the heavier the car the less the speed. No limits of speed are fixed for cars of a weight less than 3,000 kg. The width of tires was fixed by the specifications that the weight shall not exceed 150 kg. per centimeter of width. Automatic speed regulating devices are recommended for freight vehicles in excess of 3,000 kg. Provision was recommended for an international certificate for drivers and for cars.

The French recognize a distinction between vehicles with solid and with pneumatic rubber tires, and M. Chaix quotes an experiment on a newly built macadam road, on one side of which trucks weighing 6,500 kg. loaded ran at 22 km. per hour for 2,000 passages. Under pneumatic tires the surfaces were slightly cut up; the wear of material was 0.33 cubic meters. Under solid tires the surface was destroyed; the wear was 5.3 cubic meters. On a tar-macadam surface, the solid tires removed only one-quarter as much material as on the macadam surface.

M. Chaix recommends control of the speed on roads of different classes. Concerning the load per width of tire, he remarks that if the loads are unduly limited, then the number of vehicles must be increased to the detriment of road surfaces. He mentions the placing of brakes on all four wheels as is found on some cars in Europe at the present time. He remarks on the difficulty of applying the force equally to all four wheels and also leaving freedom to the guide wheels. For heavy freight trucks the continental countries provide an apparatus independent of brakes and motor, to prevent the vehicle from running back down the hill when starting.

In England and the continent, steel tires are still found on motor vehicles, especially those propelled by steam. The speed of these is especially limited. In France the law provides that within a term of six years all motor vehicles must be supplied with rubber tires.

Czechoslovakia reports the formation of road regulations as based on the French code of May, 1921.

A table of suggested weights and maximum speeds was introduced in the conclusions, against the protest of some of the delegates who considered that the information justifying such a table was not yet available.

Question 6. Traffic on Congested Streets—Probably the reports on this section will be of most value to readers in the United States, as an exposition of the elements entering into this problem, and the new ideas. The reports on this question by the French and English reporters are of especial excellence. The English are introducing safety first competitions among the school children similar to those conducted by the Highway Education Board in the United States. An observer of continental traffic, especially in Italy, is somewhat surprised to notice that the automobile dominates the situation and that the foot passenger is apologetic.

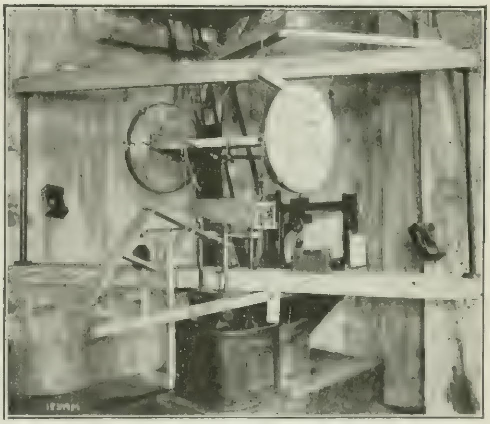
Congressional Committee on Reforestation

Before closing its season's work the U. S. Senate Select Committee on Reforestation made a trip to the Great Lake states to hold public hearings at various cities in those states and to see some of the work now going on. They found that Michigan plans to segregate all lands that are to be used for reforestation and to reduce the taxes on such land to the rate of five cents an acre for a period of twenty-five years. After that time the owners will pay back to the state twenty-five per cent of the value of all products taken. John W. Blodgett, President of the National Lumber Manufacturers Association, recommended that the federal government issue bonds for the purchase and reforestation of at least 3,000,000 acres of land in Michigan, Wisconsin and Minnesota. Filbert Roth, Dean of the Forestry School of the University of Michigan, stated that in his opinion at least 10,000,000 acres should be reforested in Michigan.

Torsion Test Rig for Testing Machine

In order to secure information for use in the design of rudder posts, elevator spars and aileron beams for aircraft, torsion tests of such members are necessary. No torsion testing machine readily adaptable to large specimens in a variety of shapes being available, engineers at the Forest Products Laboratory, Madison, Wis., built the apparatus which is here shown.

A specimen for test is secured in the two large disks which hold its ends, the motor is started and the motion of the descending crosshead of the machine is transmitted to the disks by the straps attached to the short beam (shown end foremost) bolted to this head. As this movement is received by the disks it is resolved into a rotation (counter-clockwise for the nearer disk and clockwise for the farther one) and a downward motion of both disks with the specimen. This downward motion, measured at the center of the specimen, proceeds at half the speed of the crosshead of the machine. By means of the supporting framework, the pull on the disks is communicated to the weighing platform on which the lower horizontal beam rests and is registered on the weighing dial of the machine.



TORSION TEST IN UNIVERSAL TESTING MACHINE

The amount of distortion in the specimen, caused by the opposite turning of the disks, is measured by the relative rotation of the arcs fastened to it. As the specimen twists, the light cord on the farther arc is slowly wound onto it while the cord on the nearer arc unwinds. The lower ends of these cords are fastened to a lever system which transmits the average rotation of the arcs to a fine wire passing around a small shaft carrying the pointer of the graduated dial seen in the left foreground. The distortion thus registered in inches may be converted to degrees of arc by the use of a suitable factor. The downward motion of the specimen is eliminated from the dial readings by causing the dial-and-lever system to move downward at the same rate. This correction is effected by supporting the dial on a pantograph arrangement fastened to the crosshead and adjusted to halve the crosshead motion.

The large weights on each side serve merely to counterbalance the weight of the disks on the sides not pendant from the frame. Coil springs inserted in the light chains just above these weights relieve the jar of sudden failure and protect the chains from breakage.

St. Louis Plans Wider Streets To Relieve Traffic Congestion

Major Street Plan Provides Continuous and Wider Traffic Routes to Business District From All Sections of the City

A PROGRESSIVE and well considered plan for the relief of traffic congestion in St. Louis is embodied in the Major Street Plan, funds for which were provided in the bond issue of $67,000,000 voted last fall. An item of $8,650,000 was included in this bond issue for "establishing, opening, and widening streets." With the widening of Washington Ave., and the opening of South 12th St., already undertaken according to the plan from current funds, and with the benefit assessments on property provided by charter, this bond money, as the city's share, will complete the major street plan as now laid down. It is not contemplated that the plan will definitely solve the city's traffic problem. Indeed traffic increases so rapidly that while the proposed street widening and extension will multiply the number of vehicles that can use the streets, it may be that the growth of traffic will surpass the new accommodations and when the plan is completed congestion will still exist. Then, or before then, other means of relief will be required. Estimated at its least, however, the present undertaking is a long step toward improved traffic conditions.

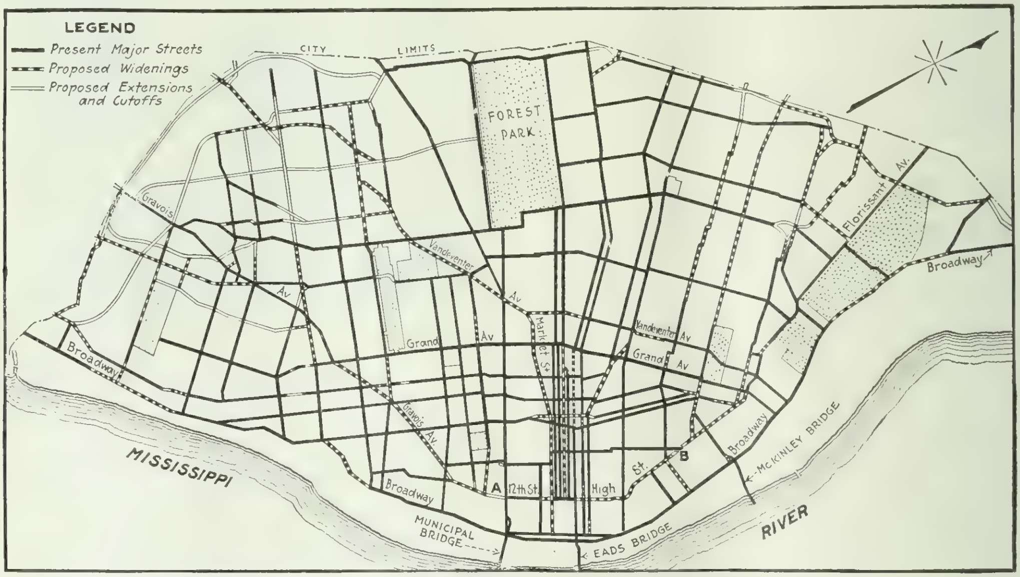


FIG. 1—MAJOR STREET PLAN TO RELIEVE TRAFFIC CONGESTION IN ST. LOUIS, MO.

Major Street Plan—Developing westward from the old settlement on the river front, St. Louis grew large without much thought given to planning streets with an outlook beyond the exigencies of the immediate requirements. In general the checkerboard arrangement adopted for the old town was continued. Radial streets as a planned means of direct access to the business center were not considered. The streets shown on the map, Fig. 1, as having a somewhat radial location—Broadway nearest the river and the route made up of Gravois and Florissant Aves. linked in the business section by 12th, High and 15th Sts.—were so located to conform to the curve of the river and not as planned radial arteries for traffic. Moreover, the link through the business section formed by S. 12th, High and 15th Sts. was broken at *A* and at *B*. All these streets, like most of the rectangular streets in the business section, were narrow.

With the street situation as briefly outlined and as indicated by Fig. 1, the City Plan Commission, Harland Bartholomew, engineer, after a careful study, reported a Major Street Plan to meet the arising traffic conditions. The nature of this improvement is indicated by the map. It is chiefly a task of street widening and in a few cases of opening new link streets. Incidentally on these streets new paving is called for and it will be designed for heavy traffic. The traffic situation that the plan is designed to improve has grown almost beyond control.

Traffic Development—In 1914 in St. Louis there were 9869 licensed motor vehicles; in 1921 there were 60,473. It is predicted that in 1926 there will be 200,000 licensed vehicles. This is not considered an illogical assumption. Los Angeles, Calif., for example now has over 200,000 motor vehicles and it is a smaller city than St. Louis. With the completion of the vast improved road programs of Illinois and of Missouri, a constantly increasing number of outside vehicles will come to the city. A large portion of this traffic comes to the business section of the city, which is approximately the area lying between 12th and 4th Sts. and Washington Ave. and Market St. This traffic at present is compelled to follow a few parallel east and west streets.

Concentration of traffic to and from the business district on a few east and west streets would be presumed from a study of the map, without further evidence.

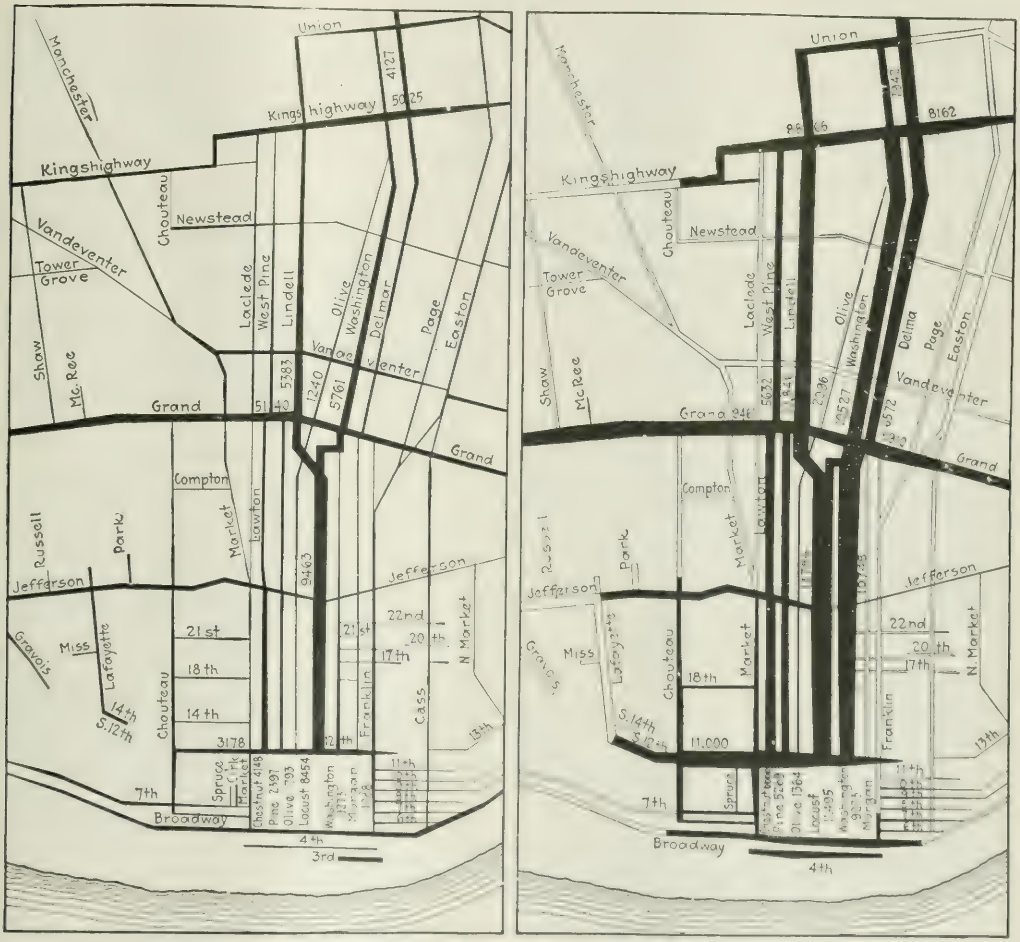


FIG. 2—CENSUS CHARTS OF TRAFFIC GROWTH IN ST. LOUIS

These streets are the direct travel routes from the west. Travel from the northwest and the southwest naturally swings into Grand Ave. and turns east on Chestnut, Pine, Locust, and Washington Sts. In fact, there are no other available routes, the partially diagonal routes are disconnected and inadequate in width and character of paving. As a matter of fact, traffic counts admit no doubt of exactly the situation described.

Since 1916 a traffic census has been kept for the group of streets mentioned. The diagram, Fig. 2, shows the results for 1916, and five years later for 1921. First, both diagrams indicate the concentration of travel on the few east and west streets which penetrate the business section. Second, it is made clear that this traffic in five years has increased to several times its volume in 1916. Incidentally the figures for 1922, which have not been charted, indicate a continuing increase. It is this enormous growth which raises the question, as has already been noted, whether congestion will not be a problem still pressing for solution when the present Major Street Plan is completed.

This plan will relieve congestion, as of present traffic, in two ways: (1) The two radial routes (a) Broadway and (b) the Gravois Ave.-12th St.-Florissant Ave. route, will be made continuous and widened and paved to offer desirable direct routes to the business district from both northwest and southwest; (2) the present narrower east and west streets will be widened and paved to accommodate more vehicles.

Financing the Improvement—The bond issue before mentioned provides the means for carrying out the Major Street Plan. In St. Louis, by charter, costs of street widening are distributed for every project in three ways: (1) Upon the frontage opened or widened, (2) upon a district deemed to be benefited by the improvement, and (3) upon the city at large. The actual distribution of cost varies in every project, and is determined by a special commission of three appointed by the Circuit Court. In every case there is a certain percentage of the cost assessed against the city as payment for a city-wide benefit. The bond money will provide the city general fund for the work proposed by the Major Street Plan.

At the present time ordinances have been passed for approximately 75 openings and widenings in accordance with the plan. It is estimated that the city's share of the cost of these projects will be somewhat over $6,000,000. In order to expedite acquisition of title and completion of improvements, where legal delays are involved in realizing the benefit assessment portion of the cost, there has also been provided a revolving fund of $2,500,000. Under the plan Washington Ave. has already been widened, the city's share being provided from current funds. This has produced great relief to traffic and substantial increases in property value have been recorded. The opening up of S. 12th St. to Lafayette, financed in the same manner as was Washington Ave., has provided an important new traffic way as the charts of Fig. 2 clearly indicate.

Quality and Treatment of Municipal Water Supplies

Abstracts of Papers Presented to the Chemical and Bacteriological Section of the American Water-Works Association at Its Recent Convention

Mixing Devices and Reaction Time

By Charles P. Hoover
Chemist-in-Charge, Water Purification Plant, Columbus, Ohio

Results of plant operations and laboratory experiments indicate that velocities of 0.3 ft. per second do not provide sufficient agitation for the treatment of turbid water or for water softening, but that the velocity does not need to exceed 0.6 ft. per second. Coagulation results obtained on turbid water at velocities of 0.6 ft. per second can be obtained at lower velocities only by adding an excess amount of coagulant. A short mixing period of 20 or 30 min. at 0.6 ft. per second velocity is more effective than a mixing period of 1½ hr. at 0.3 ft. per second velocity.

Mechanical agitators are less expensive to build, are more compact, obviate the necessity of lifting the water the extra 2 or 3 ft. necessary to pass through baffled maxing tanks and provide greater flexibility and accessibility.

Temperature is a more important factor in water softening than time.

Waters containing magnesium salts are more difficult to soften than water containing only calcium; magnesium carbonate is especially hard to remove, but magnesium salts can be precipitated by overtreatment with lime. By such overtreatment, followed by neutralizing the excess lime with sodium carbonate, waters having a hardness of 572 to 1044 p.p.m. can be reduced to a hardness of less than 30 p.p.m., or less than 2 grains per gallon. If it is not desirable to use excess treatment, better water softening results are obtained by split treatment than by the ordinary method of applying all of the chemicals to all the water under treatment.

* * *

Hydrogen-Ion Concentration and Alum in Filter Effluents

By William D. Hatfield
Superintendent of Filtration, Highland Park, Mich.

Results of numerous tests on the water of Lake St. Clair before and after filtration through the purification plant at Highland Park, Mich., have been analyzed for alum content. The following is a summary of the conclusions reached:

(1) Curves plotted according to the Clark's pH-time method from data obtained by treating Lake St. Clair water with alum show an apparent iso-electric point for aluminum hydroxide under these conditions at 6.1 or 6.3 pH units.

(2) Curves are given in the paper which show that in filtration the effluents from alum-treated waters are practically free from all the aluminum added as alum when the pH value of the treated water lies in the zone between 5.9 and 7.5 pH units. Mechanical filtration plants operating within this zone will probably not only remove all the added aluminum but also some of the aluminum naturally dissolved in the raw water.

(3) A water which has been under-treated with alum and has a pH value of more than 7.5 may have a solvent action on the floc in the sedimentation basin and on the filters such that the effluent will contain more aluminum than that in the raw water plus that added as alum. This is probably also true of an overtreated water.

(4) It is firmly believed that the importance of hydrogen-ion concentration has been established in water-supply work and that each year it will be applied more and more to practice.

* * *

Hardness of American Water Supplies

By W. D. Collins
With U. S. Geological Survey, Washington, D. C.

Thirty-nine million people living in 307 cities use the water supplies on which analytical data are reported in the forthcoming Water Supply Paper 496 now nearly ready for distribution, on which the following statements are based.

The average hardness of the water used by those in the 307 cities considered is 99 p.p.m. which is nearly the same as the average hardness of the water from the Detroit supply. The average hardness of water from surface supplies used by about 35,000,000 people is 85 p.p.m. and the average for the ground water supplies used by about 4,000,000 is 225 p.p.m. The average hardness of water from the public supplies of large cities is less than 55 p.p.m. in the New England states, in the other states except Florida along the Atlantic Ocean and the Gulf of Mexico east of Texas and in Washington and Oregon. From large public supplies in Idaho, Kentucky, Montana, Nevada, Pennsylvania, Tennessee and West Virginia, it is from 56 to 100 p.p.m. In some of these states the larger supplies are from sources that furnish much softer water than can be obtained generally in the state. In the states not named above the average hardness is from 100 to 500 p.p.m. About 3,500,000 people use water from Lake Michigan which has a hardness of about 130 p.p.m. The water is softened at several cities in the Mississippi drainage basin. Throughout this area and in the Southwest the hardness of the water of public supplies is generally between 250 and 350 p.p.m. except in the cities using water from the Great Lakes or from mountain streams, and in the cities where the public supply is softened.

* * *

The Pharmacology of Drinking Water

By Herbert C. Hamilton
Pharmacologist with Parke Davis Co., Detroit, Mich.

The most important feature in connection with mineral waters is that for one reason or another larger quantities are imbibed than of ordinary water. This is due partly to the pleasant or characteristic taste, partly to the routine prescribed by the physician and partly to the users giving themselves up to the course of treatment and making the most of it. Probably all the good of mineral waters would result equally from the similar use of any water but this should not detract from the use and exploitation of the mineral water for those who can afford it. The psychology of the treatment really requires a mineral water. The ascribing of mysterious virtues to mineral water is without basis, neither is the use of it at the springs instead of at home essential for developing its medicinal value. But scarcely indeed will the use be continued under the best conditions unless under the direct control of the attendants. Often, too, climatic and hygienic conditions are more nearly ideal at the springs and of no less importance than the water itself.

Broadly, to make water satisfactory for drinking requires only bacterial purification unless some absorbable poison is present, and most forms of purification are aimed at reduction of bacterial content. But hard water makes soap so insoluble that in some localities hardness is no less important than the bacterial content.

We may conclude that any adventitious circumstance under which water is used or any peculiar property actual or imaginary which will encourage a greater use of water, either internally or externally, is not to be underestimated in its bearing on health and, further, that few substances occurring in a natural water render it unfit for drinking purposes except the presence of pathogenic organisms responsible for intestinal diseases such as typhoid or dysentery.

* * *

Chlorine to Assist Coagulation

By Robert Spurr Weston

Consulting Engineer, Boston, Mass.

Owing to difficulties in operating the water purification plant at Exter, N. H., namely the choice between the evils of under-coagulation with inadequate purification or over-coagulation with corrosion, the accumulations of slimy coatings and mud balls in the filter sand, the high precentage of wash water and the at-times unpleasant vegetable taste of the filtered water, various expedients were tried. Prechlorination to assist coagulation seems to have given the best results.

The water is of the peaty type, soft, colored, sometimes turbid and always difficult to treat even with good mixing and an unusually long period of coagulation. The difficulties were increased following the raising of the reservoir dam in 1909 and again in 1916, thereby flooding additional unstripped areas. The average analytical results during 1913, when the water was treated with an average of 32.6 p.p.m. of sulphate of alumina, or nearly 2 grains per gallon, indicate a reduction in parts per million in color from 80 to 27, of iron from 0.84 to 0.30, turbidity from 16 to 3 and bacteria at 20 deg. C. from 408 to 39 per cubic centimeter.

At first, the bleach, mixed with alum solution, was applied in amounts equivalent to 1 p.p.m. of available chlorine. Later the dose was reduced to less than 0.6 p.p.m. It was found that the addition of 0.7 p.p.m. of chlorine effected the following change in the character of the effluent:

TABLE I—SIGNIFICANT RESULTS OF ANALYSES OF FILTER EFFLUENT WITH AND WITHOUT THE CHLORINE

	P.P.M.	
	[illegible]	[illegible]
Chlorine added	[illegible]	[illegible]
Turbidity	[illegible]	[illegible]
Color	[illegible]	[illegible]
Oxygen consumed	[illegible]	[illegible]
Nitrogen as albuminoid ammonia	[illegible]	[illegible]
Nitrogen as nitrites	[illegible]	[illegible]
Iron	0.22	0.10
Increase in chlorine	[illegible]	[illegible]
Bacteria per c.c. at 20 deg. C.	[illegible]	[illegible]
Bacteria per c.c. at 37.5 deg. C.	[illegible]	[illegible]

Subsequently chlorine gas was substituted for bleach, and the average dose decreased to 0.6 p.p.m. or less. This has been the only modification in eight years. However, the better purification decreased the amount of organic matter in the effluent and consequently the amount of water accumulating on the interior of the [illegible]. To reduce the increasing corrosive effect, soda was added whenever the alkalinity was low, thereby [illegible] the pH concentration. Soda was first added to the [illegible] water, but, with the realization of the fact that the best condition for the coagulation of color is one of low pH value, and for the prevention of corrosion one of high pH value, the treatments were separated. Alum and chlorine are now added to the raw water, and soda, when it is necessary, is added to the effluent.

Subsequently, Arthur L. Gammage made the experiments at Belfast, the results of which were published in *Engineering News-Record*, Sept. 7, 1922, p. 391, and the process has been applied by our firm at the Acadia Mills and elsewhere. Recently N. J. Howard has published the results of similar work at Toronto.

There are many plants where this process might be used with advantage, especially those which treat waters of high vegetable and color contents. Chlorine treatment of these waters before coagulation would reduce the amounts of unsaturated organic compounds in the effluent, thereby reducing the liability to the formation of odors and tastes due to compounds between organic matter in the effluent and the chlorine used to disinfect it after filtration.

* * *

The Degasification of Water

By J. R. McDermet

Research Engineer, Elliott Co., Jeannette, Pa.

The material for this paper is based upon the experience obtained in the development of a successful apparatus for the degasification of water. Part of it rests on work in the research laboratory, and part upon results gained in the application of these degasification units located variously over the entire United States, and ranging in capacity from 4,000 to 1,100,000 lb. per hour. Primarily, the apparatus derives its commercial merits from the fact that it is able to prevent corrosion in piping. [Various methods of degasification are next described and commented on.—Editor.]

The Elliott process is one of deaeration rather than degasification since the gases which are to be removed are normally the gases of the air. The apparatus operates through heat interchange, and at the same time is 100 per cent thermally efficient. In its operation the water is first heated to some 25 deg. above the temperature at which it is desired to use it, and then injected suddenly into a region of vacuum, in which the pressure is maintained at a value corresponding to the vapor pressure of the water at the temperature of use. The 25 deg. excess temperature is available as superheat in the liquid to the temperature of the vacuum, and when the water is injected, the heat immediately flashes some portion of the water into steam, evaporating it and disintegrating the rest completely. After disintegration, the water is collected and further passed back and forth over agitating spray pans for contact with the air inside the chamber. The vacuum in the separator chamber is maintained by some form of air-exhausting equipment in series with a condenser, the function of which is to condense and return to the system the vapors and the heat evolved in the boiling process. The cooling water for this condenser is supplied by the water entering the heater on its way to the heater, and the heat, therefore, interchanged by the condenser is returned to the heater.

The research laboratory has just completed an investigation on the behavior of the Elliott process upon dissolved carbon dioxide. The results will be forthcoming in a paper before the American Chemical Society, by D. H. Jackson, in collaboration with the present writer. It is possible, however, to summarize the results of this paper in advance by saying that the deaerator, so-called, and as previously described, removes all free carbon dioxide and decomposes approximately 25 per cent of the bicarbonate present, most of which is precipitated, and a small part, approximately 16 p.p.m., remains in solution as calcium carbonate. This percentage value increases slightly with concentration of bicarbonate. The pH values are changed by deaeration from slightly acid to a decidedly alkaline, the change averaging [illegible] pH. The results were obtained upon water from two surface streams, one in the vicinity of Jeannette, Pa., and the other from Pickering Creek, which supplies a suburb of the City of Philadelphia. The pH values on the raw water for the series of determinations averaged around 6.7 and the pH on the deaerated samples [illegible].

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Tractor-Operated Dredge Pump Cleans Drainage Ditch

By Frank D. Danielson
Village Manager, Hinsdale, Ill.

With a Fordson tractor and 6-in. centrifugal dredge pump, the main drainage and sewer outlet of Hinsdale, Ill., has been cleaned out with a saving of $10,000 to the village over other proposed methods. The main feature is the mounting of the pump on skids on the bank and not on a float in the stream as is usually done.

The outlet ditch runs some seven miles down through the valley known as Flag Creek and empties into the Desplaines River. The part of the stream opposite Hinsdale and for a distance of two miles south had filled up with sediment which threatened the proper functioning of the entire drainage system. The village of Western Springs also uses this stream for part of its sewage. Relief was necessary at once and there was no time to spread a special assessment in payment for the work, which was estimated at about $15,000. An experiment was made in which dredging was done by the hydraulic method applied from one side because there was insufficient water to permit mounting the pump on a scow. However, an auxiliary float was used for handling the suction hose. A 6-in. spiral pipe was used for the discharge which was directed for the greater part of the time to the opposite side of the stream. The pump was mounted on skids made from 6 x 8-in. timbers 12 ft. long, with 4 x 6-in. cross supports bolted to the skids.

CLEANING SEWER OUTLET WITH DREDGE PUMP
Tractor (at left not shown) is belt-connected to pump mounted on skids and can be reset in 25 minutes.

Sand, mud, silt and stones were readily picked up by the suction force. No agitating device was required; instead, two men, as shown in the cut, used long pole shovels. A third shaped up the sides and a fourth, acting as foreman, operated the tractor and watched the performance of the pump.

This method of dredging from the side of the stream was made possible by the use of flexible suction hose which could be moved along from point to point as the work progressed. A part of the hose rested on a float with the suction end projecting over the front. A 45-deg. elbow was used at the hose end under water. The discharge end had a flap valve, closed when priming, an operation accomplished by means of a threshers' pump. Power, speed, and size of pulleys to be used were matters of study to fit actual conditions.

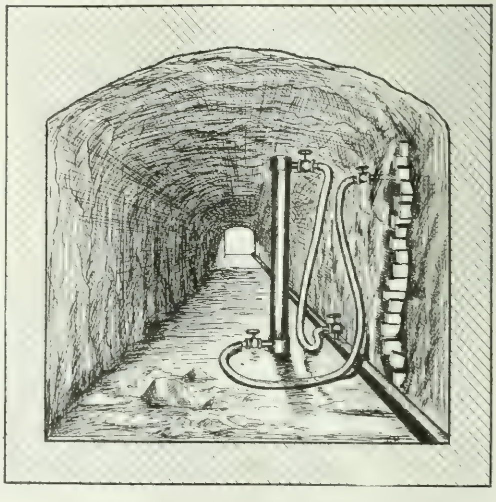
The amount of solid material pumped ranged from 15 to 30 per cent. A stretch of 20 to 25 ft. was cleaned to a depth of 5 ft. below the old stream bottom during each setting of tractor and pump. The time required for a re-setting did not exceed twenty-five minutes. About 2 cu.yd. of material were removed per lineal foot dredged, and a section from 50 to 90 ft. long was completed each day, which made the total cost of removal between 14 and 21c. per cubic foot.

Home-Made Grout Gun Stops Water Flow Into Tunnel

By John L. Digby
Big Creek, Calif.

A troublesome water-bearing seam encountered in heading No. 5 of tunnel No. 3 being driven by the Southern California Edison Co. on the Big Creek hydro-electric project was stopped by grouting with the aid of a simple device made up on the job.

This tunnel is 21 x 21 ft. in section and when the seam was encountered water flowed from it for the full 21-ft. height of the tunnel. The flow was stopped temporarily by calking it with oakum and holding the oakum with wooden wedges driven tightly for the full length of the seam exposed. This emergency method was not expected to be permanent in view of the heavy shooting at the heading a few feet away. To effect a permanent stoppage, therefore, a 1½-in. hole was drilled at an angle to the crack beginning about 2 ft. to one side of it and



APPARATUS FOR GROUTING SEAM IN TUNNEL

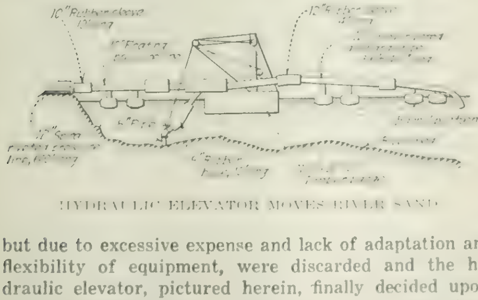
2 ft. below the roof of the tunnel. After drilling 4 ft. this hole struck the water-bearing seam. A 1½-in. pipe threaded on one end was inserted in the hole and calked, leaving the threaded end protruding about 2 ft. Flow through this pipe was stopped by fitting a valve to the threaded end.

In the meantime a 20-ft. length of 6-in. pipe capped and fitted with 2-in. valves was filled with grout and brought into the tunnel. This pipe container was set up vertically near the seam; the lower end was connected by a 2-in. rubber hose with the pipe leading into the seam and the upper end was connected by a similar hose to the main compressed air line supplying the drills and carrying a pressure of 125 lb. per sq.in. When the valves were opened in a very few minutes the 20-ft. length of pipe was emptied of cement—this being determined by tapping on the pipe. The valves were then closed and the pipe removed. Within 24 hours the seam was quite dry and in spite of heavy shots in the heading nearby, some of which used as much as 40 boxes of powder at one time, the seam gave no further trouble.

Moving River Sand by Hydraulic Elevator

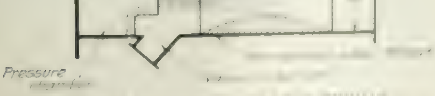
By R. Franklin Mundorff
Kansas City, Missouri

FOLLOWING the construction of a concrete dam at Decatur, Ill., it was desired to pack sand under the edge of a horizontal concrete apron. The particular job presented the problem of moving 18,000 cu.yd. of sand in a river to a new location 400 ft. away in a deep hole in the river bed. Many methods were considered, but due to excessive expense and lack of adaptation and flexibility of equipment, were discarded and the hydraulic elevator, pictured herein, finally decided upon. The equipment designed was found to be particularly adaptable inasmuch as there was available sufficient high-pressure water and because a small, inexpensive barge would accommodate necessary equipment and the pumping unit could be mounted on the shore.

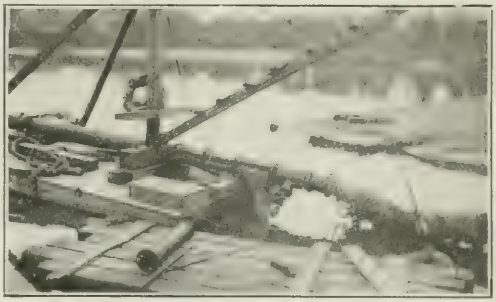


HYDRAULIC ELEVATOR MOVES RIVER SAND

The elevator was placed on a small barge and the water pressure line brought aboard on barrel pontoons. This pressure line was fitted with 10-in. by 10-ft. rubber sleeves at both the shore and barge ends. The suction consisted of a 10-ft. length of 8-in. rubber hose and two lengths of 8-in. pipe. This was supported by a block-and-tackle extending from a small stiff-leg derrick and was raised and lowered by a hand winch. The discharge line, varying from 350 to 400 ft., was supported also by barrel pontoons. The discharge end of the line was submerged in order to eliminate a static head against the elevator.



SECTION THROUGH [illegible]
All the [illegible]



MECHANICAL ARRANGEMENT OF ELEVATOR
The three flanged sections in front of the derrick constitute the elevator. The nozzle is in the rear end of the Y. The suction pipe is operated by the derrick.

A large reciprocating pump with valve gear was used to supply the pressure water. Actual results obtained were from 50 to 60 cu.yd. of sand per hour, exclusive of the time used for changing location. The pressure used was 1,670 gal. per minute with a pressure at the pump of 80 lb. per square inch. The pressure at the elevator nozzle was 70 lb. per square inch. The elevator began to pick up sand at 25-lb. nozzle pressure and worked well at 40-lb. pressure, showing no improvement above a 70-lb. pressure.

The installation was made by George B. Massey of the Randolph-Perkins Co., Chicago, Ill., for the city of Decatur.

Concreting Leakage Seams in Small Dam

INGENIOUS handling of difficult problems was involved in the repairs to the Ephratah dam of the Fulton County (N. Y.) Gas & Electric Co., recently undertaken. The repairs were necessitated by leakage through seams in which the bond was weak, and through expansion cracks. The difficulty was increased by the decision to make the repairs from the upper side of the dam.

For the purpose of this undertaking a semicircular caisson 5 ft. across and 20 ft. deep was fashioned out of ¼-in. boiler plate with reinforcement ribs of angle iron bent to fit the caisson, and with a bulkhead at the lower end. To float the caisson from one position to another oil drums were fastened at the top. When the caisson was floated into position against the face of the dam a 4-in. siphon with 20 ft. of suction head drew the water from the interior. As the water level was lowered the leakage through the sides decreased because of the increased pressure and the resultant [illegible] [illegible] of the caisson to the face of the dam. A [illegible] siphon took care of the leakage after the water had been practically all drawn off, until this leakage could be prevented by calking the space where the caisson joined the dam.

The leaks in the dam were repaired by cleaning the cracks or seams, building a protecting form over them and pouring concrete into the cracks. The concrete was allowed to set before the caisson was moved to its next position. Some of the patches were more than 12 ft. in length.

Planking and bolt stubs left in the face of the dam by the builders complicated the work, by making it difficult to seal the caisson. After some experience a 2-in. thickness of felt was applied to the edges of the caisson, replacing strips of rubber hose originally used to prevent seepage.

Melting Ice Allows Heavy Tank To Settle Slowly to Place

RECTANGULAR steel tanks used as brine containers in ice plants of the Union Ice Co. of California are lowered from construction position just above the foundation onto the permanent support with the aid of blocks of ice which carry the weight of the tank while blocking is being removed and then, as the ice melts, allow the tank to settle to its foundation. The buildings in which these tanks are installed are not designed with a frame from which the tank could be suspended and the melting ice method has been found cheaper and more satisfactory than erecting temporary means of supporting the tank while lowering it to position.

ICE CAKES LOWERING 22½-TON TANK TO FOUNDATION

The foundation prepared before work starts on the tank consists of a concrete slab covered by several inches of cork and surfaced with asphalt. The tank is riveted up on blocking 3 to 4 ft. above this foundation in order that workmen may have access to the under side of the tank during the process of riveting, calking and painting. When the tank is finished the blocks of ice are placed and the tank is lowered on jacks until the ice carries the weight, after which all jacks and blocking are removed and the melting ice allows the tank to settle to final position.

The tank shown in the accompanying photograph has plan dimensions of 33 x 84 ft., is 4 ft. deep and weighs about 22½ tons. Two rows of ice blocks were placed under it on 12-ft. centers and to hasten the melting process small wood fires were built inside the tank, one over each supporting cake of ice.

In the case illustrated, 300-lb. ice cakes whose dimensions were 11½ x 22½ x 42 in. were set on end. More frequently the cakes are set on edge, the 22-in. dimension. The tank can be quickly "jacked down" to this 22½-in. height, which is sufficient clearance for the removal of all blocking. When the ice cakes are on edge there is less danger of slipping or uneven settlement. With the aid of small fires in the tank the 22½-in. thickness of ice is ordinarily melted away in twelve hours.

Data from which the foregoing was prepared were supplied by H. L. Lincoln, superintendent of factories, the Union Ice Co.

From Job and Office

Hints that Cut Cost and Time

Design of Oil Tank Fire Walls

By F. W. Babbitt
American Petroleum Co., Houston, Texas

IN ORDER that a reasonable insurance rate may be secured on oil property, state fire insurance commissioners have laid down certain rules and specifications concerning the construction of tank farms. One of these specifications in Texas and Arkansas is that the cubic capacity inside the fire wall shall be one and one-half times the cubic capacity of the oil tank. Fire walls of course are a necessity, for with them fires, which may break out, can then be more easily controlled locally. As fire-wall design, to meet these conditions, is tedious, the writer has prepared two sets of formulas, given herewith, the first dealing with estimation of quantities where a tank is located on level ground, and the second a case in which the tank is on a side-hill location.

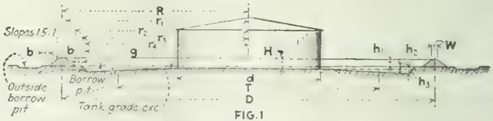


FIG. 1

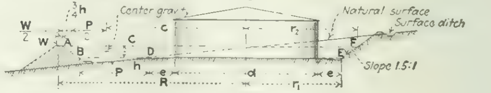


FIG. 2

For location of a tank on level ground (see Fig. 1) the following elements are involved in the fire-wall design:

Q = Cu. ft. inside of fire wall = contents of tank + 50%
Q_1 = Cu. ft. in cone frustum formed by fire wall
Q_2 = Cu. ft. in cone frustum formed by tank grade
Q_3 = Cu. ft. in borrow pit to complete fire wall
G = Cu. ft. in fire wall
D = Diameter of center line of fire wall
R = Radius of fire wall
H = Height of top of fire wall above tank grade
h_1 = Height of top of fire wall above ground line
h_2 = Depth of tank grade below ground line
h_3 = Depth of borrow pit
r_1 = Radius of top of cone frustum formed by fire wall
r_2 = Radius of bottom of cone frustum formed by fire wall
r_3 = Radius of top of cone frustum formed by tank grade
r_4 = Radius of bottom of cone frustum formed by tank grade
T = Diameter of circle of center of gravity of borrow pit
g = Top width of borrow pit
w = Top width of fire wall
b = Width of berm
d = Diameter of tank
π = Pi = 3.1416

From Job and Office

For Contractor and Engineer

The formulas which have been derived to establish the values of the foregoing elements are:

$$Q = Q_1 + Q_2 + Q_3$$
$$G = Q_2 + Q_3 = D\pi[h_1(1.5h_1 + w)]$$
$$Q_1 = \frac{h_1}{3}\pi(r_1^2 + r_2^2 + r_1r_2)$$
$$Q_2 = \frac{h_2}{3}\pi(r_3^2 + r_4^2 + r_3r_4)$$
$$Q_3 = T\pi h \times \frac{g}{2}$$
$$h_1 = \frac{3(Q - G)}{\pi(r_1^2 + r_2^2 + r_1r_2)}$$
$$h_3 = \frac{2Q_3}{\pi g T}$$
$$r_1 = R - \frac{w}{2}$$
$$r_2 = R - \left(1.5h_1 + \frac{w}{2}\right)$$
$$r_3 = r_2 - b$$
$$r_4 = r_3 - h_2$$
$$g = r_4 - \frac{d}{2}$$
$$T = \frac{4}{3}(g - 0.5h_3) + d$$

For locations of tanks on side hills, design is based on the following quantities:

Q = Cu. ft. inside fire wall = Tank contents + 50%
R = Radius of fire wall
d = Diameter of tank
h = Height of top of fire wall above tank grade
c = Distance from edge of tank to toe of slope in cut
r_1 = Radius of bottom of cone frustum *CDEF* (Fig. 2)
r_2 = Radius of top cone frustum *CDEF*
P = Long side of parallelogram *ABCD*
C = Radius of half circle made by center of gravity of parallelogram
w = Top width of fire wall
π = 3.1416 = Pi

Formulas to determine the values of the foregoing quantities are:

$$Q = \frac{h}{3}\pi(r_1^2 + r_2^2 + r_1r_2) + \pi PhC$$
$$h = \frac{3(Q - \pi PhC)}{\pi(r_1^2 + r_2^2 + r_1r_2)}$$
$$r_1 = \frac{d}{2} + c$$
$$r_2 = r_1 + 1.5h$$
$$P = R - \left(\frac{d}{2} + c + 1.5h + \frac{w}{2}\right)$$ [illegible]
$$C = R - \left(\frac{P}{2}\right.$$ [illegible]

[illegible]
DIMENSION TABLE — [illegible]

	Dimensions	310 ft	300 ft	290 ft	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	C, cu. yd	2,503	2,722	2,947	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	h_1, ft	5.7	6.0	6.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	h_2, ft	0.8	1.0	1.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	h_3, ft	1.2	0.7	1.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	H, ft	6.5	7.0	7.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	W, ft	4.0	4.0	4.0	4.0	4.0	[illegible]	[illegible]	[illegible]
	L, ft	5.0	5.0	5.0	5.0	5.0	[illegible]	[illegible]	[illegible]
[illegible]	C, cu. yd	2,893	3,371	3,461	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	h_1, ft	6.1	6.8	7.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	h_2, ft	0.5	0.5	0.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	h_3, ft	0.4	0.4	0.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	H, ft	6.6	7.[illegible]	7.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

A dimension table reproduced herewith has been computed on the basis of the fire wall containing contents of the tank plus 50 per cent. This table gives fire-wall diameters and other dimensions for tanks on level ground. The table is worked out for tanks containing 55,000 bbl. (42 gal. each) and for 37,500 bbl. and for two cases, one wherein ample drainage is presupposed and all material for the fire wall is taken from within the wall. The second case is one wherein poor drainage is present and the least amount of excavation possible is performed to provide a tank grade and drainage for the tank. The material necessary to finish the fire wall in case two is taken from the borrow pit outside.

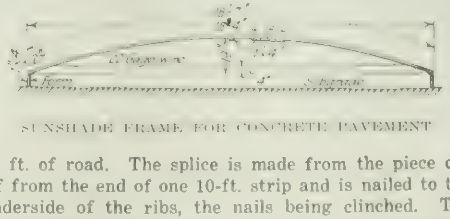
In using formulas given herewith there will be too many unknown quantities to arrive at definite results at the first computation. The second or third trial should balance the contents of the tank plus 50 per cent and the fire wall within a few hundred barrels, which will be close enough.

Sunshade for Protecting Freshly Laid Concrete Paving

By F. M. Bailey

Engineer-Inspector, Wisconsin Highway Commission

A LIGHT, inexpensive sunshade for protecting freshly-laid concrete has been designed by the Wisconsin Highway Commission. The 1923 specifications included the use of frames to cover at least one-half day's run as fast as the surface is finished. The framework is constructed from 1 x 4-in. and 1 x 3-in. strips, ¾ in. thick. The 1 x 3-in. strips are used for the ribs, five ribs spaced on 3-ft. centers making a frame to cover 12 ft. of road. The splice is made from the piece cut off from the end of one 10-ft. strip and is nailed to the underside of the ribs, the nails being clinched. The longitudinal strips to which the ribs are nailed with four nails clinched are 1 x 4 in., 12 ft. long. The framework can be nailed together on any flat surface and the sheeting tacked to the surface before the ribs are sprung. Holes ¼ in. in diameter are drilled through the ribs 1 ft. from the outer edge of the 1 x 4-in. strip, through which the wires are passed to form the lower chord and sustain the arc in the ribs.



SUNSHADE FRAME FOR CONCRETE PAVEMENT

These frames can be made up at any convenient point and transported to the job flat. When ready to use, the wires are threaded through the holes, the arc in the ribs sprung and the wires twisted up. When necessity requires the transportation of the cover from one job to another, the wires are untwisted which allows the frame to flatten.

Material for a frame consists of 37 ft. b.m. (about $3) of lumber, 25 yd. of unbleached muslin at $1.50, and 10 cents worth of wire.

As these frames are light two men can move them along as the paving proceeds. Where strong winds prevail, it may be necessary to use screw-hooks at the edges to fasten them to the forms so that they will not be blown out of place.

From Job and Office

Hints that Cut Cost and Time

Current Concrete Costs on Concrete of Reclamation Service

COSTS of concrete per cubic yard on work under way this last summer season on some of the U. S. Reclamation Service projects as taken from current cost reports are as follows:

Project	Feature	Cu. Yd.	Unit Cost Field	Unit Cost Total	Class of Concrete
Blackfeet	Drop Four Horns Reservation	565	$23.10	$30.00	Reinforced
King Hill	Relief drainage structure	89	22.62	26.60	Reinforced
No. Platte	Checks, North Port	82	21.40	25.00	Reinforced
Rio Grande	Checks and wasteway	125	19.53	23.75	Reinforced
Tieton Dam	Corewall	4,992	17.97	22.10	Reinforced
Riverton	Diversion dam	2,007	24.40	29.30	Reinforced
Riverton	Diversion dam	4,046	10.38	12.50	Plain
Yakima	Corewall	7,785	12.60	15.50	Plain

Two Types of Portable Grandstands

A NEW portable grandstand has recently been developed by the Department of Plants and Structures of New York City. The framework of the stand is built of structural steel units 5 ft. long and 1 ft. 5 in. high. Fig. 2 illustrates the method of assembling the units to form the risers of the stand. Car bolts are used to fasten the sections together. Longitudinal sway braces of 1¼ x 1¼ x 1¼-in. angle iron are bolted in between opposite panels of adjoining risers as the stand is erected. The risers are spaced 5 ft. apart. The flooring of the stand is made up in sections 1 ft. 8 in. wide and 10 ft. long, secured to the risers by clips which extend under the flange of the top angles of the riser frames. The seats are supported on pipe pedestals bolted to the floor sections.

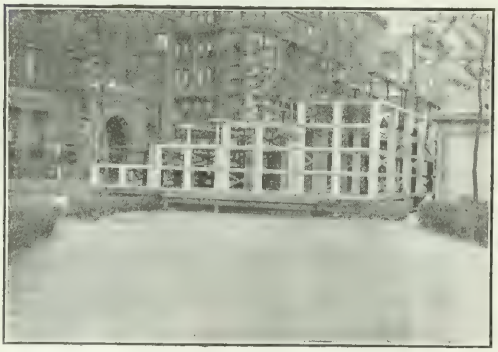


FIG. 1—PORTABLE GRANDSTAND OF DEPARTMENT OF PLANTS AND STRUCTURES, NEW YORK CITY

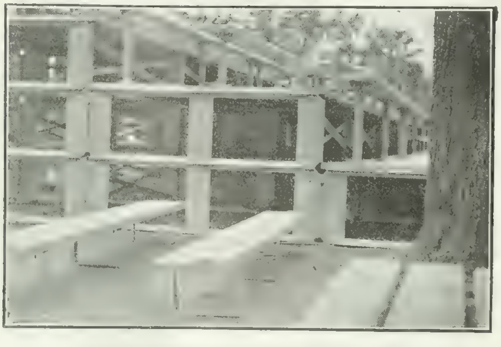


FIG. 2—DETAILS OF NEW YORK STAND

Two of the intermediate platform steps are in the foreground. The position of one of these steps can be seen between the bench supports just at the left of the tree.

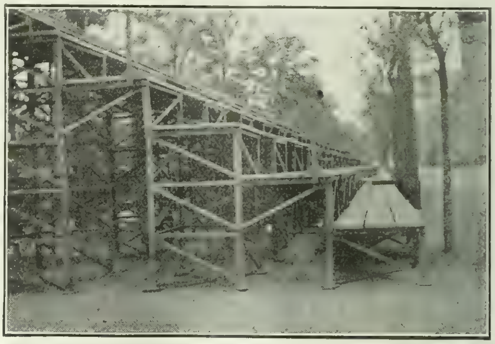


FIG. 3—PORTABLE GRANDSTAND OF WAYNE IRON WORKS

Fig. 3 shows a section of a patented portable stand built by the Wayne Iron Works. The units of this stand are horizontal sections of the square tower, each section being interlocked with the one below it. Special sections with an extension arm spanning the space to the tower in front of it carry the alternate levels of the platform. Each section is hinged at the corners in such a way that it can be folded up for storage.

A comparison of the two types of stand seems to favor the new stand of the Department of Plants and Structures, in so far as its usefulness as a stand goes. It is much less liable to collapse, and provides clean seats separate from the platform. The Wayne Iron Works stand is more economical of steel and as almost no bolting is necessary it can be erected and taken down with much greater ease.

Mess Costs per Man per Day on Reclamation Projects

THE following tabulation shows the cost of operating messes during the summer of 1922 on projects of the U. S. Reclamation Service:

Project	Location	Haul Miles	Man-Days	Cost per Man-Day
Flathead	Hubbard Dam	16	1,657	$1.04
Grand Valley	Camp 5	12	141	.86
King Hill	Camps B, C, and D	10	746	1.18
Klamath	Langell Valley	45	3,363	1.32
No. Platte	Interstate & No. Port	6	1,454	1.20
No. Platte	Fort Laramie	13	1,461	1.19
Riverton	Diversion Dam	38	1,048	1.16
Shoshone	Willwood and Shoshone Dams	13	1,448	1.47
Yakima	Tieton Dam	26	8,787	1.19

From Job and Office

For Contractor and Engineer

Ice Action and Corrosion Destroy Old Standpipe

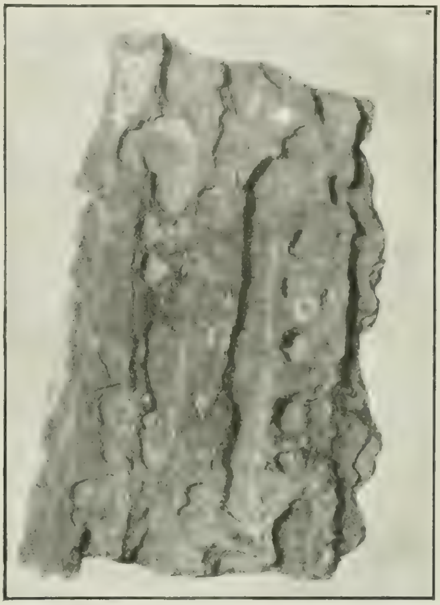
On April 9 the water-works standpipe at Black River Falls, Wis., failed by breaking off at a point about 25 ft. above ground. This standpipe was 16 ft. in diameter and 100 ft. high. The plates, as near as one could judge, were from ½ in. to 7/16 in. thick. This standpipe was erected in 1886.

The direct failure of the standpipe was probably due to ice formation. On Saturday, two days before the failure, the superintendent reports that the cake of ice rose 8 to 10 ft. above the top of the standpipe and remained there most of the time while he was pumping. Saturday night the temperature got somewhat colder, and after the water receded in the standpipe the ice also receded from view. On Sunday, when the standpipe was again filled, the superintendent was unable to make the ice float and show up above the top of the standpipe, although he overflowed the standpipe for a considerable time. Sunday night the temperature became warm again, and on Monday morning, when it was still quite warm, pumping began at about 6.45 a.m. The warm water thawed loose the enormous cake of ice, which must have been in the neighborhood of 90 ft. in height and 3 to 4 ft. in thickness all around the periphery of the standpipe. At 7.30 the standpipe failed.

At just what point this ice cake happened to be frozen to the standpipe is not known, so that it is impossible to say whether the cake first sank or whether it rose when it became loosened from the standpipe, but it must have moved in one direction or the other, and the impact was enough to start the failure. Persons who saw it said the standpipe swayed back and forth for a considerable time before it finally collapsed.

The standpipe fell to the south. The particular reason for its breaking off 25 ft. above the ground may lie partly in the fact that the bottom four rows of plates were thicker metal and had a greater resistance to the stresses produced by the ice.

There is another feature of this failure that is extremely interesting. This standpipe was painted but once, and that was when it was first put up, so that corrosion has taken place on the inside for 37 years. The water used in this system is a creek water, and is very soft and contains much organic matter.

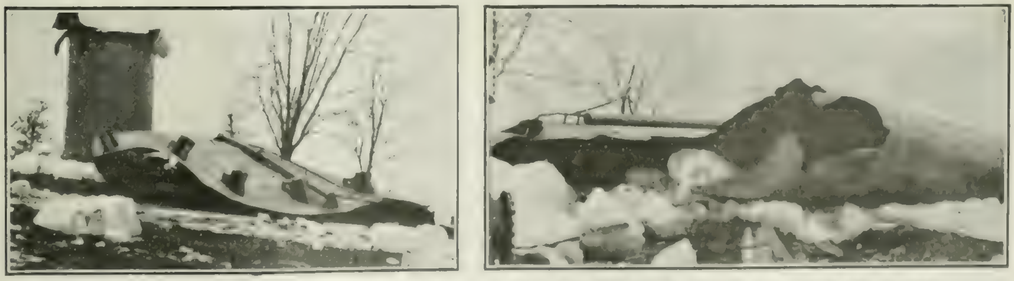


INTERIOR OF CORRODED SHELL, GROOVED VERTICALLY

A careful examination of the inside of the standpipe revealed the fact that the plates near the top were little damaged by pitting or other corrosion, but nearer the base more and more pitting appeared until finally the pits seemed to follow in channels, so that at the point of rupture the plates were furrowed as by a planer. Undoubtedly, when the water receded between pumpings drops of water collected and slid down the plates, the carbon dioxide in the water combining with the iron, continuation of this process picking up more iron and furrowing deeper and deeper into the plates. At some places the remaining metal of the standpipe was less than ⅛ in. thick and appeared to be greatly laminated.

In the views of the standpipe are shown some very large wooden blocks attached to its upper portion. These blocks originally supported a wooden balcony.

The city is now using the 25 ft. of standpipe for storage and pressure. A new elevated tank or standpipe is to be erected. W. G. Kirchoffer, of Madison, Wis., consulting engineer to the city on this and other water-works improvements, furnished the above information on the failure.



BLACK RIVER FALLS STANDPIPE AND FRAGMENTS OF THE ICE CAKE WHICH CAUSED ITS FAILURE

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Constructive Criticism Needed

Sir—I am pleased to endorse your editorial on page 1029 of *Engineering News-Record* of June 14, 1923, which takes the position that a constructive criticism of the plan of railroad consolidation is much to be desired. It was my pleasure to attend the general hearings in Washington during which the tentative plan of the commission was discussed, and I am satisfied of the correctness of your position that this subject needs much study and discussion. A complete scientific investigation of this problem will require much additional time.

Washington, D. C.
June 19, 1923.

EDWIN F. WENDT,
Consulting Engineer.

Louisville Sewer Contracts and Arbitration

Sir—Referring to the editorial in *Engineering News-Record*, June 14, 1923, p. 1030, it seems that some explanation should be made.

Six contractors have signed written assertions about the methods our engineers employ. Of these six only three have ever done work for us, one has never submitted a bid. One of the original objectors after reading a reply to his assertions has recognized the justice of our position by recently making bids, one of which was under our engineers' estimate of cost.

The Commissioners of Sewerage of Louisville are four of the leading business men of the city, two of whom are Democrats, and two Republicans, the mayor being an additional ex-officio member. Not one of them can made or lose a penny regardless of the cost of building the sewers.

These five men have agreed to sit as a board of arbitration and hear any claim which any contractor may present as to losses due to arbitrary rulings of the engineer or a claim in equity due to unforeseen conditions and additional work. It is significant that in spite of general statements made by two contractors not a single claim for compensation has been presented to the commission for adjudication.

They have not tested out the arbitration clause which they now have. Further, the commission has not said that it will not arbitrate any specific matter which seems to warrant it, but it has refused to delegate to outside parties the responsibility placed upon it by the city of Louisville.

The commission does demand and expects to continue to demand that sewers be laid to line and grade and that they be of the material and of the quality set forth in the specifications. No claim has been made that it has ever demanded anything not set forth in the contract drawings and specifications placed in the hands of the contractors before they made their proposals.

Losses have been claimed by contractors. Our cost figures show on two contracts that the excavation did cost more than the prices bid. No claim that our inspectors have been arbitrary in their rulings can be substantiated regarding these losses.

Another loss is claimed because selected earth was required to be put immediately over the masonry in accordance with the specifications. This contractor was urged to put his rock on one side of the trench and his earth on the other in order that the selected earth would be available to place over the sewer barrel. No attention was paid to this suggestion and when backfilling was commenced the earth which under the specifications must go in first, was covered with rock and some difficulty was experienced in getting to the earth. The engineer was as liberal in this matter as the specifications permitted.

Another claim was that an underdrain was not continued throughout the entire length of the trench and that this cost the contractor money. We are ready to adjudicate this claim, whenever the contractor sees fit to present it, on the basis of equity in spite of the fact that the engineer's estimate of quantity clearly indicated that only one-half the length of the sewer would have an underdrain.

It is our intention to build the best sewers that can be built. Contractors know that we insist on high class workmanship and should take this into consideration in making their proposals.

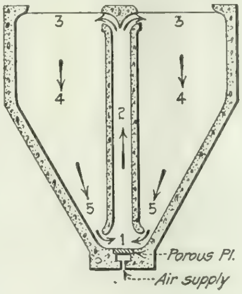
P. H. HOGE, JR.,
Secretary and Treasurer, Comsioners of Sewerage of Louisville.

Louisville, Ky.
June 20, 1923.

A Proposed Variation of Activated Sludge

Sir—Dr. Buswell's article in *Engineering News-Record*, May 10, 1923, on the "Importance of Oxygen and Stirring for Activated-Sludge Growth" is very interesting and suggestive. This article and your editorial upon it remind us of the wastefulness of present activated-sludge methods in the use of compressed air, and re-open the subject of what can be done to eliminate this waste.

Some very convincing evidence is brought forward by Dr. Buswell in support of his conclusion that activated sludge will grow at low oxygen levels, and that the principal useful result we accomplish by the liberal use of air in the activated-sludge process is the stirring of the sewage and the holding of the sludge in suspension. Assuming that this conclusion is correct, and granting that compressed air is a convenient agent for stirring the sewage and elevating the floc, the question arises as to whether our present method of utilizing air for these purposes is the most efficient that can be devised. When air is forced in quantity through a porous plate at the bottom of an ordinary tank of sewage, it generates in the sewage strong upward currents which are opposed and deflected by return currents from the surface, causing the contents of the entire tank to be thrown into commotion. In watching the whirling and eddying of the liquid in a typical activating tank, one is led to the thought that this process is destructive of energy, and that efficiency in the use of air would be promoted by controlling the currents which are generated.



While studying over this subject, the following ideas have presented themselves to the writer: (1) If a portion of our object is to elevate the floc to counteract its tendency to sink through the sewage to the bottom of the tank, would it not be advantageous to do this by continually gathering the sewage rich in floc from the lower part of the tank and raising it quietly and efficiently to the upper part of the tank by means of an air-lift? Reason tells us that this would require less air than the agitation process with its conflicting and opposing currents. (2) If the remainder of our object is to bring each particle of the floc into intimate contact with successsive portions of the surrounding aerated sewage, could we not accomplish this by other means than violent stirring? Would not the same result be secured by allowing a continual supply of floc particles to settle under their own weight through a region of quiescent aerated sewage?

For carrying out these ideas, the arrangement of tank and air-lift shown in the figure has suggested itself. This arrangement provides for the circulation of the sewage through a series of zones, the action proposed for each zone being as follows:

(1) Zone of Aeration: Here the sewage is intimately mixed with finely divided air rising from the porous plate. Each particle of floc is surrounded by tiny eddies generated by the rising bubbles. These eddies sweep away the by-

products of biologic growth, diffuse the oxygen absorbed, and bring the dissolved, colloidal, and suspended organic matter into close contact with the floc particles.

(2) Air-Lift Zone: Aerating effects are continued. Mixture of air, sewage, and floc rises at velocity of greatest air-lift efficiency. Large eddy-currents, impacts, and short circuiting of flow cannot occur.

(3) Air-Releasing Zone: Mixture of air bubbles, sewage, and floc spreads out on surface of tank while air is being released.

(4) Settling Zone: Floc particles settle downward through quiescent sewage, growing in size and firmness, and sweeping from the sewage its dissolved, colloidal, and suspended organic matter.

(5) Collecting Zone: Settling sludge is here collected and directed toward the entrance of the riser. Concentration of sludge particles to the exclusion of oxygen-bearing water is prevented by constant withdrawal from below.

The above proposals for securing economy of air in the activated-sludge process seem to offer an interesting field for study and experiment. As a help in planning such experiments, any suggestions or criticisms by others who have been working along similar lines would be appreciated by the writer.

Harold A. Thomas,
Professor of Hydraulic Engineering,
Rose Polytechnic Institute.

Terre Haute, Ind.,
May 14, 1923.

Clay Brick Interests Criticise Tests

Sir—Because the comparative tests of clay and concrete brick piers made recently by Columbia University were conducted under conditions which differ widely from current practice in the field, the Board of Directors of The Common Brick Manufacturers' Association of America, on June 12, unanimously rejected the test results as recently published by Columbia University (*Engineering News-Record*, May 31, 1923). The United States Bureau of Standards was also asked to conduct at the earliest possible moment comparative tests on clay and concrete brickwork so that the construction industry might have the truth as to the real properties of each kind of material.

Taking up the report in detail, in the first place mortar was used which is not comparable to that employed in ordinary construction. Although the tests were made upon brickwork supposed to represent New York City practice, the mortar was 1:3 portland cement mortar. The report does not state that any lime whatever was used in this mortar, and presumably there was none. The New York Building Code, however, specifically permits a certain percentage of the cement in cement mortar to be replaced by lime and this is typical of building codes throughout the land. This provision is intended to allow the use of a much more practical mortar than 1:3 cement mortar could possibly be. I doubt whether any reader of *Engineering News-Record* has ever put through a complete job using pure cement mortar without any lime in it. Such mortar works "short," and requires much greater time for the laying of a piece of brickwork than where the usual percentage of lime is used. It would be an extremely difficult, if not impossible, matter to get such mortar employed. The saving to the contractor in material and in bricklayers' time and the better grade of work resulting from the addition of lime to cement mortar presents such a powerful combination of reasons for the contractor to use it that only the most vigilant and constant inspection could insure the type of mortar used in this series of tests. Was [illegible] mortar used comparable to that employed in actual construction?

Again, I would draw the attention of those of your readers who are practical masons or who are familiar with practical work to the illustrations of the typical fractures of test specimens shown on pp. 960-961 of the article of *Engineering News-Record*. Again I [illegible] to leave it to the good judgment of these readers to [illegible] with a pure cement mortar [illegible] in the proportion of one part of portland cement to three parts sand, they ever, in the whole course of their experience, saw brickwork laid up with such full and perfect joints as those shown in the illustration. You will note that every joint is absolutely full of mortar, in spite of the fact that cement mortar works "short." The following, however, is quoted from the report: "The joints were struck off flush, and no special care was taken to produce other than a good grade of common brick masonry."

Your readers will also recall that it is much simpler to apply plaster or stucco to a brick wall than to concrete and that the bond between brick and the plaster or stucco is almost always good. We are invited to believe, however, that, where the concrete surface is a brick and the mortar is in the form of a mortar joint, by some mysterious means a better bond is secured than with a real brick. Possibly the following extract from the report may have some bearing upon this very extraordinary conclusion: "After construction they (the piers) were sprinkled daily with water for about one week." Has any mason contractor reader of this paper ever sprinkled a wall daily for one week after he has built it?

It is a fact also that concrete brick are much harder to lay than real brick, owing to the thin film of cement which forms their outside surface and which causes them to slide on the mortar bed. The bricklayer has to spend considerable time keeping the wall in line and nursing it along and this condition is aggravated in cold weather. This may be the reason why these brick, according to the report, were laid dry and may also have some bearing on the fact that the piers were afterward sprinkled daily.

The common brick industry now submits that in all fairness a series of tests be conducted under conditions comparable to those found in actual construction upon piers of the same size as those recently tested in Columbia University, to be made by an impartial and competent laboratory, preferably that of the United States Bureau of Standards; that the selection of the material and building of the piers be done under the supervision of competent engineers, so that the construction industry may have the truth regarding the comparative merits of clay and concrete brick.

William Carver,
Architect, Common Brick Manufacturers'
Association of America.

Cleveland, Ohio, June 18.

Where Home-Use-Only Products Control Would Lead

Sir—Your editorial in the June 21 issue, entitled "Interstate Power Transmission," in which you comment on the West Virginia natural gas ruling of the United States Supreme Court, is both timely and interesting. The Maine idea of confining within the state the use of its natural resources is too selfish and misguided to find wide acceptance. If Maine should carry this principle to its logical conclusion and prohibit the export of that other great natural resource of hers, the potato, to say nothing of her timber, fish, etc., she would soon be in a bad way! In the case of New York State, it is significant that Governor Smith reverses his position on the question of the export of electric energy.

The United States Supreme Court in this ruling in the West Virginia case merely confirms a prior ruling in the West *v.* Kansas Natural Gas Co. (221 U. S. 229,255) case of a few years ago. The State of Oklahoma undertook by statute to prevent the piping of natural gas out of the state. The Supreme Court decided that no state has the power to prohibit the sale or shipment of its products to other states. Justice McKenna said in part as follows: "If the states have such power a singular situation might result. Pennsylvania might keep its coal, the Northwest its timber, the mining states their minerals. And why may not the products of the field be brought within the principle? To what consequences does such power tend? If one state has it, all states have it; embargo may be retaliated by embargo, [illegible]."

So long as our Supreme Court has the ability of [illegible] and breadth of [illegible] indicated in these [illegible] decisions, the country has little to fear from the [illegible] and the [illegible].

[illegible]

Poughkeepsie, N. Y., June [illegible]

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Shandaken Tunnel to Be Put in Operation Jan. 1

Preparatory to putting into use January 1, 1924, the Shandaken Tunnel, the Board of Water Supply of the City of New York will soon advertise a contract for clearing of the Schoharie Reservoir which contract also includes construction of a rock-filed timber crib dam which will serve to divert water into the tunnel. Most of the clearing will be done during the season of 1924. Contractors who are interested in the work may obtain preliminary information at the office of the Board of Water Supply, Municipal Building, New York City.

Feiker Enters Consulting Field

F. M. Feiker, formerly vice-president of the McGraw-Hill Company, Inc., and more recently on leave of absence as special agent to the Department of Commerce at Washington, will after his return from Washington, be associated with the staff of the Society for Electrical Development, 522 Fifth Ave., New York City. Mr. Feiker will be available to act as a special counselor to engineers, manufacturers, central stations, jobbers, contractor-dealers and publishers, for which his special training and wide knowledge in the engineering publishing and public relations fields of many industries well qualify him. Mr. Feiker will retain a consulting relation to the McGraw-Hill Co., Inc., and he will continue in a similar capacity his relations to the problems of personnel and organization of the Department of Commerce at Washington.

Howard B. Gill Leaves A.G.C.

Howard B. Gill, who for the past four years has been connected with the Associated General Contractors of America, first as assistant secretary and then for three years as publication manager, is soon to leave the Association and become publicity and financial secretary of the National Council for Prevention of War. Mr. Gill became assistant secretary in May, 1918, having been first secured to take charge of and publish the proceedings of the organization meeting of the A.G.C. in Chicago in November of 1918. Mr. Gill organized the committee in research work of the association and established the monthly magazine now known as the *Constructor*. He also established the statistical service published in *Index*.

The National Council for Prevention of War, with which Mr. Gill becomes associated, is a federation of thirty-six national organizations, including the National Board of Farm Organizations, National Education Association, National Consumers' League, etc. Its officers and executive board include President Lowell, of Harvard, Jane Addams, Will Irwin, William Allen White, President Hibben, of Princeton, and other publicists and leaders in national life.

Two-Car Elevated Train Plunges 30 Ft. to Street in Brooklyn; Seven Persons Killed

Rear Truck on Second Car Becomes Derailed on Tangent Track; Two Score Injured; Wooden Car Bodies Built in 1898

Seven persons were killed and more than two-score injured, some of them seriously, when a two-car train of the Brooklyn-Manhattan Transit Co., on its way from Bay Ridge to Manhattan, became derailed near the Atlantic Ave. station in Brooklyn, New York, and fell from the elevated structure to the pavement about 30 ft. below. Just what caused the derailment is now the subject of a series of investigations being undertaken by the transit company and the Department of Plants and Structures, of this city. The accident occurred about two o'clock the afternoon of June 25, and about 60 to 70 passengers occupied the two cars.

An examination of the track where the accident occurred seemed to indicate that the rear truck of the rear car was the first to derail, an assumption borne out by a statement issued late on the day of the accident by W. S. Menden, president of the newly reorganized company, which changed its corporate name but a few weeks ago from the Brooklyn Rapid Transit Co. The first indications of derailment were noticeable at the heel of the frog. The train was trailing a crossover switch located about half way between a curve and the Atlantic Ave. station, on a stretch of tangent track roughly estimated as 500 ft. long.

Condition of Frog

The heel of the frog showed slight abrasions. The fishplate which connected the wing guard rail to the frog casting was loose, there being a play of about an inch in this wing across the ties. The first indications of cutting by the wheel flange on the ties was immediately in front of the frog. This cutting of the ties continued up and across the ties until, at a distance about 10 ft. beyond the point of switch, the rear truck apparently became detached from the body of the car. This rear truck, according to the statement of Mr. Menden, was the one that remained on the elevated structure, all the others being carried to the street below. A thorough examination is to be made of this truck to determine if there was any structural weakness that might have contributed to the derailment.

The cars, when they fell, were badly splintered, and considering the age of the rolling stock, it is remarkable that there was not greater loss of life. The cars were built by the Pullman Co. in 1898, and were first used when the elevated line was a steam road. When the line was electrified (the electrification beginning in 1898) new trucks replaced the old ones.

A number of investigations into the cause of the accident are being carried

(*Continued on p.* 1141)

Menden Issues Statement

A statement was issued by W. S. Menden, president of the Brooklyn-Manhattan Transit Co. several hours after the accident, and after he had personally looked over the track and wreckage. This statement follows:

Mr. Menden, president, stated late this evening (June 25) that the investigation of cause of the accident this afternoon, while not complete, indicates that the rear truck of the rear car of the two-car train was derailed, for some cause not yet ascertained, at the frog of the switch just east of the Atlantic Ave. station, causing the rear car to be precipitated into the street, dragging the forward truck of the rear car and the entire forward car, with its trucks, into the street, leaving the truck which was first derailed on the structure practically at right angles to the running rail.

"The track and switches at the location in question had been inspected in the morning and found in good condition. Both cars of the train had been inspected June 15, 1923, in accordance with the established practice and found O.K. The two cars in the train had been operated on the same line over the same switch and frog for nine trips on the same day without any difficulty of any kind. The train was in charge of an experienced motorman with a good record.

"The investigation is being continued in co-operation with public authorities to ascertain more definitely the cause of the derailment."

Am. Soc. C. E. Takes Prompt Action on Ousting of Arthur P. Davis

Steps to investigate the ousting of Arthur P. Davis from the position of director of the U. S. Reclamation Service were taken by the Executive Committee of the American Society of Civil Engineers on June 25. A special investigating committee is being formed. Meanwhile data for the committee is being gathered. Ex-director Davis and Secretary Work have been requested to submit statements of their respective sides of the case and telegrams have been sent to engineers in the West asking for facts and opinions on the subject. It is hoped that the investigating committee will be able to report to the Board of Direction July 9, at the summer meeting of the society at Chicago.

Davis Removal Part of General Upheaval

Reported in Washington that Engineers Will Be Replaced in all Projects By Business Men

Following the removal of Arthur P. Davis as director of the United States Reclamation Service last week, there have been a number of reports in Washington regarding the future policy of the Interior Department in the conduct of the Reclamation Service. Secretary Work, of the Department of Interior, is in the West at the present time and has refused to give out any definite interview. However, other officials of the department, who may not be quoted, are responsible for statements of the intentions in the department.

In the first place, it may be said that Director Davis resigned at the request of the secretary, who gave no other reason than that he proposed to put this branch of the Interior Department on a business basis. Mr. Davis thereupon demanded a hearing under the civil service regulations, but he was informed by the secretary that such a hearing was not necessary because he had not been removed from office, but rather the office had been abolished. By abolishing the old title of director and giving the incoming head of the service the name of Commissioner of Reclamation, it becomes unnecessary for the secretary to give a statement in writing to the dismissed director as to why he was discharged from the service.

OTHER SUBSTITUTIONS POSSIBLE

It is understood further that Secretary Work plans to carry his reorganization of the service to the point where he will substitute business men for the technically trained project managers on the irrigation works in the West. The reason for this move, together with the inside explanation of why Mr. Davis was removed, is not officially available. The following statement, however, may be accepted as a fair picture of the views of Dr. Work, the Secretary of the Interior:

"In the natural evolution of the Reclamation Service, the engineering problems are being subordinated to the business policy of making a commercial success of the farms embraced in reclaimed areas. The engineering problems now are such that they can be handled by the chief engineer of the service. The crying need of reclamation is to devise means whereby the individual farmers can make reasonable profits. Under present conditions, their earnings are inadequate. They cannot pay even the water charges. Drastic steps must be taken if the overhead is to be cut down and the great commercial problem of making their farms pay solved. The West believes the [illegible] of these reclaimed lands is economically sound. Under proper direction, the farmers' deficits can be changed into profits.

"Governor Davis, the new commissioner, is believed to be the type of man who can accomplish that purpose. His long association with the farmers' problems on reclamation projects and the fact that he has been the president for several years of the Western States Reclamation Association, fit him for the task of [illegible] the business [illegible] of the reclamation farmer. In that connection it was pointed out that Governor Davis would delegate all engineering matters to W. E. Weymouth, the chief engineer of the service, who has the confidence of all water-users. Secretary Work, however, recognized the value to the service of the dismissed director and tendered him employment at $20 a day to act as consulting engineer of the service. This Mr. Davis declined.

"In addition to the principle involved in making the change, there also was the matter of Mr. Davis' personality. He had served under several secretaries and had come to regard the job as his own. He was in many cases arbitrary and frequently insisted on having his own way. At times he insisted on following his judgment rather than that of the Secretary of the Interior. This led to serious trouble between him and Secretaries Lane and Fall. He is that type of capable man who refuses to play the game and who makes team work impossible."

It may be further stated that Retiring Director Davis did not feel at liberty to leave the Reclamation Service of his own motion. He frequently has declined offers which carried with them much higher salaries. With legislation finally on the statute books, which if carried into effect carefully, would mean the full reclamation of the West, it has been his avowed purpose to stay in the path of those who would repudiate reclamation obligations and of those who would dilute the fund by overloading it with new projects. In both of these stands he has had the consistent support of the conservative business element in the West. The fact that Mr. Davis has been dismissed does not remove him entirely from that path. He expects to find means whereby he can continue to be a thorn in the side of those who threaten the ultimate success of the whole conception by catering to the selfish demands of those who would attach more importance to immediate personal advantages than to the future of reclamation as a whole.

Col. Sawyer New A.G.C. Secretary

Col. D. H. Sawyer has been appointed secretary of the Associated General Contractors of America effective July 1, according to announcement by Gen. R. C. Marshall, Jr., manager of the Association. He will succeed Eugene Young, who recently resigned the office to enter private business in Minneapolis. While the appointment is not formally effective until July 1, Col. Sawyer is already at the Washington headquarters of the A.G.C. familiarizing himself with the details of the office.

Col. Sawyer is a native of Illinois and a graduate of the engineering college of the University of Illinois. He has had wide experience as a constructor and as an engineer. For several years he was chief engineer of the Illinois Traction System. Later, he became a member of Sawyer Bros., consulting engineers, with offices in Seattle and Spokane.

When the United States entered the World War, Col. Sawyer joined the Construction Division of the War Department, being commissioned a colonel. Camp Brant and Camp Bragg were constructed under his direction, as was the nitrate plant at Cincinnati.

Western Society Holds Annual Meeting

Engineers Seen as Treasury Watchdogs, Public Protectors, Financiers and Practical Men—Society's Work

The engineer's relations to financial affairs were presented in two different aspects by two addresses at the fifty-third annual meeting and dinner of the Western Society of Engineers, held at Chicago on June 18. His relation to authorizations for and construction and maintenance of public improvement work was the main feature of the address of the incoming president, Charles A. Morse. He urged that the Society take an active part in public affairs not merely to inform the membership, but more especially to keep the general public informed before it authorizes expenditures on improvements, and to support the public official who is trying to run his department economically.

Closer understanding between the engineer and the banker in regard to private investments were advocated by E. Hill Leith, of Halsey, Stuart & Co., who emphasized the fact that the engineer must rely on the banker to handle securities which provide funds for his enterprises, and the banker must rely upon the engineer to safeguard his construction investments.

Opportunities and responsibilities of the engineer in the development of the future "greater Chicago" were visualized in the address of J. L. Hecht, retiring president, who stressed the point that in the development of a great and connected residential and industrial district, composed of many separate communities whose public work and services are, however, part of a comprehensive plan, the problems are those which must be prosecuted under the direction of competent engineers.

WASHINGTON AWARD MADE

Presentation of the Washington Award to Captain Robert W. Hunt was the prominent feature of the meeting. This presentation was made by W. L. Abbott, who reviewed Captain Hunt's close connection with the development of the iron and steel industry of the United States since, at the age of 21, he threw in his fortune with the old Cambria Iron Works. His life's work in this direction, his liberal assistance in establishing and aiding the work of engineering societies, the efficiency and engineering skill of the business enterprise which he established, as well as his personal attainments and character were all considered in selecting him as the recipient of the award for 1922.

In reviewing the year's work, Mr. Hecht pointed out that there was a balance of $828 instead of last year's deficit of $1,574. Nine members have been lost by death and there is a net membership of [illegible], not including a number who are expected to be reinstated on payment of back dues. During the year [illegible] meetings were held, with an average attendance of 172. Among the committees, notable work has been done by the committee on public affairs.

Officers for the year were announced as follows: President, Charles A. Morse, chief engineer of the Chicago, Rock Island & Pacific Ry.; vice-presidents, [illegible]; [illegible], H. H. [illegible]; [illegible], Geo. W. Hand; secretary, Edgar S. Nethercut.

Engineering Educators Meet at Ithaca

"Training for Leadership" Keynote of Papers—Comprehensive Survey Probable

One of the most successful meetings of the Society for the Promotion of Engineering Education was held at the College of Engineering of Cornell University, in Ithaca, N. Y., from June 20 to 23. Nearly 300 members and guests were in attendance, fully two-thirds of whom came from out of town. The outstanding feature of the meeting was a series of papers all grouped under the general head, "Training for Leadership." In addition, there were the usual committee reports, special conferences of the deans, the teachers of English, the drawing teachers, etc., and a thought-provoking suggestion as to improvement in the theory of engineering courses by Prof. Edwin Bennett, of the University of Wisconsin.

Progress was reported in the work of the so-called development committee appointed last year to formulate an answer to the question, "What can the society do in a comprehensive way to develop, broaden and enrich engineering education?" It has had a number of meetings and has succeeded in interesting several of the large foundations, notably the Carnegie Corporation, in a comprehensive study of engineering education. The Carnegie Corporation board is yet to meet, but Dr. Pritchett, its head, thinks the prospect of some funds being awarded the study distinctly favorable. This study is to be carried on under the direction of the society with a paid director and is to be distinct from some previous studies in that each one of the engineering schools is expected to make an exhaustive investigation of its own curriculum and administration as a preliminary to the work of the general inquiry. In a letter to Dr. Pritchett, it is stated that "It is proposed that the investigations of the society be directed to a study of the objects of engineering education and the fitness of the present-day curriculum for preparing a study for his profession. It will study the process by which the curriculum of fifty years ago has come to its present form; it will seek to set forth the nature and the weakness of the curriculum as at present administered; and it will indicate such modifications or developments as would seem to make for a sound, well balanced and fruitful course of study for engineering students."

Kimball Opens Discussion

Dean D. S. Kimball, of Cornell University, opened the discussion on "Training for Leadership." He outlined the development of the industrial control of the world and said that the engineer unquestionably is soon to be in command of industry, and therefore promises to be in control of the world. Certainly, the problem of leadership is now up to him. The engineer has the scientific method common to all science, but adds to it its application to human problems. It is, therefore, first necessary in engineering education not to weaken the curriculum in its instruction in the scientific methods of approach, for it is on that basis the engineer must take his lead. He would substitute for the word "engineer" possibly the term "industrially intelligent group" in any discussion of the engineer's prospective leadership. He said that the future lies either in the hands of the engineer or the business man, but the business man will have to know more about industry and have a broader vision toward the universal wellbeing if he hopes to become the future leader, taking the place of the present lawyer as the leader. He said that while the engineer has many virtues, he has the weaknesses of not being sufficiently broadly trained, that he is a cave dweller, not interested in people or things, that he lacks economic knowledge. When the engineer learns who he is, where he came from, and what his civilization stands for, he will be better trained.

Dean Kimball was followed at subsequent meetings by T. H. MacDonald, of the Bureau of Public Roads, who discussed "The Engineer as a Leader in Public Service," E. H. Lee, of the Chicago & Northern Indiana Railroad Co., on "The Engineer as a Leader in Transportation," Oliver S. Lyford, of the National Industrial Conference Board, on "The Engineer as a Leader in Industry," and W. E. Wickenden, assistant vice-president of the American Telephone & Telegraph Co., on "The Engineer as a Leader in Business." All of these speakers emphasized again and again the necessity of teaching fundamentals in engineering education, but this became so frequent in all of the discussions through the sessions that its force was somewhat weakened because there seemed to be no possibility of uniting on what fundamentals were, although the National Industrial Conference Board has defined them in some detail.

So far as the engineer's leadership in business is concerned, Mr. Wickenden did not speak very hopefully. He said that business was distinct from industry in that industry was productive and business distributive and commercial, and that the principles underlying business are not necessarily those underlying industry, involving as they do very much more of the element of risk, which is not common to the engineering type of mind. He felt, however, there was no reason why engineering instruction should be modified to fit business, and that there was no advantage either to the business man or to the engineer in insisting on such a joining together.

The paper by Professor Bennett of Wisconsin, entitled "Engineering Courses for the Functional rather than the Industrial Divisions of Engineering," pointed out that the functional divisions of engineering might be set up as research, design, supervision, management, and sale, whereas the industrial divisions as now established are roughly civil, mining and metallurgical, mechanical, electrical, chemical, and administrative. It is on the basis of these industrial divisions that engineering courses are now divided. He feels that a better division would be along the lines of functional divisions, especially as it may be possible in time to discover early in the student's career his special aptitudes toward the functional branches, a thing that cannot be discovered early as regards the industrial branches. Professor Bennett's suggestion, therefore, for an improved course involves not only the division along functional lines but a more intensive study of the student's early aptitudes with faculty counsel to direct the students into the line toward which his aptitude points.

His suggestion was not received with any tremendous enthusiasm by the professors present, though Prof. D. C. Jackson, of the Massachusetts Institute of Technology, said that in a way the scheme had been applied in the institution in the last two years, particularly in the increased choice of electives in those years. Dean O. M. Leland, of the University of Minnesota, contended that the interest of the boy himself in picking his course is one of the most important elements in his training and that the functional division is not so important to the student. He does not ask himself whether he is going to be a salesman or a manager or a research man, but he does say am I going to be an electrical engineer, a civil engineer, etc.? His functional choice comes later. Dean Leland, therefore, contended that it is very much more difficult to set up the functional division than the industrial one.

Five-Year Course

In the conference of the deans there was considerable discussion of the five-year prescribed course in engineering, but no conclusion was reached. Dean W. G. Raymond, of the University of Iowa, submitted a diagram of the five-year course which had been developed in his institution and which had been adopted by the faculty and has been referred to the president and governing board. It permits the degree of B.S. at the end of four years and of a professional degree in engineering at the end of five years, but most of the specialized engineering comes in the fifth year. A somewhat similar course was shown by Dean Cooley, of the University of Michigan. His course had been prepared by a committee and had been laid on the table by the faculty so that it is not in prospect of early adoption.

P. F. Walker, dean of the College of Engineering, University of Kansas, was elected president for the ensuing year, and F. L. Bishop, dean of the College of Engineering, University of Pittsburgh, secretary.

Harding Succeeds Isaacs as S. P. Consultant

Carroll R. Harding, who since 1916 has been assistant consulting engineer of the Southern Pacific Ry., on June 1, 1923, upon the retirement of John D. Isaacs, was appointed to succeed Mr. Isaacs as consulting engineer of the southern Pacific Ry. Mr. Harding was born at Hallowell, Maine, in 1888, and graduated from Cornell University with the degree of civil engineer in 1910. For three years he was employed by the American Bridge Co. and on surveys in Alaska, Michigan, and Costa Rica. He entered service with the Southern Pacific Ry. in 1913, and has been successively draftsman in the office of John D. Isaacs, chief draftsman in the same office, and assistant consulting engineer. He is president of the Cornell Society of Engineers, and is a member of the American Society of Civil Engineers and of the American Railway Engineering Association.

Elevated Train Plunges 30 Ft., Killing Seven

(*Concluded from p.* 1138)

on by the Brooklyn Manhattan Transit Co. by the city and by the Transit Commission.

Edwin P. Parcell, the motorman of the train, who escaped with minor face lacerations, was arrested immediately after the accident and released later on bail of $1,000. He was held pending an investigation into the condition of the switch, which, it was first said, might have been tampered with. But as the train was trailing rather than facing the switch, the switch, except at the frog, seems to have had little to do with the accident.

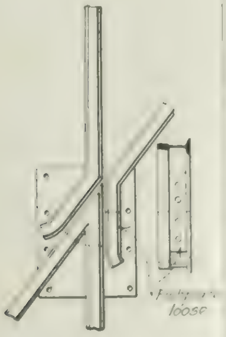
As the train fell from the elevated structure, one of the cars hit the front of a light delivery truck, but the driver jumped and thereby escaped injury. No other automobiles were struck, although Times Plaza, where the accident occurred, is one of the busiest of Brooklyn's centers of traffic. Traffic had been stopped in a direction oblique to the elevated structure axis.

Immediately after the accident, when ambulances from almost a score of hospitals had cared for the injured, wrecking crews were put to work to clear the debris. Half a dozen oxyacetylene torches were operated most of the afternoon to burn the structural parts of the cars to sufficient size so that the wreckage could be handled.

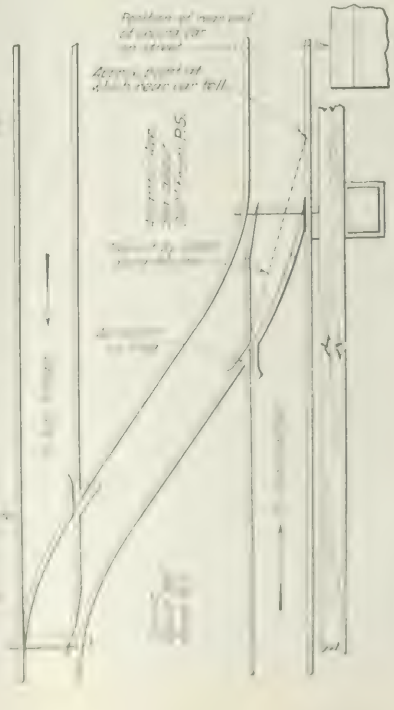
TYPE OF ELEVATED STRUCTURE FROM WHICH TRAIN FELL

RIGHT—SKETCH OF ACCIDENT AREA

Plan is not to scale; gives approximate line along which inside wheels crossed ties.



DETAIL OF FROG SHOWING PLAN AND ELEVATION OF LOOSENED CONNECTION



Random Lines

Still Another Brand

A new novel, a newspaper blurb says, is "one of the finest pieces of imaginative engineering in many, many moons."

* * *

Down in North Carolina there is a city engineer who says that there's not a lot or block corner stake in town. "The only monuments are those at the town limits and in the cemetery."

* * *

Why Rail Transportation Lags

Kansas has, or had, a law which ordered that "when two trains approach each other at a crossing they shall both come to a full stop, and neither shall start up again until the other has gone."

* * *

Out West the other day the President said he would rather be an engineer than anything else in the world. He has ample precedent. Most public men would rather be than see one—especially in any kind of authority.

* * *

Publicity has at last got the better of Tom Edison. The newspapers have found out that one of his sons has just graduated from Boston Tech. and they are trying to get him to reconcile his practice with his press-agent's stories about the worthlessness of college men. This isn't the first of the Edison boys to get an engineering degree, but the Old Man has hitherto managed to keep it out of the papers.

* * *

Hot Weather Note

"It is reported," translated Florio from old Michel, Lord of Montaigne, "that in ancient times they made no fire in their houses, but without and at the foote of them: Whence by tonnels, which were convaide through their thickest wals, and contrived neere and about all such places as they would have warmed; so that the heat was convaied into every part of the house." But he does not report the price of coal or whether father did the stoking.

* * *

A South African dispatch reports the discovery of a fossil human skull that compares in age with the Neanderthal and Piltdown relics of prehistoric man. We may well wonder what concerns [illegible] the contents of that cranium some 100,000 years ago. But it's a safe bet that one of them was "the effect of sea-water on concrete."

* * *

It's fine, of course, that inventive genius has found means to strengthen and amplify the voices of public speakers. Pity 'tis that no one has yet devised some contraption that will proportionately strengthen and amplify the thinking behind the voices.

Connecticut Water Pollution Bill Vetoed by Governor

A bill creating a commission to control water pollution in Connecticut was vetoed on June 21 by Charles A. Templeton, governor of that state. In its original form the bill was submitted to the Legislature by a stream pollution commission created by the Legislature of 1921. This commission was headed by C. M. Saville, chief engineer and manager, Hartford water-works, and had two other engineer-members, besides representatives of the manufacturing and oyster industries of the state. The original bill was supported by the State Chamber of Commerce and the State Manufacturers' Association and by individual manufacturers also. It is characterized by the governor as "a reasonable compromise between all interests" but it is reported that it was opposed by some manufacturers.

The governor states that the bill was put aside in the last days of the Legislature and in its place an unsatisfactory substitute was passed. The original bill distinctly mentioned public health and covered the discharges from municipal sewers as well as from individual manufacturing plants. The substitute omits all reference to public health and covers nothing but the discharge of wastes from manufacturing plants. The governor urges that although the state health laws fully protect waters used for drinking purposes, there is still need for legislation to protect the public health from sewage for other reasons, mentioning shell fish. He declares that "it is fully as important to purify the streams from sewage as to purify them from factory wastes."

A marked inequality in the application of the substitute bill to mill and factory owners is pointed out by the governor, who states that trade wastes discharged into the streams through city sewers would not be covered by the substitute bill, but that the proposed water commission would have full jurisdiction over trade wastes from all manufacturing plants having their own outlets direct into streams and that this would be a particular hardship upon manufacturing plants outside the cities, since such plants within cities generally discharge their wastes through the city sewerage systems. Another objection made by the governor to the substitute bill is that it eliminates the provision of the original bill for directing first operations against new manufacturing plants.

Two years ago the Connecticut Legislature failed to give support to an earlier commission on stream pollution, that had conducted some quite extensive investigations of the subject, and created the commission whose bill was emasculated by the 1923 Legislature and has just been vetoed by the governor. (See *Engineering News-Record*, Nov. 3 and 10, 1921, pp. 745 and 757.)

Civic Center Plan Approved for Pasadena

Voters of Pasadena, Calif. on June 7, by a plurality of more than 3 to 1, approved a $3,500,000 bond issue for acquiring land and constructing a city hall, a library and an auditorium. These buildings are to be arranged in a group as a civic center in accord with a plan proposed by the city planning commission.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, Annual Convention, Chicago, July 11-13.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

The St. John, N. B., Branch of the Engineering Institute of Canada recently gave a banquet in honor of W. J. Francis, the newly elected president of the Engineering Institute of Canada, this being the first stop in the tour arranged for the new head of the society.

The New England Water Works Association's Nominating Committee announce nominations as follows for the year ending September, 1924, for president, David A. Heffernan, Milton, Mass.; for vice-presidents, Theodore L. Bristol, Ansonia, Conn., and Stephen M. Taylor, New Bedford, Mass.; and treasurer, Frederic I. Winslow, Framingham, Mass.

The Detroit Engineering Society at its meeting June 22 was addressed by the mayor of Detroit, Frank E. Doremus, on the engineer's duties and opportunities as citizens.

Personal Notes

W. J. King has been appointed resident engineer of Kansas Federal Aid Project No. 149, under the state highway commission, with headquarters at Holton, Kan. Mr. King was for many years county engineer of Labette County, Kan., and later was Kansas representative of the Portland Cement Association.

G. F. Nicholson, chief engineer, Port of Seattle, has been retained as consulting engineer by the Port of Olympia (Wash.) Commission to prepare a comprehensive plan for the development of Olympia harbor. A bond issue of $450,000 for these improvements is to be voted on by the Olympia port district July 10.

Aubrey Riebennacht, Lowville, N. Y., has been appointed junior engineer in the Illinois State Highway Department with headquarters at Effingham, Ill.

Major G. R. Young, of the Board of Engineers for Rivers and Harbors, of the Corps of Engineers, has been made secretary of the International Navigation Congress. He succeeds Col. J. C. Sanford. In future the secretaryship of the Congress will be vested in the member of the Board of Engineers for Rivers and Harbors who is resident in Washington.

E. K. Mentzer has been appointed principal assistant engineer of the Boston & Albany R.R., with headquarters in South Station, Boston, succeeding G. W. Abbott, who is taking up private practice. W. A. Bump is appointed division engineer of the Albany division with headquarters in Springfield, succeeding Mr. Mentzer in that position.

E. G. Raynor has been appointed highway engineer in the Bureau of Public Roads with headquarters at Pierre, S. D. Mr. Raynor has worked in the state highway departments of New York and Iowa and recently was assistant division engineer of the Nebraska State Department of Public Works. He served in France as captain of engineers.

Gabriel Henry, who has been consulting engineer of the department of roads of the province of Quebec, has been appointed chief engineer of the department, succeeding H. N. Necker, who is to be connected with a road contracting firm at Sherbrooke.

C. C. Congdon has been appointed city engineer for the city of LaCrosse, Wis., to succeed E. C. Blake, resigned.

Dr. Richard Bishop Moore, chief chemist and mineral technologist of the U. S. Bureau of Mines, has resigned and has taken charge of the development department of the Dorr Co., engineers, with headquarters in their New York office. Dr. Moore's work at Washington has included general supervision of the chemistry research of the Bureau of Mines, and charge of the work in non-metallics, ceramics, rare metals, helium, and alloys. He built and operated the government radium plant at Denver and directed the construction and operation of three government helium plants during the World War. With the Dorr Co. Dr. Moore will have charge of research in the development of new processes in metallurgy and chemistry.

Brillhart-Brothers Co. and F. H. Clement Co. have been merged into a new corporation, F. H. Clement & Co., with offices in Bethlehem and Philadelphia, Pa., and equipment yard at Bingen, Pa. The organization and operating personnel of the former companies will be retained, and the new company will solicit railroad and general building construction.

O. B. Kercher has succeeded W. T. Horn, resigned, as engineer of the Fort Wayne district, Indiana, for the state highway commission. Mr. Kercher has recently been employed with the U. S. Bureau of Public Roads at Fort Worth, Tex. He will have 700 miles under his jurisdiction.

C. W. Campbell, until recently field representative in Southern states for the Portland Cement Association, has been appointed assistant engineer of Buncombe County, N. C.

Samuel M. Ellsworth has been appointed sanitary engineer for the Village of Rye, N. Y. Until recently he was assistant engineer in the office of Weston & Sampson, consulting engineers of Boston.

Otto W. Knutson has been made project engineer with the Missouri State Highway Commission, having entered that work from the office of R. E. Tilden, of Winnemucca, Nevada, where he was employed as assistant engineer.

Edmund I. Mitchell, until recently a draftsman in the office of the Board of Water Supply, New York City, has joined the consulting engineering firm of Waldo S. Coulter, New York City. Mr. Mitchell is the engineer in charge of sewer construction at Spring Valley, N. Y.

William J. Knauer, former county engineer of Chautauqua County, New York, has become superintendent and junior partner of the general contracting firm of Hitchcock & Knauer, of Olcott, N. Y.

Daniel C. Cooper has left the U. S. Gypsum Co., with which firm he was employed as superintendent of construction at Oakfield, N. Y., and has gone to Los Angeles, where he now becomes assistant engineer on harbor improvements with the harbor commission of that city.

Elijah H. Owen, of Owen & Seabrook, Detroit, Mich., states that since the death of his associate Charles R. Seabrook, the firm has been dissolved and he has become associated with **Alva M. Hull** in a new firm, Hull & Owen, architects and engineers, Detroit.

Alfred L. Vezina, recently associated with Matthew O'Brien, San Francisco architect, and formerly with the California state department of engineering and the Thompson-Starrett Co., has, with John Diestel, entered the contracting business in San Francisco with an office in the Russ Bldg.

L. B. Reynolds has been appointed professor in civil engineering at Stanford University, Palo Alto, succeeding Prof. C. D. Marx, who becomes emeritus professor.

D. B. Steinman has been retained as designing engineer for the Carquinez highway bridge across Carquinez Strait, Calif. **Charles Derleth, Jr.**, of Berkeley, Calif., is chief engineer; and **William H. Burr**, of New York, is consulting engineer. The main structure is to be 3,350 ft. long, including two cantilever spans of 1,100 ft. In addition there will be about 1,400 ft. of steel viaduct construction, making the total length of structure nearly one mile. The estimated cost is about $5,000,000. The plans and specifications will be prepared in Dr. Steinman's office in New York City. The bridge is being built by the Rodeo-Vallejo Ferry Co.

W. J. Forbes, director of Concrete Constructions, Ltd., designing and contracting engineer of Sydney, N.S.W., is in the United States studying highway design and construction and the erection of large buildings. After spending some time on the Pacific Coast and in the Middle West, he is now in New York.

R. K. West, chief engineer of the Central Board of Roads, Republic of Panama, is in the United States and has been spending time in New York and Washington on various business matters.

Will P. Blair, vice-president, National Paving Brick Manufacturers Association, has returned from the International Road Congress at [illegible] Spain. While abroad, he spent some time in detailed study of the [illegible] of England and Scotland.

George Mattis, former city engineer of Oakland, has become associated with the F. F. Porter Company of Oakland, Calif., real estate operators, as an industrial and consulting engineer.

E. E. Carpenter, member of the firm of Baker & Carpenter, consulting and construction engineers of San Francisco, has been appointed chief engineer of the British Columbia Electric Ry. Co., Vancouver, B. C. The appointment was made effective immediately and Mr. Carpenter is already in Vancouver engaged in his new work.

Lazarus White, member of the firm of Spencer, White & Prentis, New York, foundation specialists, and for a number of years division and department engineer on the Catskill aqueduct, sailed from New York last week for a trip abroad. He will first visit London and then proceed to the continent returning some time in September.

Charles Shalter Krick, St. Davids, Pa., was given the degree of Doctor of Engineering at Lafayette College, June 11. Mr. Krick is general manager of the Eastern region of the Pennsylvania R.R.

F. G. Somner, for several years division engineer of the California State Highway Commission at Willits, Calif., has resigned and will be succeeded by **Thomas A. Bedford**, who has been division engineer at Dunsmuir, Calif., and who will be succeeded in the Dunsmuir office by **H. S. Comly**, previously assistant division engineer at that point.

T. Hees has been appointed district engineer, Canadian Pacific R.R., and is stationed at Calgary, Alberta.

C. F. Price, formerly of the engineering department of the California State Highway Commission, has been appointed city manager of San Mateo, Calif.

Stewart Purcell has been appointed chief engineer of Baltimore, Md., succeeding August E. Christhilf, the appointment being effective July 1. Mr. Purcell was born in Ireland and is a civil engineering graduate of Cornell University. He was employed by the Pennsylvania R.R. for seven years and entered the employ of the city of Baltimore in 1901, where he has been structural engineer in the building inspector's department, assistant division engineer in the filtration division in charge of the construction of the Montebello filtration plant under the direction of J. W. Armstrong, designing engineer, and, more recently, connected with the city highway department.

Julius R. Hall, formerly principal assistant engineer of the Sanitary District of Chicago, has resumed practice [illegible] Dearborn St., Chicago, and will specialize in the reports and estimates for public and industrial work.

William Hood, formerly chief engineer of the Southern Pacific Co., [illegible] four years of service, received the [illegible] College, of which he [illegible] Mr. Hood's [illegible] California which [illegible] in 11 miles.

Dr. Edward Bartow, head of the Department of Chemistry, University of Iowa, was given the honorary degree of master of science at the commencement of Williams College, Williamstown, Mass., June 25. Dr. Bartow is a Williams man.

Obituary

J. A. McCampbell, of Philadelphia, died recently from heart trouble. Mr. McCampbell had been for seventeen years associated with Stone & Webster, Inc., and at the time of his death was superintendent of construction on the 90,000-kw. power house extension for the Philadelphia Electric Co. He had had charge of construction of many power plants for the company, including the 95,000-kw. steam station for the Buffalo General Electric Co.

W. A. Ducker, for some years past connected with the Manitoba department of public works, died recently in Winnipeg at the age of 71 years. He was at one time in the service of the Canadian Pacific Ry. and was later appointed by the Dominion Government as swamp lands commissioner.

John T. Child died recently at Albemarle, N. C., where he was resident engineer on a sewer and pavement project for the Gilbert C. White Co. of Durham, N. C. Mr. White was a graduate of Cornell University, had been assistant engineer on pavement and sewer construction in Illinois and Texas, was 35 years old, and had served seven years as engineer of the Rochester, N. Y., Bureau of Municipal Research.

E. C. Strachaeur, division construction superintendent of the California State Highway Commission, died at his office in Norman, Calif., June 9, aged 48 years.

Philip Kirschner, contractor, Cleveland, Ohio, died recently at Johns Hopkins Hospital, Baltimore. Mr. Kirschner, who was 63 years old, had in twenty-five years of contracting in Cleveland built as many as two hundred of the city's schools.

William G. Armstrong, chief engineer of the St. Paul Union Depot, died June 12 in St. Paul, Minn. Mr. Armstrong went to St. Paul in 1915 to work on plans for the Union Depot. Those plans were adopted in 1917 and Mr. Armstrong has since then been in charge of construction of the Union Depot and the elevation of the tracks approaching it. The head-house is finished and the general project is about half completed. Before his death Mr. Armstrong gave to his assistant full [illegible] for the completion of the work. Mr. Armstrong was born in Iowa in 1859 and was a civil engineering graduate of [illegible] outstanding works of his are the Boone [illegible] the Chicago & Northwestern R.R., one [illegible] of the Chicago & Northwestern R.R. [illegible] American Society of Civil Engineers [illegible]

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

The Lubrication of Construction Equipment

Hints for the Contractor for Lengthening the Life and Improving the Operation of Excavating Machinery and Concrete Mixers

(*From Information Supplied by The Texas Co., New York.*)

IN the operation and maintenance of construction equipment proper lubrication offers to the contractor a means of counteracting the injurious effects of severe service and exposure of his machinery to all kinds of weather. If cylinders and bearings are to resist scoring, due to the entry of abrasive particles of foreign matter; if gears are to operate without abnormal wear in the presence of dust; and if wire rope and chains are to function safely, day after day, without broken or rusted strands or links, continued vigilance must be practiced in the selection and the regular application of lubricants.

Excavating Machinery

Steam Cylinders—Under the general classification of excavating machinery are normally included power shovels, ditching machines, dragline excavators, trenching and backfilling equipment and dredges of various types. The digging, handling and disposal of earth, gravel, sand, ore and other solid and semi-solid materials preparatory to construction work are among the most important operations which the contractor has to perform. In order to keep power shovels, dredges, trenching and back filling machines in continuous operation, it is essential to give careful attention to their lubrication at all times. Perhaps the most important detail is the lubrication of steam cylinders. In any of the above machines which are steam driven the existing conditions and methods of operation will be such that if any but a high-grade, properly compounded lubricant is used the cylinders will suffer accordingly.

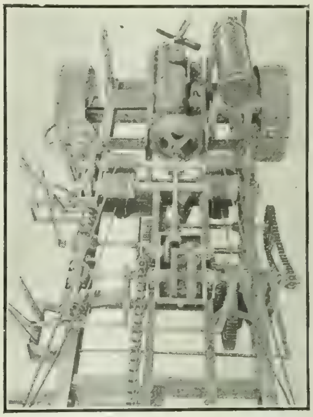
Steam used on such machines will, in general, be of comparatively low pressure (100 to 150 lb.) and will have quite a large moisture content. Although steam is taken from the highest part of the boiler it will frequently be relatively wet when it enters the header. Furthermore, line condensation and moisture content will be high between the boiler and engines, with a corresponding decrease in pressure, due to the fact that steam pipes are often not covered to any great extent, and the engines are frequently subject to intermittent operation. As a result there will almost always be an accumulation of water above the throttle valves, prior to starting the engines, depending in amount upon the length of time they have been stopped. If the cylinders are not covered with a tenacious film of properly compounded lubricant the admission of these slugs of water will tend to wash the lubricant from the wearing surfaces, and for the next few strokes insufficient lubrication will be possible and scoring and abnormal wear may occur. The constant repetition of this action produces compression losses and inefficient operation of the entire machine due to steam leakage past the piston rings. Groaning of the engines or rattling of the valves on their seats may also occur in extreme cases.

The problem, therefore, is to select and use a grade of cylinder oil which contains a sufficient amount of high-grade animal or fixed oil to promote the formation of an extremely tenacious film of emulsified lubricant, which will adequately resist the washing action of any water that may be present. The base of this lubricant should be a medium viscosity, highly adhesive, steam refined cylinder stock. For this purpose a comparatively high compound cylinder oil of about 130″ Saybolt viscosity at 210° F. has proved to be most satisfactory.

This article gives practical suggestions for the lubrication of:

Steam Cylinders
Crawler Traction
Journal Boxes
Engine Bearings
Gasoline Engines
Electric Motors
Gears
Chains and Wire Rope
Concrete Mixers
Roller Bearings

In order efficiently to lubricate such steam cylinders the oil should be delivered by a positive feed lubricator, preferably of the force feed type, via suitable atomizers. Hydrostatic lubricators could be used, were the engines to operate continually, but the usual intermittent service involved would either require constant closing and opening by the fireman or else a waste of oil would follow if the lubricator were left in service while the engines were stopped. The location of the oil pipes and atomizers in the steam lines is also important. These points should be approximately 6 ft. back from the throttle valves. In cases where a steam thrusting engine is located on the boom in certain types of these machines, the oil line often enters the steam pipe much further back from the throttle, with the result that in the event of steam leaks at the ball or swing joint there will be considerable loss of oil as well, with subsequent insufficient lubrication unless the leak is stopped.



MODERN CONSTRUCTION MACHINERY REQUIRES LUBRICATION OF MANY PARTS

General Lubrication—Where excavating machines are equipped with caterpillar tractors the lubrication of link-pins and rollers is important to insure against excessive friction losses and power consumption. Automatic lubrication is generally regarded as the most satisfactory, the lubricant being furnished from internal reservoirs located in the treads and rollers. For this service a relatively heavy pure mineral lubricant having a viscosity of about 200″ Saybolt at 210° F. will be most suitable.

On certain types of railroad shovels and other excavating machinery, journal boxes similar to those used in railway service will be installed on traction wheel journals. As a general rule these journals, although they are not subjected to the same high speeds and lengthy periods of operation as railroad journals, are lubricated in a similar manner, i.e., by packing the journal box with wool waste which has been saturated in mineral oil. For this purpose a 300″ to 500″ Saybolt viscosity (at 100° F.) pure mineral oil, as recommended for general bearing service hereafter, will be suitable.

The lubrication of other wearing parts on the average excavating machine can be well taken care of by means of a medium viscosity straight mineral oil or a high-grade compression cup grease. Many builders recommend grease lubrication and accordingly equip their machines with compression grease cups. Grease for this purpose should be free of acid or alkali and should contain no filler such as talc or asbestos, which tends to clog the oil grooves. External lubrication on excavating machinery, whatever its nature, is necessarily a difficult proposition, and enough dirt, dust and abrasive matter will work its way into the bearings, without the addition of any more in the form of improperly compounded greases.

When engine bearings, etc., are lubricated with oil, the viscosity of the latter should be in the neighborhood of 300 to 500″ Saybolt at 100° F. For electric motor bearings, however, in-

To Train Oxy-Acetylene Welders

The American Welding Society has just issued an outline of a course for the training of oxy-acetylene welders. This report was prepared by a committee and combines the experience of experts of the Federal Board of Vocational Education, the American Welding Society and the National Research Council. For the information of the person who is selecting candidates, the text includes a discussion of the qualifications which the candidates for training should possess. For the information of the instructor, the text includes the fundamentals in gas welding, together with a detailed statement of content, classified under type welding jobs arranged in the order of difficulty. Copies may be secured from the American Welding Society, 29 West 39th Street, New York City.

Construction Equipment Exported

Figures from the Department of Commerce indicate the following exports of construction equipment during April, 1923:

Ten steam and power shovels valued at $89,474 were shipped, five of them going to Canada and two to Australia. Eleven cranes, costing $101,494, were exported, Canada, with seven, again being the largest consumer. In the concrete mixer field 64 machines were sold for $66,951; 26 of these units went to Canada and 14 to Japan. During the month miscellaneous construction equipment not specifically classified totaled 462,831 lb., costing $88,760.

(*Continued from Page* 1144)

volving ring oiling systems, a lighter oil will be best, ranging from 180 to 200" viscosity. The method of applying engine oils is worthy of comment.

Hand oiling is frequently customary, but is not recommended due to the possibility of oil holes becoming clogged with dust and dirt, and the bearings suffering accordingly. It has been proved that sight-feed oil cups are probably the best equipment to use. They should at all times be so covered that the contents are kept free from contamination.

INTERNAL COMBUSTION ENGINES

Where excavating machinery, such as power shovels and trench machines, etc., is driven by kerosene or gasoline engines instead of steam, lubrication develops into a problem similar to that involved in the modern tractor or automobile. For such service the motor lubricant is of chief importance and should be given careful consideration. Usually some form of force feed lubricating system is involved which passes the oil through a hollow drilled crankshaft under sufficient pressure to reach all wearing parts. On gasoline engines a straight mineral motor oil of from 500 to 750" Saybolt viscosity at 100° F. will be suitable, the grade selected being dependent upon the weather and operating temperatures. For tractor type engines a somewhat heavier lubricant should be used, the viscosity of which varies from 70 to 110" Saybolt at 210° F.

(To Be Continued Next Week. Subjects: Lubrication of Gears, Wire Rope Chains and Concrete Mixers.)

Recommend Fewer Varieties of Hollow Building Tile

At a meeting held June 19, at the Department of Commerce, the Standards Committee of the Hollow Building Tile Association reported to the Department's Division of Simplified Practice, the results of a survey which the association had made of existing varieties in types, sizes, and weights of hollow building tile. The survey showed 36 different sizes—each made in a wide variety of weights. The committee recommended the elimination of 23 of the 36 sizes, and the retention of 13 as "standards" for the industry. A standard weight, with a permissible variation of 5 per cent over or under the standard weight, was also recommended for each of the 13 sizes retained.

The committee requested the Department of Commerce, through its Division of Simplified Practice, to call a general conference next October of manufacturers, architects, engineers, contractors, and builders to discuss the general adoption and use of the recommended standard sizes and weights.

Cargo Beam Patent Valid

The validity of the Lenke patent (No. 1,228,120) for cargo beams used in unloading material from the holds of vessels to wharves has been upheld by the United States Court of Claims in a decision rendered June 4 by Judge Booth in the case of the Richmond Screw Anchor Co., Inc., against the United States. Instead of being rigid, like previous types of construction, the Lenke cargo beam is so mounted as to "swing in response to the application of the load wherever it may be situated and presents its full inherent strength by adapting its position to the angle of the hoist without more than normal strain under any circumstances." The beam consists essentially of a pivoted I-beam weighing about 1,300 lb. as compared with the heavier channel and cover-plate type of construction weighing 3,300 lb. formerly used. The suit was based on the use of the Lenke cargo beam by the Quartermaster Corps at the army supply base in Brooklyn in 1918.

Cement Making Pictured in New Film

Much of the equipment involved in making cement is illustrated in a two-reel moving picture called "The Story of the Manufacture of Portland Cement," just released for general showing. Starting with views of one of the large cement plants, the film pictures in a non-technical way the essential steps in transforming raw materials into portland cement. From the moment that a blast breaks loose a cliff of limestone in the quarry to the time when the finished cement goes into storage in big concrete bins the process of manufacture is almost entirely mechanical.

In addition to straight photography, animated drawings have been inserted to make clear what occurs inside the grinding mills, what goes on within the white-hot interior of the huge kilns, and how the cement sacks, suspended mouth down, are filled after they have been tied. The film can now be secured without charge by interested organizations through any office of the Portland Cement Association, or from association headquarters at 111 W. Washington St., Chicago.

Business Notes

BOND CO., Boston, has been appointed representative for the New England territory by the T. L. Smith Co., Milwaukee, to handle sales of concrete mixers, excavators and loaders.

HUNKINS-WILLIS LIME & CEMENT CO., St. Louis, has opened a new yard and warehouse on Forsythe Boulevard, west of the Rock Island tracks.

THOMAS O'BRIEN, who has been connected with John F. Allen Co., New York, as engineer and sales manager for the past twelve years has been made general manager. The company manufactures a line of portable pneumatic compression and hammer riveters.

NUGENT STEEL CASTINGS CO., Chicago, is the new name adopted at a meeting of stockholders May 28 to supersede the Electric Steel Co. The officers of the organization include Charles Piez, president; W. J. Nugent, vice-president and general manager; Prentiss L. Coonley, treasurer; and C. A. MacDonald, secretary. The company began operations in its present plant in 1915 and is claimed to be one of the first foundries to use electric furnaces on a large scale in the production of steel castings.

CHARLES F. HALL has resigned his position with the Equipment Corp. of America and has organized the Acme Equipment Co., dealers in construction equipment, with headquarters in Pittsburgh.

A. O. BEAUCHEMIN, formerly consulting hydraulic engineer of Montreal, is now vice-president of the Layne-New York Co., a subsidiary of the Layne & Bowler Co., water supply contractors, Memphis, Tenn., located in New York City. Mr. Beauchemin is a graduate of McGill University, and was in business for himself for several years in Montreal. Later he entered the employ of Layne & Bowler Co. and was a sales engineer for this company approximately five years.

STANDARD SCALE & SUPPLY CORP., Pittsburgh, has purchased and is now operating under new management the business formerly conducted by the Standard Scale & Supply Co. The new corporation manufactures scales, concrete mixers, and contractors' equipment. It has branch offices in New York, Philadelphia, Cleveland and Chicago.

MCWANE CAST IRON PIPE CO., Birmingham, Ala., announces the opening of its southwestern sales offices in the Magnolia Building, Dallas, Texas. J. L. Hill, formerly of Birmingham, has been appointed southwestern district sales manager, and will have charge of sales of the company's McWane precalked-joint cast-iron pipe in the very small sizes, in the states of Arkansas, Louisiana, Oklahoma, Texas, New Mexico and in Mexico.

STANLEY P. SEWARD has been appointed advertising manager, the White Co., Cleveland, to succeed M. H. Newton.

Atlas Portland Cement Co. (of Kansas) has been incorporated to acquire the property of the Western States Portland Cement Co. at Independence, Kansas, which manufactured the Cowboy brand of cement.

Equipment and Materials

For Patching Concrete Floors

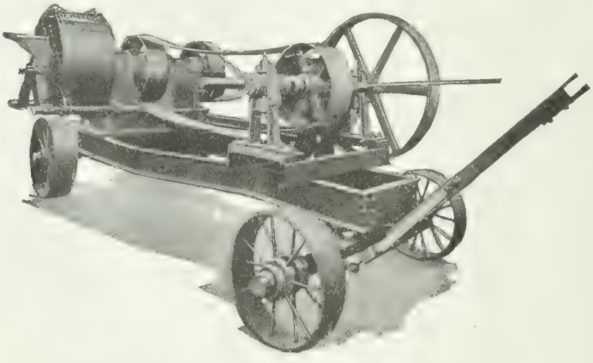
"Quickfix," a new compound for repairing concrete floors by producing a hard patch in 48 hours has recently been developed by the Master Builders Co., Cleveland. The installation of patches with this product, the company claims, can be made by any handy man, not necessarily skilled in the handling of concrete, by following directions furnished with the material. Interference with traffic is largely eliminated. Patches can be laid Saturday noon and put into use Monday morning. The cost of using the material for floor repair, according to the manufacturer's estimates, is less than 2c. a square foot.

Mounted Disc Crusher

To produce a well graded product for repairing macadam roads the Symons mounted disc crusher, illustrated herewith, was designed by Chalmers & Williams, Inc., Chicago Heights, Ill., to recrush 2½-in. gravel or stone to a size of from ½ to ¾ in., with a certain percentage of fine crushed rock and a small percentage of dust. One of the features of the equipment is its portability. It is mounted on a substantially built steel truck carrying countershaft, bearings and pulleys for driving the crusher mechanism.

It has been found in practice, the manufacturers report, that when the crusher is adjusted so that all of the product is reduced to pass a slot ½ in. in width, the capacity ranges from 10 to 15 tons per hour, depending upon the character of material being crushed and the method of feeding. Fifteen tons can be secured, crushing gravel or limestone, provided the feed does not contain any pieces over 2½ in. in diameter.

A 25-hp. motor is ample for driving crusher and countershaft, the actual power requirements being from 18 to 20 hp., when under full load. The crushing faces are manganese steel and as they wear uniformly the same character of product is produced throughout the life of the crushing members.



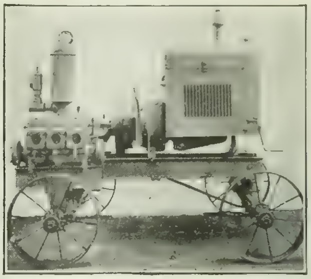
Asphalt Heater for Mounting on Army Trailer

To utilize the supply of army trailers in the storage yards of state, county and city highway departments, Littleford Bros., Cincinnati, have designed a tar and asphalt heater expressly made for mounting on the Army spring-suspended chassis trailer and rubber-tired wheels. With this running gear a tar and asphalt heater can be trailed behind rapidly moving vehicles, enabling the highway department to cover more mileage. The equipment is known as the Trail-o-Heater.

The kettle of the heater has a capacity of 300 gal. All seams are electric-welded. A 2-in. draw-off valve is provided on each side. The cover is arranged with a warming hood under which a barrel of tar or asphalt may be placed for draining. The furnace shell completely surrounds the kettle; it is supported on each side and is bolted to the chassis frame. It has a large fire-box with an improved type fire door, renewable grate bars, a large ash pit and draft control door.

Portable Triplex Pump for Road Builders

Designed especially for road builders' use to deliver water through long lines of small pipe a new triplex portable pump, powered by a four-cylinder, 15-hp. LeRoi gasoline engine, has been added to the line of contractors' equipment manufactured by the Domestic Engine & Pump Co., Shippensburg, Pa. The pump will deliver from 46 to 60 gal. per minute against a gage pressure of 300 lb. per square inch. The complete unit is mounted on a steel-wheel truck and is equipped with pole trees and neck yoke or tractor hitch.

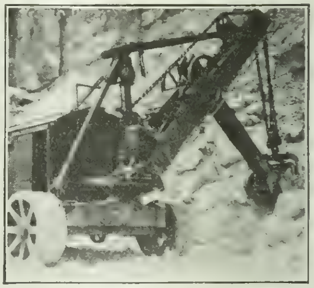


The engine is equipped with radiator, cooling fan, magneto, governor, air filter, and is completely inclosed in metal housing. An air-circulating fan insures engine cooling. A friction clutch is provided between engine and pump, and a uniform speed is secured by a fly-ball governor.

Traction Wheel Mounting for 6-Yd. Railroad Shovel

Traction wheel mountings for its heaviest type of railroad steam shovel with 6-cu.yd. dipper, have been built and tested recently by the Osgood Co., Marion, Ohio. Previously this model of shovel had been mounted on standard railroad trucks for use in quarries and open mines where a considerable amount of blasting had to be done. The necessity of laying track and moving the shovel back and forth between blasts slowed down operations and decreased output.

To eliminate the track-laying operation giant traction wheels, 6 ft. in diameter and with faces of 36 in. on the front and 30 in. on the rear wheels, were designed. The front wheels are used as drivers and power is delivered through a series of gears from the hoisting engines on the shovel. Steering is accomplished from the cab by turning the rear wheels by means of a screw shaft and traveling nut.



In recent tests made in a large Pennsylvania stone quarry, the manufacturer reports, the shovel was moved a distance in one day that under old track-laying methods would have required at least ten days. The traction mountings are designed to facilitate the use of large railroad type steam shovels in solid-bottom quarries and mines by increasing mobility and eliminating the necessity of pit men and jack arms.

The advantage of traction wheels

over railroad trucks for large railroad type steam shovels, are thus summarized by the Osgood Co. Greater mobility of machine, elimination of pit crew, easier accessibility to face of excavation, elimination of tracks and reduction of side strains and racking to the machine in general. Traction wheels, it is claimed, are also much less complicated, simpler to operate and have a low upkeep cost.

The 6-yd. shovel on which the traction wheels are used has an overall length of 85 ft., a width of 20 ft. and a maximum height over the cab of 15 ft., while the boom extends to a height of 32 ft. This type of mounting also is available for the 5, 3½, 3, 2½ and 1½-yd. shovels.

Publications from the Construction Industry

Steel Gratings and Stair Treads—**MITCHELL-TAPPEN CO.**, New York, devotes a new 24-p. illustrated catalog to its Mitco interlocked steel grating and stair treads. The interlocking feature involves a series of dovetailed slots on fixed centers in the bearing bars into which the lateral or transverse bars are forced under heavy pressure. The gratings are designed particularly for use in connection with subways and as flooring in industrial and power plants where ventilating openings must be provided. A slightly different design of grating is employed for a coal grizzly.

Rolling Doors—**J. G. WILSON CORP.**, New York, illustrates and describes in detail, in a newly published 16-p. catalog, its vertical rolling doors of steel and wood and its new horizontal folding door adapted for use in piers, freight sheds, warehouses and factories. The latter type is spring counterbalanced and may be folded up overhead out of the way.

Sewer Construction Equipment—**W. H. ANDERSON TOOL & SUPPLY CO.**, Detroit, lists and describes its line of sewer builders' tools and equipment in a recent 16-p. bulletin. The equipment includes trench braces, manhole steps, winches, clay cutting knives, mud boxes, sewer cars, plank pullers, and ground augers.

Excavating Equipment—**PAWLING & HARNISCHFEGER CO.**, Milwaukee, has issued three new bulletins featuring trenching machinery and convertible crane and power shovel rigs.

Tractor Sub-Soiling—**C. L. BEST TRACTOR CO.** is distributing a 40-p. illustrated booklet entitled "Subbing the Soil," which explains the use of tractor-operated sub-soil plows and chisels. While intended primarily for the agricultural field, the method has an application in construction work as is exemplified by the use of five standard tractor-operated chisel plows in building the stadium for the University of California where the broken ground was later handled by wheel-scrapers. Also, on the Merced irrigation project a multiple standard subsoil plow hauled by a Best tractor loosened material in the bottom of the canal so that it could be removed by four-horse scrapers.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

N. Y. Bricklayers Win Strike for $12 Daily Wage

Bricklayers in New York City won their strike, which has been in progress since May 21, when the Mason Builders' Association last week agreed to demands for a basic wage of $1.50 an hour, or $12 a day for a period of two years. This represents an increase of $2 a day over the basic daily rate of $10, which has been in effect since 1920. During the strike it was estimated that from $150,000,000 to $200,000,000 worth of work was being held up.

The construction concerns hit by the strike were among the largest in the United States. They included the George A. Fuller Co., the Thompson-Starrett Co., Cauldwell and Wingate, Marc M. Eidlitz & Son, William Crawford, Hegeman-Harris Co., John Lowry, Jr., G. Richard Davis, James Stewart Co., Starrett & Co., Charles T. Willis, Inc., and Cunningham & Foley.

Among the large operations affected by the strike were the Federal Reserve Bank, Nassau and Liberty Sts., the new store of Saks & Co., Fifth Avenue and Fiftieth St.; the Cotton Exchange, the Home Insurance Co., Maiden Lane and William St.; the Standard Oil Building, and the Pershing Square Building.

Structural Steel Sales in May

The Department of Commerce announces May sales of fabricated structural steel, based on figures received by the Bureau of the Census in co-operation with the Structural Steel Society. Total sales of 130,929 tons were reported for May by firms with a capacity of 225,790 tons per month.

Tonnage booked each month by 175 identical firms, with a capacity of 229,575 tons per month, is shown below, together with the per cent of shop capacity represented by these bookings. For comparative purposes, the figures are also prorated to obtain an estimated total for the United States on a capacity of 250,000 tons per month.

1922	Actual Tonnage Booked	Per Cent of Capacity	Estimated Total Bookings
[illegible]	200,588	87	217,500
[illegible]	184,738	81	202,500
[illegible]	[illegible]	73	182,500
[illegible]	157,631	69	172,500
[illegible]	[illegible]	68	170,000
[illegible]	[illegible]	64	160,000
[illegible]	[illegible]	58	145,000
[illegible]	111,794	49	122,500
[illegible]	[illegible]	60	150,000
1923			
[illegible]	172,413	75	187,500
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	145,000

[illegible] 229,435

[illegible] 157 firms with a capacity of 225,790

Cement Production Gains

Statistics issued by the Department of the Interior and prepared under the direction of Ernest F. Burchard, of the U. S. Geological Survey, from reports received from producers, show the production of portland cement in the United States for May, 1923, to be 12,910,000 bbl., as compared with 11,359,000 bbl. for April of this year and 11,176,000 bbl. for May, 1922.

For the first quarter of this year production exceeded that for the same period in 1922 by 10,415 bbl., the figures being, respectively, 25,669,000 and 15,254,000 bbl. A steady gain in production is also indicated by the statistics for the first five months of this year when the output was 75,607,000 bbl. as compared with 50,927,000 bbl. for the same period of 1922.

May (1923) shipments were 14,257,000 bbl., an increase of 1,508,000 bbl. over shipments for the same month a year ago.

The accompanying table contains the figures in detail.

PRODUCTION, SHIPMENTS, AND STOCKS OF FINISHED PORTLAND CEMENT, 1922 AND 1923, IN BARRELS

Month	Production		Shipments		Stocks at end of Month	
	1922	1923	1922	1923	1922*a*	1923
January	(*a*)4,291,000	7,704,000	(*a*)2,931,000	5,419,000	13,316,000	(*a*)11,470,000
February	4,278,000	8,085,000	3,285,000	5,963,000	14,142,000	(*a*)13,502,000
March	6,685,000	9,880,000	7,002,000	10,326,000	13,848,000	(*a*)13,045,000
First quarter	15,254,000	25,669,000	13,218,000	21,708,000	....	....
April	9,243,000	11,359,000	8,592,000	12,954,000	14,470,000	(*a*)11,463,000
May	11,176,000	12,910,000	12,749,000	14,257,000	12,893,000	10,115,000

Weekly Freight Loadings Again Pass Million Mark

For the second time this year, according to the Car Service Division of the American Railway Association, loading of revenue freight exceeded the million mark during the week which ended on June 9, for which the total was 1,013,249 cars. The first time the million mark was exceeded was during the week of May 26 when the total was 1,014,029 cars.

Freight car loadings are the heaviest for this season of the year in the history of the railroads, and for the week of June 9 were only one-half of one per cent under the record week in history, which was that of Oct. 14, 1920, when the total was 1,018,539 cars.

Despite the record loadings car shortage which was reported at 12,978, had virtually disappeared for all classes of equipment. At the same time reports showed more than 11,000 surplus freight cars available for service whenever transportation conditions warranted.

From Jan. 1 to June 9, inclusive, 20,981,06[illegible] cars have been loaded with revenue freight, compared with 17,41[illegible],111 during the corresponding period last year, and 16,[illegible],067 during the corresponding period in 1921.

The total for the week of June 9 exceeded the corresponding week last year by [illegible] cars and the corresponding week in 1921 by [illegible] cars. It also exceeded by [illegible] cars the preceding week this year when freight loadings were curtailed by the observance of Memorial Day.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 379 to 393, are the following:

Telephone exchange, New York, N. Y., to Marc Eidlitz & Son, Inc., $11,250,000.

Office building, Chicago, Ill., to R. C. Wieboldt Co., $7,000,000.

Bank and office building, Chicago, Ill., to H. Erickson Co., $5,500,000.

Office building, New York, N. Y., to S. S. Roth & Bros., $5,000,000.

Turbo units for power plant, Detroit, Mich., to Westinghouse Electric & Mfg. Co., Pittsburgh, Pa., $1,254,000.

Grain elevator, Ft. Worth, Tex., to Southwestern Eng. Co., Springfield, Mo., $1,500,000.

Concrete arch, Detroit, Mich., to Lennane & McIlvenna, $663,285.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 379 to 393, are the following:

Railways, Montreal, Que., Canada, for Canadian National R.R., $20,992,000.

Hospital, Nashville, Tenn., for Vanderbilt University, $2,000,000.

Industrial plant, Toledo. O., for Libby Owens Sheet Glass Co., $1,500,000.

Cement mill, Ft. Worth, Tex., for South West Portland Cement Co., El Paso, $1,500,000.

High School, Kansas City, Mo., for Board of Education, $1,400,000.

Factory and warehouse, Dallas, Tex., for Brown Cracker and Candy Co., $1,000,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of June 7; the next, on July 5.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montrea
Structural shapes, 100 lb.	$3.64	$4.30	$4.50	$3.40	$3.55	$4.20	$3.95	$4.10	$4.25
Structural rivets, 100 lb.	4.40	5.00	4.95	3.75	4.25	5.40	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	4.25	+3.80	3.32½	3.45	3.85	3.65	4.10	4.00
Steel pipe, black, 2½ to 6 in. lap, discount	44%	52%	45%	47%	53-5%	36%	35.2@47.6%	40%	32.76
Cast-iron pipe, 6 in. and over, ton	62.50@63.50	—53.00	63.00	60.20	60.50	69.00	+62.00	70.00	60.00
Concreting Material:									
Cement without bags, bbl	2.70@2.80	2.85	2.25	2.20	2.39	2.84	2.71	2.90	2.25
Gravel, ¾ in., cu.yd	2.25	1.90	2.25	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd	1.25	1.24	1.95	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd	1.75	2.00	2.50	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	64.00	42.00	+55.00	58.50	43.25	60.00	41.00	—31.00	90.00
Lime, finishing, hydrated, ton	18.20	23.50	—22.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	—2.35	1.50	1.50	2.70	1.75	2.80	10.00
Common brick, delivered, 1,000	23.50	14.00	+13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.109	.115	.1032	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1573	.109	.115	.0825	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	—1.13	—1.20	—1.35	1.29	1.29	1.39	1.24	.86	1.38
Common Labor:									
Common labor, union, hour	.75	.35	....	......	....	.50@.55	.55	....	......
Common labor, non-union, hour	....	.30	.30@.50	.85	.55	.35@.50	.50	.50@.62½	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 90c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.62). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Prices of finished steel products have continued fairly stable during the last two months. Reinforcing bars are still quoted at $2.40, with plates and shapes at $2.50 per 100 lb., f.o.b. mill. Heavy oil production is creating an increased demand for storage-tank plates. Considerable new business in plates and structurals developed during the last week despite the recent quiet tone to the structural market, brought about by the suspension of many projects.

Douglas fir lumber market shows a slight tendency to soften. Seattle reports a decline of $1 per M. ft. in structural sizes. Yellow pine, however, advanced $2 per M. ft. in Dallas, due to unusually heavy local demand.

Slight fluctuations appear in cast-iron pipe prices throughout the South and West. Seattle reports steel and cast-iron pipe holding at levels quoted but with continuing shortage, and shipments practically impossible to obtain.

Raw linseed oil declined 1c. in Dallas; 3c. in New York and 4c. per gal. in Atlanta, during week.

A formal agreement between the New York Mason Builders' Association and the bricklayers was signed Monday, May 25. The contract calls for a basic wage of $12 per day for two years. Hod carriers are also to receive $8 per day during the same period. Iron workers and cement and concrete laborers are on strike. The former for the forty-four-hour week and abolition of the open shop, and the latter for a wage advance of $1 per day.

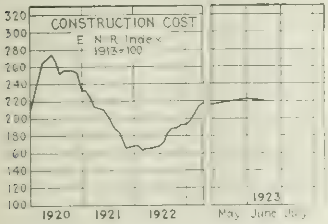
CONSTRUCTION NEWS

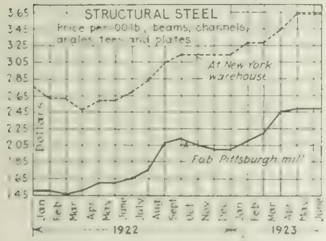
The Construction Barometer

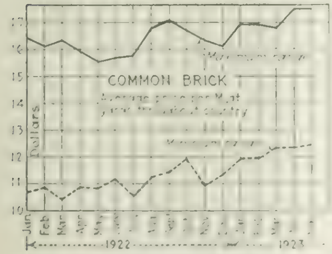
Decline In Price of Pig Iron — Little Change In Other Materials During Week

COST remains flat, the only important price development being the disappearance of the premium on steel. Shapes sell for $2.50 per 100 lb. at the mill. Indicative of lessening demand is the drop of nearly 308,000 tons of unfilled orders on the books of the U. S. Steel Corporation. Price of pig iron continues to decline.

Production is going forward at full speed to fill orders already placed. The volume of June contracts is 13 per cent lower than May. Next week special attention will be given to demand as indicated by the latest figures of production and contracts awarded.







E. N.-R. Statistics

VALUE OF LARGE CONTRACTS LET IN THE UNITED STATES

Week Ending	Public Work	Private Work	Total Contracts
June 7	$25,144,000	$18,704,000	$43,848,000
June 14	23,681,000	14,052,000	37,733,000
June 21	15,417,000	20,308,000	35,725,000
3 weeks	$64,242,000	$53,064,000	$117,306,000

LARGE BUILDING CONTRACTS— NUMBER AND VALUE

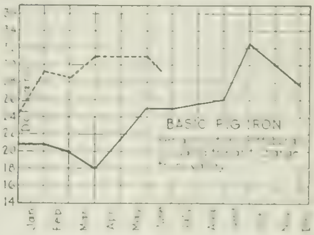
Week Ending	No.	Public Work	No.	Private Work
June 7	13	$2,558,000	37	$11,303,000
June 14	11	7,593,000	36	9,742,000
June 21	9	4,63[illegible],000	28	10,941,000
3 weeks	33	$14,787,000	101	$31,986,000

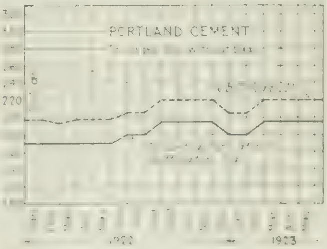
NUMBER OF LARGE JOBS NOW OUT FOR BIDS

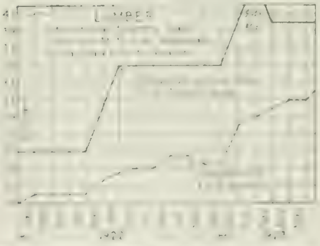
		Public			
Week Ending	Pr[illegible]	All	Streets [illegible] Roads	Water Works and Sewers	All Buildings
June 7	[illegible]	202	7[illegible]	2[illegible]	46
June 14	2[illegible]	211	80	41	35
June 21	23	205	84	37	37

BASE PRICES FIRM NO PREMIUMS ON STEEL

	Quoted on	[illegible]	Price [illegible]	[illegible]
[illegible]		$2 [illegible]	$2 50	June 21
[illegible]			$2 [illegible]	
[illegible]	[illegible]	2 [illegible]	2 [illegible]	Feb. 1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible] 14
[illegible]	Tran., M ft	41 00	39 00	[illegible] 5
[illegible]	[illegible]	[illegible]	[illegible]	May 31







PROPOSALS

For proposals Advertised see the pages immediately following the "Construction News" Section.

WATERWORKS

Bids Close			See Eng. News-Record
July	2	Lathrop, M[illegible]	[illegible]
July	3	Ft. Worth, T[illegible]	[illegible]
July	3	Ft. Worth, T[illegible]	[illegible]
July	3	Madisonville, Tenn.	[illegible]
July	3	[illegible]	[illegible]
July	5	[illegible], Md.	[illegible]
July	6	Ft. [illegible], Wis.	[illegible]
July	7	[illegible]	[illegible]
July	7	[illegible]	[illegible]
July	9	Point Grey, B. C.	June 28
July	16	Lemmon, S. D.	June 28
July	17	Deland, Fla. Adv. June 21 and 28.	June 21

SEWERS

Bids Close			See Eng. News-Record
July	2	Akron, O.	June 21
July	2	[illegible]	[illegible]
July	2	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	June 14
July	3	Newton, N. J. Adv. June 21 and 28.	June 21
July	[illegible]	[illegible] Adv. June 21 and 28.	June 1
[illegible]	[illegible]	[illegible]	[illegible]
July	[illegible]	[illegible]	[illegible]
July	[illegible]	[illegible]	[illegible]
July	[illegible]	[illegible], Mich.	[illegible]
July	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	June [illegible]

BRIDGES

Bids Close			See Eng. News-Record
[illegible]	[illegible]	[illegible]	[illegible] 7
July	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible] Adv. June 21 and 28.	[illegible]

Bids Close			See Eng. News-Record
July	[illegible]	[illegible]	[illegible]
July	[illegible]	[illegible]	[illegible]
July	[illegible]	[illegible]	[illegible]
July	[illegible]	[illegible]	[illegible]
July	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible], Wis.	[illegible]
July	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible] Adv. June 28.	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Indianapolis, Ind.	June 28
July	[illegible]	Ft. Wayne, Ind. Adv. June 28.	June 28
July	18	Phila. [illegible] 28.	June 28
July	[illegible]	[illegible]	June 28
[illegible]	[illegible]	[illegible]	May 3
Nov.	[illegible]	[illegible]	Apr. 19
[illegible]	[illegible]	[illegible]	June 28

DAMS

Bids Close			See Eng. News-Record
July	[illegible]	[illegible]	June 21

RAILWAYS

Bids Close		See Eng. News-Record
July 5	New Jersey	June 28

EXCAVATION, DRAINAGE, IRRIGATION

July 5	Sisseton, S. D.	June 28
July 6	Corinth, Miss.	June 28
July 10	Ottumwa, Ia. Adv. June 21 and 28.	June 14
July 10	Merced, Calif.	June 28
July 11	Trenton, Mo.	June 28
July 17	Dunkirk, N. Y. Adv. June 21 and 28.	June 21
July 26	New Orleans, La. Adv. June 28.	June 28

STREETS AND ROADS

June 29	Medford, Mass.	June 28
July 2	North Tarrytown (Tarrytown P. O.), N. Y.	June 21
July 2	Ebensburg, Pa.	June 21
July 2	Wynnewood, Okla.	June 28
July 2	Gardner, Mass. Adv. June 28.	June 28
July 2	Mayersville, Miss.	June 28
July 2	New York, N. Y.	June 28
July 2	Michigan	June 28
July 2	Dayton, O.	June 28
July 2	Chicago, Ill.	June 28
July 3	University (St. Louis P. O.), Mo.	June 21
July 3	Alabama	June 7
July 3	Akron, O.	June 14
July 3	Trenton, N. J.	June 21
July 3	Michigan	June 28
July 3	Belleville, N. J.	June 28
July 3	Nutley, N. J.	June 28
July 3	Denver, Colo.	June 28
July 3	Louisville, Ky.	June 28
July 3	Marysville, Calif.	June 28
July 5	Maplewood (St. Louis P. O.), Mo.	June 14
July 5	Abbeville, La.	June 21
July 5	Lincoln, Neb.	June 21
July 5	Steelton, Pa. Adv. June 14 and 28.	June 28
July 5	Brooklyn, N. Y.	June 28
July 5	Baltimore, Md.	June 28
July 5	Sayre, Okla.	June 28
July 5	Lincoln, Neb.	June 28
July 5	Weleetka, Okla.	June 28
July 6	Mannington, W. Va.	June 21
July 6	Akron, O.	June 21
July 6	Virginia	June 21
July 6	Lancaster, S. C.	June 21
July 6	Greensburg, Pa.	June 14
July 6	Alabama	June 21
July 6	Quebec	June 28
July 6	Michigan	June 28
July 6	Scottsville, Mich.	June 28
July 6	Missouri	June 28
July 6	Fergus Falls, Minn.	June 28
July 6	Albany, Ga.	June 28
July 6	Nashville, Tenn.	June 28
July 6	Emporia, Kan.	June 28
July 6	Alabama	June 28
July 7	Grandview Heights (Columbus P. O.), O.	June 28
July 9	California	June 21
July 9	Laurel, Miss. Adv. June 28.	June 28
July 9	New Jersey Adv. June 28.	June 28
July 9	Michigan	June 28
July 9	Keyport, N. J. Adv. June 28.	June 28
July 9	East Grand Forks, Minn.	June 28
July 9	Kansas City, Mo.	June 28
July 9	St. Paul, Minn.	June 28
July 9	Ft. Davis, Tex.	June 28
July 9	Richmond, Va. Adv. June 28.	June 28
July 9	Edgerton, Wis.	June 28
July 10	Fairmont, W. Va.	June 21
July 10	St. Albans, W. Va.	June 21
July 10	Nashville, Tenn.	June 21
July 10	Circleville, O.	June 28
July 10	Michigan	June 28
July 10	Washington	June 28
July 10	Florida	June 28
July 11	Louisiana	June 28
July 11	Michigan	June 28
July 11	Vero, Fla.	June 28
July 12	Faribault, Minn.	June 21
July 12	Michigan	June 28
July 14	Bolivar, Pa.	June 28
July 15	Western Springs, Ill.	June 28
July 15	La Grange, Ill.	June 28
July 15	South Bend, Wash.	June 28
July 16	Plainfield, N. J. Adv. June 28.	June 28
July 17	St. Louis, Mo.	June 21
July 17	Pottsville, Pa. Adv. June 21 and 28.	June 28
July 18	New Mexico	June 28
July 24	West Virginia Adv. June 28.	June 28

INDUSTRIAL WORK

July 6	Verona, N. J.	June 28

BUILDINGS

Bids Close		See Eng. News-Record
July 1	Coffeyville, Kan.	June 28
July 2	Columbus, O.	June 14
July 2	Leavenworth, Kan.	June 28
July 2	Syracuse, N. Y.	June 28
July 2	Milwaukee, Wis.	June 28
July 2	Louisville, Ky.	June 28
July 3	Kitchener, Ont.	June 21
July 3	Bergenfield, N. J.	June 14
July 5	Bloomfield, N. J.	June 28
July 5	Pittsburgh, Pa.	June 28
July 6	Virginia, Minn.	June 7
July 6	Athens, O.	June 28
July 7	Athens, O.	June 28
July 9	Maplewood, N. J.	June 21
July 9	Easton, Pa.	June 21
July 10	Holdenville, Okla.	June 28
July 15	Astoria, Ore.	June 7
July 15	Knoxville, Tenn.	June 21
July 16	Dover, O.	Jnue 28
July 16	Pawhuska, Okla.	June 28
July 16	Nashville, Tenn.	June 28
July 20	Logan, O.	June 28
July 21	Pittsburgh, Pa.	June 28
July 24	Conrad, Pa.	June 21
Aug. 1	Jackson, Miss.	June 21

FEDERAL GOVERNMENT WORK

July 2	Bridge—Washington	June 28
July 3	Remodeling — Frankfort, Ky.	June 14
July 3	Bridges—California	June 28
July 3	Removing Superstructure, etc. —Duluth, Minn. Adv. June 28.	June 28
July 5	Pumps—New Orleans, La.	June 14
July 5	Extension — New York, N. Y.	June 21
July 9	Steps—Denver, Colo.	June 14
July 9	Dredging — Wilmington, Del. Adv. June 14 to 28.	June 14
July 10	Conveyor—Memphis, Tenn. Adv. June 21 and 28.	June 21
July 18	Extension—Pearl Harbor, H. T.	June 21
July 18	Fire Protection System — Pearl Harbor, H. T.	May 31
July 18	Storage Facilities — Pearl Harbor, H. T.	June 7
July 19	Tanks—Memphis, Tenn. Adv. June 21 and 28.	June 21
July 19	Dredging—New Orleans, La. Adv. June 21 and 28.	June 21
July 20	Dredging—Galveston, Tex. Adv. June 21 and 28.	June 21
July 20	Intake Chamber, etc.—Wash., D. C. Adv. June 21 and 28.	June 28
July 21	Dredging—Galveston, Tex.	June 28
July 31	Dredging—Baltimore, Md.	June 28

MISCELLANEOUS

July 2	Sea Wall — Vicksburg, Miss.	June 7
July 2	Asphaltic Cement—New York, N. Y.	June 28
July 2	Underground Return Lines—New York, N. Y.	June 28
July 3	Stone Crusher — Trenton, N. J.	June 21
July 5	Structural Steel Framing, etc. —New Orleans, La.	June 21
July 5	Landing — New Orleans, La.	June 28
July 11	Pier—San Diego, Calif.	June 28
July 16	Power Equipment—Taylorville, Ill. Adv. June 28.	June 28
July 20	Timber—Webb, N. Y. Adv. June 28.	June 28
Aug. 31	Cable and Accessories — Melbourne, Australia	June 21
Feb. 28	Headworks — Wellington, New Zealand	May 24

Where name of official is not given inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Waterworks

PROPOSED WORK

Pa., Allentown—Plans new mains in 15th Ward. $31,000. H. F. Bascom, city engr.

Md., Hagerstown—Having surveys made new water supply system from Potomac River, incl. filters, pumps, 7 mi. supply line, etc. $1,450,000. G. L. Bean, 806 Abbott Bldg., Phila., Pa., engr.

Miss., Greenwood—Plans extension to water system to incl. North Greenwood. W. S. Hawkins, engr.

Miss., Vicksburg—City having plans prepared 3 or more pumping plants in connection with drainage project and land reclamation along river front. Miller-Butterworth Co., 624 Southern Trust Co. Bldg., Little Rock, Ark., engrs.

Tenn., Covington—Voted $71,000 bonds for repairs to water and light plant. Oil burning engine and miscellaneous equipment, to Fairbanks Morse Co., 900 South Wabash Ave., Chicago.

O., Conneaut—Making plans 2 story, 125 x 150 ft. brick and concrete filtration plant. $150,000. Burgess & Nipel, 223 East Broad St., Columbus, engrs.

Ill., Mt. Prospect—Plans extensions to mains. $25,000. Consoer Eng. Co., 2007 Ogden Ave., Chicago, engrs.

Ill., Niles Center—See "Sewers."

Ia., Dubuque—See "Contract Awarded."

Minn., St. Paul—July 16, to vote on $870,898 bonds for Vadnais Lake conduit, $90,000 for Pleasant and Sucker Lake conduit and canal, $61,000 for Centerville conduit, $598,300 large feeder mains, $850,000 distribution mains, meters and other accounts for 5 years. G. M. Shepard, city engr.

Neb., Crawford—Voted $45,000 bonds for waterworks and extensions, incl. new settling basis, new filtration, raising dam, etc. J. J. Rasmussen, Crawford, engr. Noted June 14.

S. D., Castlewood—Making plans waterworks system. $18,000. Chenoweth, Kennedy & Rettinghouse, Boyce-Greeley Bldg., Sioux Falls, engrs.

Mo., Holden—Election soon to vote on $75,000 bonds for waterworks. Benham Eng. Co., 512 Gumble Bldg., Kansas City, engrs.

Tex., Hubbard—July 3, to vote on $55,000 bonds for new mains, pumps, etc. J. C. Mecklin, mayor. Engineer not announced.

Tex., Throckmorton—Making surveys reservoir, earth dam, concrete spillway, elevated tank and tower. Plans election to vote on $40,000 bonds. Baker & Von Zuben, Ellison Bldg., Ft. Worth, engrs.

Calif., Visalia—Plans to vote on $150,000 bonds to purchase and improve privately owned water works system, and construct extensions, latter to cost in excess of $25,000. L. H. Gadsby, city engr.

Ont., Kirkland Lake—Plans waterworks system, incl. c.i. mains, pumps, hydrants, valves, pump house, reservoir or tank. $150,000. M. Campbell, clk. Engineer not selected.

Ont., Toronto—Plans 9,000 ft. 6 in. c.i. mains in Beachwood and Rose Aves., Benson, McKinstry and Cline Sts., Dalewood, Dromore and Haddon Crescents, North Oval and Whitton Rd. $25,000. R. C. Harris, city engr.

Ont., York—York Twp. plans 18,000 6 in. c.i. mains in Queensdale, Poulton, Burgess, Knight, Lesmount, Edison, Cardona, Carlow, Sprule, Gordon, Carrington, Glenhaven, Hillsdale, Larratt, Orla and Syndicate Aves., Dilworth Crescent, Don Mills Rd. and 6th St. $45,000. F. B. Goedike, 40 Jarvis St., Toronto, engr.

BIDS DESIRED

N. Y., Tonawanda—July 7, by Town Bd., Village Hall, mains in Water Dist. 4. To exceed $25,000. G. C. Diehl, Ellicott Sq. Bldg., Buffalo, engr.

Md., Baltimore—July 5, by Bd. Awards, 100,000 ft. (more or less) single vitr. clay conduit. C. F. Goob, ch. engr.

O., Grandview Heights (Columbus P. O.) —July 7, by E. Gross, village clk., 16,580 ft. 6 in. mains in Parkway N., Parkway Dr., Timberman and Copeland Rds., Goodale and Northwest Blvds., Thomas, Mulford, Dover, Norton, Holly and 2nd Aves. $50,000. Burgess & Nipel, 223 East Broad St., Columbus, engrs. Noted May 24.

Ill., Niles—July 3, waterwork incl. pumping station. $56,000. Consoer Eng. Co., 140 South Dearborn St., Chicago, engrs.

Wis., Ft. Atkinson—July 5, by W. D. Leonard, city clk., brick, rein.-con. and steel pumping station, and rein.-con. reservoir, 60 ft. diameter, 15 ft. deep, 300,000 gal. capacity. $15,000. W. G. Kirchoffer, Dean Bldg., Madison, engr.

Mo., Lathrop—July 2, at A. T. Archer & Co., engrs., 609 New England Bank Bldg., Kansas City, new water supply system, here. $40,000. Former bids rejected. Noted June 14.

S. D., Lemmon—July 16 (change of date) by R. M. Watson, city aud., 2,200 lin.ft. 8 in. iron or wood mains, 2,100 lin.ft. 4 in. c.i. pipe, 24 x 35 ft. steel standpipe, pump and deep well, etc. $25,000. C. L. Pillsbury, Co., 1200 2nd Ave. S., Minneapolis, Minn., engrs. Noted June 21.

B. C., Point Grey—July 9, by H. Floyd, clk., 17,000 ft. 4-8 in. lapwelded sheet

Waterworks (Continued)

c.i. pipe. f.o.b. Vancouver. W. B. Greig, 5851 West Blvd., Vancouver, engr.

BIDS RECEIVED

Md., Baltimore — Bd. Awards. furnishing and delivering valves, Contr. 69, from Kennedy Valve Mfg. Co., East Water St., Elmira, N. Y., $56,362. Noted June 14.

CONTRACTS AWARDED

Md., Baltimore — Furnishing filter rate controllers and venturi meters for Montebello Filtration Plant, to Simplex Valve Co., 5722 Race St., Phila., Pa., $40,626.

La., Lecompte—W. H. Jones, mayor and Bd. Alderman, furnishing and erecting one 100 hp. and one 50 hp. oil engines directly connected to alternator, panel switchboard, motor driven domestic service pump, motor air compressor, to Fairbanks, Morse & Co., 608-14 Magazine St., New Orleans, $23,475; concrete reservoir, concrete foundation and new building, to Hayden Constr. Co., Pass Christian, Miss., $12,750; water well, to Gray Artesian Well Co., Amer. Natl. Bank Bldg., Pensacola, Fla., $4,000. Noted May 24 under "Industrial Works."

O., Columbus—See "Streets and Roads."

O., Dayton—Montgomery Co. mains in Oakwood Heights Sewer Dist., southern section to C. F. Smith & Son, 54 Davies Bldg., $121,609; northern section to Connelly Bros., Cincinnati, $41,470.

O., Upper Arlington (Columbus P. O.)—See "Streets and Roads."

Mich., Detroit—For 52 x 130 ft. pumping station, with 40 ft. well rein.-con., 5 electrically operated centrifugal pumps, two 24 in., two 15 in. and one 12 in., provision made for additional pumping units as needed, to Natl. Constr. Co., 1031 Dime Bank Bldg., $177,700. Noted June 21.

Mich., Detroit—Furnishing 250 tons centrifugal pipe in various sizes, to U. S. Cast Iron Pipe & Fdry. Co., East Burlington St., Burlington, N. J., 6 in. $0.94 per ft., 8 in. $1.34, 10 in. $1.81, 12 in. $2.60.

Wis., Oshkosh—New pumping machinery for waterworks plant, to Langstadt-Meyer Electric Co., 14 Waugoo St., $31,738. Noted May 31.

Minn., New Ulm—For 11,000 lin.ft. 4 and 6 in. c.i. mains and 20 hydrants, to Mankato Constr. Co., Mankato, $16,609, and Feyen Constr. Co., 277 Burgess St., St. Paul.

Ia., Dubuque—To J. A. Gregory, 1120 Iowa St., 2 pumping stations, $29,477 and $11,187 respectively; C. W. Varner, 1695 Washington St., drilling artesian well, $9,417. Mead & Seastone, engrs., Journal Bldg., Madison, Wis., soon take bids on equipment. Noted May 10.

Tex., Austin—Making plans 8 m.g. filtration plant. $25,000. C. E. Leonard, city engr. John B. Hawley, Cotton Exch. Bldg., Ft. Worth, consult. engr.

Tex., Edgewood—Waterworks and street lighting systems, to Municipal Eng. Co., Praetorian Bldg., Dallas, $40,000 and $15,000 respectively.

Tex., Ft. Worth—Pumphouse, to West & Womack, Dan Waggoner Bldg., $17,592; pumps, etc., to Conner-Hudson Co., Southwest Life Bldg., Dallas, $14,996; [illegible],000 gal. tank on 130 tower, to Pittsburgh-Des Moines Steel Co., Praetorian Bldg., Dallas, $30,000. Noted May 24.

Mo., Kansas City — Fire & Water Bd., 1,200 tons 8 in. pipe, to U. S. Cast Iron Pipe & Fdry. Co., 604 Interstate Bldg., $70,980.

Sewers

PROPOSED WORK

Conn., East Hartford (branch of Hartford)—Plans [illegible] ft. 10-20 in. vitr. [illegible] sewers in [illegible] and Main Sts. [illegible] C. H. Olmsted, Comstock Blk., engr.

Pa., Erie—Rejected bids Sewer [illegible] 1, 2, 3 and [illegible] $[illegible]. Will readvertise. F. G. Lynch, city engr. Noted June 7.

Pa., Pittston—See "Streets and Roads."

Fla., Bartow—July 17 to vote on [illegible] bonds for sanitary sewerage [illegible] & McDonnell, [illegible] Interstate Bldg., [illegible] City, Mo., engrs. Noted Apr. [illegible]

Miss., Greenwood—[illegible] extension, $[illegible] and [illegible] W. S. Hawkins, engr.

O., Delaware—[illegible] prepared and [illegible] posal plant at Girls' Industrial Home, here. R. H. Simpson, Columbus, engr.

O., Kenmore—Plans [illegible] plant. $300,000. E. A. [illegible] Serv.

Ill., Bensonville—[illegible] and sewage disposal plant. $[illegible],000. E. Hancock, 2007 Ogden Ave., Chicago, engr.

Ill., Elmwood Park (Chicago P. O.)—Soon takes bids 4-12 in. mains. $330,000. E. Hancock, 2007 Ogden Ave., Chicago, engr.

Ill., Niles Center — Plans extensions to sewers and watermains. $25,000. Consoer Eng. Co., 140 South Dearborn St., Chicago, engrs.

Ill., Palatine—Plans sewerage system. $160,000. Consoer Eng. Co., 140 South Dearborn St., Chicago, engrs. Marr, Green & Co., 400 North Michigan Ave., Chicago, consult. engrs.

Ill., West Chicago—Soon takes bids storm sewerage system. $40,000. E. Hancock, 2007 Ogden Ave., Chicago, engr.

Neb., Fairbury—July 3, to vote on $40,000 bonds for sewerage system and drainage work. H. W. Fouts, clk.

S. D., Castlewood—Making plans sanitary sewerage system. $25,000. Chenoweth, Kennedy & Rattinghouse, Boyce-Greeley Bldg., Sioux Falls, engrs.

Mo., Sikeston—Soon takes bids 27,000 ft. 8 in. vitr. and 25,600 ft. 10-48 in. segmental block sewers. $158,000. W. A. Fuller, 1917 Ry. Exch. Bldg., St. Louis, engr. Noted May 17.

Tex., Stamford—Making plans Imhoff tanks, sanitary sewers, etc., $30,000 bonds voted. John B. Hawley, 403 Cotton Exch. Bldg., engr. Noted May 31.

Ore., Albany—Takes bids about July 10, storm sewers. $65,000. Stevens & Koon, Spalding Bldg., Portland, engrs.

Calif., San Francisco—Plans constructing unit of Army St. sewer. $70,000. M. M. O'Shaughnessy, city engr.

Ont., Galt—Soon takes bids 9,000 ft. sanitary sewers along river. $35,681. D. T. Black, City Hall, engr. Noted Feb. 8.

Ont., Weston—Having estimates and plans prepared sewerage system, probably 10,000-12,000 ft. 8-12 in. vitr. tile. $30,000. James, Proctor & Redfern, 36 Toronto St., Toronto, engrs.

BIDS DESIRED

Vt., Essex Junction—July 10, by Bd. Village Trustees at office of A. Martin, village clk., sewerage system. L. A. Evans, pres.; adv. this issue.

N. Y., New York—July 2, by J. Miller, pres. Manhattan Boro, Municipal Bldg., sewers in west side of Amsterdam Ave., etc.

N. J., Bloomfield—July 2, by J. C. Johnson, town clk., 8,175 lin.ft. 8-12 in. sanitary sewers in Parkway W, Mill St., Myrtle, Weaver and Franklin Aves., $28,521; paving 3,600 sq.yd. Vesper and Orchard Places, Fontaine and Farrandale Aves., asphalt penetration telford, $6,300; curbing and paving 4,200 sq.yd. Race and Fulton Sts., asphalt penetration telford, $11,975. E. Baechlin, Natl. Bank Bldg., town engr. Noted Apr. 12.

Pa., Neville Island (McKees Rocks P. O.) Dravo Contg. Co., Diamond Bank Bldg., Pittsburgh, will build 1 story, 75 x 273 ft., structural shop, steel and concrete, here, by separate contracts. $75,000. L. Vincent, Jenkins Arcade, Pittsburgh, engr.

Fla., Vero—July 11, by F. E. King, mayor, 12,000 ft. 6-30 in. vitr. clay storm sewers, etc. $25,000. Carter & Damerow, Vero, engr.

Ky., Louisville—July 17, by Comm. Sewerage, for Napolean Blvd. sewer and drain and Speed Ave. laterals "South." J. B. F. Breed, ch. engr.; adv. this issue.

O., Grandview Heights (Columbus, P. O.)—July 7, by E. Gross, village clk. 14,166 ft. 6-18 in. vitr. sewers in alleys in plats 4 [illegible] addition to Grandview Heights. $25,000. Burgess & Nipel, 223 East Broad St., Columbus, engrs.

Ill., Shermerville—July 9, sewerage system. $[illegible] [illegible] Eng. Co., 140 South Dearborn St., Chicago, engrs.

Mo., Lathrop—[illegible] A. T. Archer & [illegible] Bldg., [illegible] and disposal plant, here, for city. $60,000. Former bids [illegible]

Calif., Anaheim—[illegible] vitr. or concrete pipe.

Calif., Los Angeles—[illegible]

BIDS RECEIVED

N. Y., Brooklyn—[illegible]

N. Y., Brooklyn — E. Riegelmann, boro pres., Boro Hall, June 20, timber supports Sect. 1, Fort Hamilton Parkway, from Necaro Co., Inc., 97 Court St., $153,300. Noted June 14.

N. Y., Brooklyn—E. Riegelmann, boro pres., Boro Hall, June 20, sewers in (1) Church St. (2) 64th St. (3) 84th St. (4) East 31st St. (5) East 8th St., from Necaro Co., Inc., 97 Court St., (1) 100.97% engrs. est. ($269,436); M. Tozzi, 1362 63rd St., (2) 88.25% ($7,145); Nazzaro & Querriero, (3) 88% $6,586); Tomasetti & Co., Inc., 1133 60th St., (3) 88% (4) 86% ($4,834); J. McBride, (5) 89.99% ($1,600). Noted June 14.

N. Y., New York—H. Bruckner, pres Bronx Boro, 3rd and Tremont Aves., June 21, sewer in Jarvis Ave., from McDonald & Wilson, $5,669; Pelham Parkway, from Anita Constr. Co., 2975 Marion Ave., $40,042; Tryon Ave., from Spadaro & Turiano, 3185 East Tremont Ave., $5,417.

O., Euclid—Inlet trunk sewer in Lake Shore Blvd. and Bliss Rd., 110 ft. No. 6 circular brick, 275 ft. 4-24 in. concrete and 700 ft. 24 in. tile pipe, from C. W. Jackson, 1318 East 84th St., Cleveland, $35,247.

O., Toledo—Storm water regulators and connections, brick manholes, Contr. 8, from Harris & Tansey, Toledo, $173,658.

Wis., Marshfield — Sanitary sewerage system, incl. 14,973 ft. 8-12 in. vitr. pipe, 45 manholes, etc., storm sewers incl. 4,765 ft. 10-30 in. pipe, 20 manholes, 3 catchbasins, 1 concrete outlet, 2,105 lin.ft. trunk sewer, from Pastoret Constr. Co., 308 Sellwood Bldg., Duluth, Minn., $77,192. Noted March 29.

CONTRACTS AWARDED

N. Y., Brooklyn—E. Riegelmann, boro pres., Boro Hall, to S. Ambrosio, 1016 60th St., sewer in Ave. I 93% of engrs. est. ($1,400), Ave. I 90% ($1,050); to C. F. Vacharas, 643 40th St., Benker St. 105% ($700) 72nd St., 95% ($400), Ave. J 94% ($400) 12th Ave. 99% ($1,680) 48th St. 109% ($1,539), East 10th St. 90% ($800); to B. Peconi & Sons, 76th St. 87% ($11,265); to Nazarro & Querriero, Bay 28th St. 91% ($6,834); to Tomassetti & Co., 1133 6th St., East 32nd St. 86.86% ($4,905). Noted June 14.

N. Y., Mamaroneck—E. L. Howe, village clk., completing sewage disposal works, to Mapes & Erway, Little Britain Rd., Newburgh. Engrs. est. $100,000. Noted May 10.

N. Y., Waterloo — Sanitary and storm sewer in Cox St., to R. J. Logan, 107 West Main St., $10.35 per lin.ft. Noted May 24.

Pa., Erie — For 11 sewers in Frontier Place Sub-division, 5 to F. G. and H. G. Diefendorf, Erie, $16,285; 6 to Doyle Contg. Co., Erie, $16,661. Noted June 7.

Pa., Erie—Mill Creek Valley monolithic sewer drain to F. G. Diefendorf, Erie, $43,006. Noted June 7.

Fla., Plant City—City will construct sanitary sewerage system, by day labor. Materials incl. 16,760 ft. 8 in., 1,300 ft. 10 in., 2,450 ft. 15 in. and 1,760 ft. 6 in. vitr. clay pipe, etc., to Macon Sewer Pipe Wks., Georgia Casualty Bldg., Macon Ga. Total cost $[illegible]

O., Cleveland Heights (Warrensville, P. O.)—For 10,700 ft. 8-30 in. tile sewer in Silsby Rd., to Hadded-Mall Co., Schofield Bldg., Cleveland, $34,250. Noted June 21.

O., Columbus—See "Streets and Roads."

O., Upper Arlington (Columbus P. O.)—See "Streets and Roads."

Ind., Hammond—[illegible]

Mich., Detroit—Connors Creek Sewer. [illegible]

Wis., Milwaukee—[illegible] to Wheeler, Arnold Co., Wittenberg, $33,[illegible] May 31.

Minn., Cloquet—See "Streets and Roads."

S. D., Yankton—State Bd. Charities & [illegible] Jensen, 2407 Wirst St., Omaha, Neb., [illegible]

Tex., [illegible]—[illegible]

Calif., Long Beach—[illegible]

Waste Disposal

PROPOSED WORK

Minn., Duluth—[illegible]

Waste Disposal (Continued)

CONTRACTS AWARDED

Pa., Harrisburg — Superintendent Pub. Safety, 408 Dauphin Bldg., 50 ton incinerator plant, to Superior Incinerator Co., Dallas, Tex., $39,850.

Bridges

PROPOSED WORK

Mass., Springfield—City, Administration Bldg., and Boston & Albany R.R., South Station, Boston, plan reconstructing 40 ft. rein.-con. and steel bridge, 30 ft. wide, over railroad tracks on Berkshire Ave., here. $130,000. R. S. Marsh, city engr. Noted Nov. 16.

Alabama—State Hy. Dept., Montgomery, having plans prepared treated timber bridges, 18 ft. roadways, on Linden-Thomaston Rd., Marengo Co., 1½ in. cold mix bituminous concrete surfacing, $40,000; concrete bridges on Russellville-Phil Campbell Rd., Franklin Co., incl. one 80 ft. steel span, $50,000; 983 ft. concrete bridges, Clay Co., incl. one 120 ft. steel span, 18 ft. roadway, $90,000; 228 lin.ft. rein.-con. bridges, 18 ft. roadway, on Center-Etowah Co. line Rd., Cherokee Co., $25,000. W. S. Keller, state highway engr.

Kentucky — State Rd. Dept., Frankfort, having plans prepared 380 ft. concrete and steel bridge, 1 mi. south of Hazard, Federal Aid Project 104, Perry Co., three 100 ft. steel and two 40 ft. concrete spans; 200 ft. concrete and steel bridge 1 mi. north of Hazard, Federal Aid Project 103, Perry Co., two 100 ft. spans, trestle approaches; 200 ft. concrete and steel bridge over North Fork of Kentucky River, 3 mi. north of Hazard, Federal Aid Project 103, Perry Co., two 100 ft. spans; 280 ft. concrete and steel bridge, over Kentucky River, near Jeff Station, Perry Co., two 100 ft. steel and two 40 ft. concrete spans. J. S. Boggs, state highway engr.

Ohio—See "Streets and Road."

Ia., Cedar Rapids—Making plans Municipal Island improvement incl. one 90 ft. bridge span and 300 lin.ft. retaining wall, etc., along Cedar River. $75,000. Marsh Eng. Co., 206 Masonic Temple Bldg., Des Moines, engrs.

Calif., San Francisco—City and San Francisco Co. appropriated $30,000 to repair bridges on 4th, 6th and 7th Sts. and Islais Creek Bridge. M. M. O'Shaughnessy, city engr.

BIDS DESIRED

Conn., Bridgeport—July 25, by East Washington Ave. Bridge Comn.. City Hall, constructing East Washington Ave. bridge. J. A. McElroy, city engr.; adv. this issue.

N. Y., Binghamton—Aug. 1, by Bd. Contr. & Supply, Municipal Bldg., 5 span rein.-con. arch bridge. W. E. Weller, city engr.; adv. this issue. Noted Feb. 22.

New Jersey—July 9, by State Hy. Comn., Trenton, 2 span steel and concrete bridge. State Highway Route 4, municipalities of Berkley and Lacey Twps., Ocean Co., also 1 span rein.-con. slab bridge, State Highway Route 16, Harding Twp., Morris Co. J. L. Vogel, 772 Broad St., Newark, bridge engr.; adv. this issue.

Pa., Phila.—July 18, by Delaware River Bridge Joint Comn., 806 Widener Bldg., anchorage cable bents for bridge over Delaware River, between here and Camden, N. J., adv. this issue.

Georgia—July 6, by State Hy. Dept., East Point, 371 ft. bridge on Elberton-Royston Rd., Elbert Co., 384.5 cu.yd. concrete, 52,010 lb. reinforcing, etc.; 214 ft. bridge on Columbus-Talbottom Rd., Muskogee Co., 1,520 lin.ft. wood piling, 373.9 cu.yd. concrete, 43,086 lb. reinforcing, etc.; 1,241 ft. bridge over Satilla River, Ware Co., Contr 1, 16,379 cu.yd. earth embankment, 700 sq. yd. stone rip rap, 1,620 sq.yd. sand clay surfacing, etc., Contr. 2, 741 cu.yd. excav., 620 cu.yd. concrete in piers, 1,410 cu.yd. concrete, alternate with concrete bents supported by wood piling, 620 cu.yd. concrete in piers, 1,900 cu.yd. concrete, 2,482 sq.yd. 4 in. concrete paving, etc.

Florida—July 5, by State Rd. Dept., Tallahassee, constructing approaches to Safety Harbor Bridge, Project 527, Road 17, (130) Pinellas Co., both north and south approaches incl. timber protection work, being 1,555 ft. long. W. F. Cooke, state highway engr.

Louisiana—See "Streets and Roads."

Ohio—See "Streets and Roads."

Ind., Ft. Wayne—July 12 by Comrs. Allen Co., bridge over Maumee River on Columbia St., O. M. Darling, co. engr.; adv. this issue.

Ind., Indianapolis—July 12 by Comrs. Marion Co., 23 bridges, $1,000-$5,000 each. J. J. Griffith, co. engr.

Wis., Albany—July 6, by Green Co., State Rd. Road and Bridge Com. at Village Hall, here, Sugar River Bridge, two 65 ft. span concrete deck girders. C. J. Smith, Monroe, comr.

Wis., Albeman—July 3, by Sauk Co. State Road and Bridge Com. at Village Hall, here, constructing Ableman Bridge, three 50 ft. concrete deck girder spans. W. Halbersleben, Baraboo, comr.

Wis., Stoughton—July 6, by city, 2 span rein.-con. bridge over Yahara River on Forton St., earth approach and fill. T. Pankow, Washington Bldg., Madison, engr.

Missouri—July 6, by State Hy. Dept., Jefferson City, eleven 20 ft. rein.-con. slab spans, etc., over overflow of Grand River, two 10 ft. rein.-con. slab spans over stream, two 10 rein. slab spans, etc., over Indian Creek, one 40 ft. and four 20 ft. I-beam spans over Little Muddy Creek, one 40 ft. and four 20 ft. I-beam spans over Muddy Creek, one 40 ft. and four 20 ft. I-beam spans over Muddy Creek Drainage Ditch, two 150 ft. steel truss, four 40 ft. and two 20 ft. rein.-con. slab spans over Grand River, all foregoing in Davies Co.; one 60 ft., one 80 ft. and one 140 ft. steel truss spans, etc., over Salt River, one 80 ft. steel truss and six 20 ft. rein.-con. slab spans, etc., over Otter Creek, Monroe Co.; one 40 ft. rein.-con. deck girder span, etc., Mercer Co.; one 20 ft. rein.-con. slab span, etc., over Kaolin Branch, Iron Co.; one 40 ft. rein.-con. deck girder span, etc., Mercer Co.; one 40 ft. and two 25 ft. rein.-con. deck girder spans, etc., over Yellow Creek, Sullivan Co.; four 80 ft. steel truss spans, etc., over Salt River, Shelby Co.; one 120 ft. steel truss span, etc., over River Des Peres, St. Louis Co.; one 75 ft. steel truss, and four 20 ft. rein.-con. slab spans, etc., over Muddy Creek, Barton Co.; one 40 ft. rein.-con. deck girder span, over Mill Race, Jasper Co.; one 120 ft. steel truss span over Railey Creek, and three 20 ft. rein.-con. slab spans, etc., over Pine Run Creek, Stone Co.; three 10 ft. rein.-con. slab spans over Spring Creek, Douglas Co.; one 100 ft. steel truss span over Gladden Creek, and one 50 ft. steel truss span over Spring Creek, Dent Co.; one 12 ft. rein.-con. slab and one 60 ft. steel truss spans over Minnow Branch, Marion Co.; cleaning and repainting steel work on two 200 ft. and two 120 ft. steel truss spans over Merramec River, St. Louis Co. B. H. Piepmeier, state highway engr. Noted June 7 and 14.

Washington—July 10, by State Hy. Comn., Olympia, 2 rein.-con. bridges over Hama Hama River on Olympic Highway, Mason Co. J. Allen, state highway engr.

BIDS RECEIVED

Alabama—State Hy. Dept., Montgomery, 1,388 ft. bridges on Demopolis-Linden-Millers Rd., Marengo Co., one 102 ft. steel span, from Bosworth-Smith Co., 1st Natl. Bank Bldg., Montgomery, treated timber, $74,438; The Smith Co., 30 3rd Ave. W., Birmingham, concrete $125,210; grading, gravel surfacing and bridging 6.19 mi. road from Wilcox Co. line to Thomasville, Clarke Co., from Stanley & Singer Constr. Co., Lafayette, with timber bridges $74,907, concrete bridges $80,205. Noted June 7.

Ky., Irvine—Estill Co., steel truss highway bridge over Kentucky River in South Irvine, from International Steel & Iron Co., 243 Edgar St., Evansville, Ind., $49,975, Vincennes Bridge Co., Vincennes, Ind., without end approach, $47,500. Noted May 24.

Ohio—See "Streets and Roads."

Ia., Davenport—Scott Co., 50 box culverts, 2 slab bridges, 3 pony truss and 6 I-beam spans, erection of 1 old truss on new abutments, from Miller-Fifield Constr. Co., L. & J. Bank Bldg., Waterloo, $116,301; W. D. Phelen Constr. Co., Davenport, $116,900.

Ia., Des Moines—Polk Co., one 40 x 24 ft., one 38 x 18 ft., two 36 x 18 ft. and one 40 x 18 ft. concrete girder bridges, one 100 x 18 ft. pony truss and one 10 x 10 ft. box culvert, from N. M. Stark & Co., 1213 Mulberry St., $37,212.

CONTRACT AWARD

Ohio—See "Streets and Roads."

O., Columbus—See "Streets and Roads."

O., East Sparta — Stark Co. (Canton), concrete arch bridge, here, to Roberts Supply Co., 419-21 Opera Blk., Lima, $47,810. Engrs. est. $56,000.

O., Navarre—Stark Co. (Canton) steel bridge, here, to Standard Eng. Co., Toledo, $38,787. Engrs. est. $40,000. S. K. Hilton, Genl. Del., Canton, local representative for contractor.

Ill., Algonquin—Concrete bridge to R. Fitzsimmons, Dundee. Engrs. est. $25,000.

Wis., Kewaskum—Washington Co. (West Bend), overhead bridge crossing highway north of here, to Newton Eng. Co., 185 Mason St., Milwaukee, 15,000 cu.yd. earth excav. $0.80, 3,500 sq.yd. concrete pavement $1.60, 475.4 cu.yd. concrete $23, 8,500 lb. reinforcing steel $0.05, etc., total $31,111.

Ia., Clinton—Clinton Co., one 3 span pony truss bridge over Wapsipinicon River, to A. Olson Constr. Co., 401 Black Hawk Bank Bldg., Waterloo, concrete figures $28.51, structural steel erected $0.0725, total $27,300.

Ia., Iowa City—Johnson Co., to A. P. Munsen, Marion, 7 circular and 9 box culverts, and 1 I-beam bridge, $13,778; to J. C. Watkins & Co., Marion, 15 box and 26 circular culverts, $18,690.

Mo., St. Louis—Dept. Pub. Serv., rein.-con, viaduct, 80 ft., with 550 ft. southern and 200 ft. northern approaches, on 14th St., to F. A. Stiers, 4500 Enright Ave., $468,943. Noted June 14.

Ont., Guelph—Wellington Co., concrete bridges, incl. Mount Forest Bridge, to J. Tilker, Harriston, $12,000; Augers and Creekbank Bridges to C. Martin, Fergus, $5,500; Hagarty Jordan and Schmidt Bridges, to E. Symmons, Drayton, $6,200; Erin Bridge, 35 ft. concrete truss, to W. Vallery Bellwood, $2,000; grading at Augers and Mount Forest Bridges, to W. Davies, Stratford, $12,415. Noted Apr. 19.

Dams

PROPOSED WORK

Wis., Peshtigo—See "Miscellaneous."

N. D., Grand Forks—Plans 10 ft. rock dam across Red River of the North. J. H. Solstad, city engr.

Calif., Merced—Merced Irrigation Dist., had plans prepared for Exchequer Dam, 278,000 cu.yd. concrete. Starr, Thebo & Anderson, Sharon Bldg., San Francisco, engrs. R. C. Starrett, resident engr.

Calif., Ravendale — See "Excavation, Drainage, Irrigation."

CONTRACTS AWARDED

O., Troy—For 300 ft. low concrete dam in Miami River, to Price Bros., 54 Davies Bldg., Dayton, $59,000. Engrs. est. $65,000. Noted Jan. 18.

Railways

PROPOSED WORK

Kentucky—Louisville & Nashville R.R. Co., 10th St .and Bway., Louisville, plans 16.63 mi. second track from Baileys to Walls End, on Cumberland Valley Div. $1,799,579. W. H. Courtenay, ch. engr.

Texas—Texas & Pacific Ry., Texas & Pacific Bldg., Dallas, takes bids this summer, ballast, alterations, new steel, etc., in Paris yards. $25,000. E. F. Mitchell, ch. engr.

Canada—Canadian National R.R., 230 St. James St., Montreal, Que., soon takes bids following railways, from Sunny Brae to Guysboro, N. S., $3,500,000; Meductia, N. B., to United States boundary, $1,260,000; Long Lac to Nakima, Ont., $1,944,000; Thunder Hill Branch to Prince Albert Branch, Sask., $1,656,000; Bengough Branch past Fife Lake, Sask., $1,404,000; Turtleford Branch to near Hafford $2,313-000; Bunblane Branch to Mawrer, $2,767,000; Alliance Branch, Alberta, $1,034,000; Hanna Branch to Warden, Alberta, $1,445,000; Loverna Branch to Westerly, Alta., $1,362,000; Okanagan Branch to Kelowna and Lumly, $2,307,000; about $40,000 per mile. C. B. Brown, Montreal, ch. engr.

Ontario—Michigan Central Ry., 15th St., Detroit, Mich., plans to lay about 75 mi. new rails in Ontario this year and will reballast about 50 mi. between Villa Nova and United States border. $1,000,000. J. F. Diemling, ch. engr.

BIDS DESIRED

New Jersey—July 5, by S. Blum, Nutley, town clk. of Nutley, reconstructing 6,000 lin.ft. double track electric railway tracks, furnishing new rails, ties and ballast also laying 11,750 sq.yd. reclipped granite block on concrete, between tracks, on Franklin Ave. between Centre St. and Kingsland Rd. $135,000.

BIDS RECEIVED

New York—Transit Comn., 49 Lafayette St., New York City, June 20, switchback track and other miscellaneous work east of Queensboro Plaza Station, Corona Branch, Queensboro Rapid Transit R.R., Queensboro, Routes 36 and 37, Sect. 1, from B. T. and J. J. Mack, Inc., 200 Bway., New York City, $28,562. Noted June 14.

CONTRACT AWARDED

Florida—Florida East Coast Ry. Co., St. Augustine, constructing 1st section of Okeechobee-Miami extension, beginning at Okeechobee and running 20 mi. southward through Okeechobee and Palm Beach

Railways (Continued)

Counties, 25,000 cu.yd. earth excav., 125,000 cu.yd. earth fill, to J. N. Cole, Graham Bldg., Jacksonville. Noted June 7.

Michigan — Dept. Street Rys. St. Jean Ave., Detroit, special track work for street car lines, extensions and replacements, to W. Wharton, Jr. & Co., Easton, Pa., $41,360.

Wisconsin — Madison Street Rys., 2302 Fair Oaks Ave., Madison, will lay double track on East Johnson St. and extend track on Monroe St., by day labor. Private plans. Noted June 14.

Excavation, Drainage Irrigation

PROPOSED WORK

Fla., Bartow—Election July 17, to vote on $25,000 bonds opening up McKinney Creek to Peace River. C. V. Turner, city mgr.

Ia., Sioux City—Making plans changing channel of Perry Creek, 50,000 cu.yd. excav., also laying 14 x 39 ft. conduit. $335,000. L. N. Hintgen, Sioux City, engr.

Minn., Blue Earth—Faribault Co. making plans Judicial Ditch 6, 21,588 lin.ft. 6-12 in. new tile and reconstructing 55,491 lin.ft. 6-24 in. tile, etc. $25,000. Jones & Curtis, Fairmont, engrs.

Tex., Waxahachie—See "Miscellaneous."

Calif., Ravendale—Red Rock Irrigation Dist. having surveys made canals, dams, etc., for irrigation district, comprising 22,500 acres. About $40 per acre. Will vote on bonds for above. T. H. Means, 369 Pine St., San Francisco, consult. engr.

BIDS DESIRED

New York—Thomas Crimmins Contg. Co., Tuckahoe Rd. and Aqueduct, Yonkers, will sublet approximately 20,000 cu.yd. backfill and excavation, suitable for 40 ft. boom dragline machine, in Fort Hill and Yonkers.

Miss., Corinth — July 6, by Bd. Comrs. White Oak and Hatchie D. D. of Tippah and Alcorn Counties, at office T. H. Johnston, atty., Corinth, 246,327 cu.yd. drainage channels, etc. A. Livingston, Louisville, engr.

La., New Orleans—July 26, by Bd. Port Comrs., Court House, hydraulic dredging in Inner Harbor Navigation Canal between Lock and Louisville & Nashville R.R. bridge. J. H. Walsh, genl. mgr.; adv. this issue.

Mo., Trenton—July 11, by Bd. Supervs. Brimson D.D. of Grundy and Harrison Counties, at office of R. E. Kavanaugh. W. B. Hazen, 409 Empire Trust Bldg., St. Joseph, engr. Noted Nov. 30.

S. D., Sisseton — July 5, by Auditor Roberts Co. D. D. 1, 13,610 cu.yd. shallow ditch excav. and 11,750 ft. 6-24 in. tile. Dakota Eng. Co., 309-13 Western Natl. Bank Bldg., Mitchell, engrs.

Calif., Merced—July 10, by A. L. Cowell, secy. Merced Irrigation Dist., constructing Lateral Canal 9, Le Grand system, 47,[illegible] ft. long, involving 50,000 cu.yd. earthwork, etc.; Lingard Lateral Canals, Le Grand system, 55,191 ft. long, 50,000 cu.yd. earthwork, etc. R. C. Starrett, ch. engr.

B. C., Vancouver—Dominion Government, Ottawa, Ont., will widen channel of first narrows by 500 ft. at entrance to Vancouver Harbor, 35 ft. deep, by day labor. $179,778 bonds voted.

CONTRACTS AWARDED

Wis., Biron (Wisconsin Rapids P. O.)—See "Miscellaneous."

Wis., Milwaukee—J. Hunholz, 2310 Vliet St., excavating for 6 story and basement 53 x 104 ft. brick and concrete apartment, plain foundation, to Cutter Constr. Co., 886 46th St. Noted May 24.

Minn., Albert Lea—C. Holway, aud. Freeborn Co., Judicial Ditch 9, 101,862 cu.yd. excav., leveling 25,428 lin.ft. spoil banks. 41,119 lin.ft. 6-40 in. drain tile, rein.-con. bulkhead and retaining wall, etc., to [illegible] & Curtis, Medford, $61,[illegible]. Noted M[illegible].

Minn., Alexandria — V. Thomas, aud. Douglas Co., Co. Ditch 23, 62,100 [illegible] in. drain tile, etc., to W. Bower, Long Prairie, $51,375. Noted May 31.

Minn., Fergus Falls—Otter Tail Co. [illegible] 25, Co. Ditch 70, furnishing 60,400 lin.ft. 6-24 in. drain tile, to Fergus Falls Tile Works, Fergus Falls, $11,700 [illegible] Jensen, Wa[illegible], $9,169.

Tex., Houston—Harris Co. D. D. [illegible] H. L. Washburn and [illegible] in Brays Bayou, to Howard K[illegible] ing Co., 3602 McKinney Av[illegible] $0,135.

Streets and Roads

PROPOSED WORK

N. Y., Dansville—[illegible] 1.03 mi. Ossian St. $[illegible] announced.

N. Y., Jamestown—Plans paving 10th St. Livingston Ave., brick on concrete. $25,000. L. O. Bergman, city engr.

N J., New Brunswick—Plans sheet asphalt paving on several streets. $151,450. A. Atkinson, Mine St., engr.

Pa., Pittston—Voted $275,000 bonds for street and sewer improvements. Engineer not announced.

Fla., Bartow—Election July 17, to vote on $75,000 bonds paving various streets. C. V. Turner, city mgr.

Fla., Bradentown—Comrs. Manatee Co. rejected bids grading, filling, bridging, creosoted piling and paving various streets. $50,000. McElroy Eng. Co., 32-34 Giddens Bldg., Tampa, engrs. Noted June 7.

Fla., Bushnell—Flagler Co. election July 10, to vote on $225,000 bonds paving "B" road Ocean Shore Impvt. Dist., rock, asphalt, macadam or concrete. J. C. Geiger, clk.

Fla., De Land—Volusia Co. election July 10, to vote on $225,000 bonds paving "A" road, Ocean Shore Impvt. Dist., 18 ft., rock, asphalt, macadam or concrete. S. D. Jordon, clk.

Fla., Tavares—Lake Co. election July 10, to vote on $100,000 bonds constructing roads and bridges in Yalaha, Okahunipka, Moscott and Graveland Dists. G. E. Heller, Tavares, engr.

Alabama—State Hy. Dept., Montgomery, having plans prepared grading and topsoiling 14.29 mi. Lineville-Delta Rd., Clay Co., $190,000; grading and gravel surfacing 11 mi. Linden-Thomaston Rd., Marengo Co., 12.128 mi. Jackson Highway, Franklin Co.; grading and surfacing with gravel and chert, 10.15 mi. CenterGadsden Rd., Cherokee Co., $95,000; grading, gravel surfacing and treated timber bridges on 10 mi. road from end of Federal Aid Project 73 to Mississippi State Line, Choctaw Co., $110,000. W. S. Keller, state highway engr.

Miss., Greenwood—Plans repaving 38,700 sq.yd. in business district and 120,000 sq.yd. new paving. W. S. Hawkins, engr.

Miss., Lexington—Plans paving 15,000 sq.yd. Court Sq. and Depot St. W. S. Hawkins, Greenwood, engr.

Kentucky—State Rd. Dept., Frankfort, having plans prepared surfacing Cumberland Ave., 16 ft. each side of boulevard, and Fitzpatrick Ave., 18 ft., total length 4,400 ft., State Project 38, Sect A., in city of Middlesboro, Bell Co. J. S. Boggs, state highway engr.

Kentucky—State Rd. Dept., Frankfort, having plans prepared grading 4 mi. Christopher-Jefferson Rd. (Hazard-Whitesburg Highway), State Project 4, Sect. A, Perry Co.; surfacing 3.56 mi. La Grange-New Castle Rd., State Project 19, Sect. A, Oldham Co. J. S. Boggs, state highway engr.

Ohio—Dept. Highways and Pub. Wks., Columbus, cancelled bids which were to be opened June 22, grading, bridging and paving 9.052 mi. roads in Brown Co., waterbound macadam; 3.435 mi. roads in Clermont and Perry Counties, bituminous macadam; 2.367 mi. road in Harrison Co., rolled sandstone base; 1.38 mi. road in Trumbull Co., bituminous macadam or rein.-con. Noted June 21.

Ohio—Dept. Highways and Pub. Wks., Columbus, cancelled bids which were to be opened June 19, grading, bridging and paving 14.331 mi. roads in Lawrence, Stark, Trumbull and Hardin Counties also bridge in Lawrence Co. Noted June 7.

Ohio—Dept. Highways and Pub. Wks., Columbus, received no bids June 19, grading, bridging and paving 1.356 mi. Sect. "K" McConnelsville-Athens Rd., Morgan Co., bituminous macadam asphalt or tar, $39,084. Noted June 7.

Ohio—City of Columbus making plans filling, grading and waterbound macadamizing ½ mi. Eversole Rd., 16 ft., also 40 ft. concrete bridge, 18 ft. wide, on above road. [illegible] C. B. Hoover, City Hall, Columbus, engr.

O., Canton—Stark Co. making plans paving [illegible] ft., probably brick, $175,000, state to appro[illegible] ville-Ravenna Rd., 18 ft., brick $90,000, [illegible] C. A. [illegible] House, engr.

Ind., New Albany—Bd. Pub. Wks. having plans hard surfacing, curbing and gutter [illegible] $15,000 [illegible]

Ill., Elizabeth—[illegible]

Ill., Hinsdale—[illegible]

Ill., Harvard—[illegible] Ave., Chicago, engr.

Ill., Palatine—Plans concrete paving Colfax St. $50,000. Consoer Eng. Co., 140 South Dearborn St., Chicago, engrs. Marr, Green & Co., 400 North Michigan Ave., Chicago, consult. engrs.

Ia., Marshalltown—Marshall Co. election soon to vote on $800,000 bonds to improve Lincoln Highway and various roads. G. Enderly, co. aud.

Kan., Ft. Scott—Bourbon Co. making preliminary surveys paving 4½ mi. Ft. Scott-Kansas City Rd., Sect. 1, 16 ft., vitr. brick or macadam. B. Boyle, Co. engr.

Kan., Independence—Montgomery Co. had plans prepared paving 6 mi. Independence-Elk City Rd., 16 ft., bituminous macadam. H. K. Hibbard, co. engr.

Neb., Hastings—Soon takes bids 40,000 yd. paving, various types. P. T. Naylor, Hastings, engr.

Mo., St. Louis—Soon takes bids resurfacing with asphalt 9,055 sq.yd. Hamilton St., 7,500 lin.ft. granite curb, $27,500; 2,850 sq. yd. Kingsbury St., asphalt or bitulithic, 1,900 lin.ft. concrete curb, $10,000. W. W. Horner, City Hall, engr.

Tex., Cisco—Making plans paving 68 blocks, incl. West 4th, 5th, 6th, 9th, Bway. East 5th, Ave. A, and South Ave. D, probably brick. $250,000. Elrod Eng. Co., 3206 Elm St., Dallas, engrs.

Tex., Corsicana—Navarro Co. plans election to vote on $4,500,000 bonds improving various roads. McClendon & Purnell, Corsicana, engrs.

Tex., Franklin—Robertson Co. making plans grading and gravel surfacing 15 m. State Highway 43 A, 16 ft. $120,032. L. A. Peterman, resident engr.

Tex., Rock Springs—Edwards and Kerr Counties making plans grading and topping 18 mi. road from here toward Kerrville, 18 ft., waterbound macadam. $168,000. W. E. Simpson Co., N. B. C. Bldg., San Antonio, engrs.

Okla., Barnsdall—Takes bids after July 3, for 7,000 sq.yd. concrete paving. $30,000. V. V. Long & Co., 1300 Colcord Bldg., Oklahoma City, engrs.

Okla., Bartlesville—E. D. Kirkpatrick, engr., Bartlesville, takes bids about July 1, 20,000 sq.yd. concrete paving for city. Noted Apr. 26.

Okla., Paul Valley—Soon takes bids paving Dist. 18, various types. $30,000. V. V. Long & Co., 1300 Colcord Bldg., Oklahoma City, engrs.

Okla., Sayre — Soon takes bids paving Dist. 8, 15,000 sq.yd. concrete. $56,000. V. V. Long & Co., 1300 Colcord Bldg., Oklahoma City, engrs. Noted June 14.

Okla., Tulsa—Tulsa Co. voted $2,000,000 bonds hard surfacing various roads. Noted Jan. 11.

Okla., Vinita—Craig Co. plans election soon to vote on $100,000 bonds for road work. Noted May 24.

Wash., Seattle — Bd. Pub. Wks. opens bids about Sept. 1, grading and paving 3 mi. 16th Ave. S. W. $100,000. J. D. Blackwell, city engr.

Calif., Oroville—Having plans prepared curbing, guttering and paving 22 blocks. To exceed $25,000. S. J. Norris, city engr.

Calif., San Diego—Common Council had plans prepared improving Ash St. between 5th and Atlantic Sts., 145,042 sq.ft. 2 in. asphaltic concrete on 3 in. bituminous, etc.; Beech St. between 5th and Atlantic Sts., 141,234 sq.ft. 2 in. asphaltic concrete on 3 in. concrete, etc. F. A. Rhodes, city engr.

Calif., San Francisco—City appropriated $15,000 to pave 2nd St. and $12,500 paving Main St. M. M. O'Shaughnessy, city engr.

Calif., San Francisco—City Supervisors appropriated $71,000 for repairs to Liberty, Sanchez and Collingwood Sts. M. M. O'Shaughnessy, city engr.

Calif., San Francisco—City and San Francisco Co., had plans prepared improving Jamestown St. between 3rd St. and Ingalls Ave., 18,548 sq.ft. artificial stone walks, 39,776 sq.ft. asphaltic concrete, etc. [illegible] M. M. O'Shaughnessy, city engr.

Que., Montreal—[illegible] 960 ft. Mousseau St., 30 ft., $13,720, 2,884 ft. Girouard Ave., 52 ft., $62,300; 5 ft. con[illegible] sidewalks on 122 ft. Victoria St., $810; [illegible] $808, 600 ft. Lariviere St., $485. E. [illegible]

Que., Montreal—[illegible] facing 7 mi. Gouin Blvd., 18 ft., asphalt on [illegible] Pub. Wks., engr.

Ont., Ft. William—[illegible] 9,000 sq.yd. concrete, asphalt or waterbound [illegible]

Ont., Newmarket—[illegible] sq.yd. concrete, asphalt or bitulithic pave[illegible]

Streets and Roads (Continued)

BIDS DESIRED

Mass., Gardiner—July 2 by F. W. Proctor, supt. of streets, approximately 4,000 sq.yd. paving; adv. this issue.

Mass., Medford—June 29, by E. E. Gaffey, street comr., concrete and bituminous macadam paving. To exceed $100,000. Noted June 14.

N. Y., Brooklyn—July 5, by E. Riegelmann, boro pres., Boro Hall, asphalt paving Delaware Pl., Gelston and Tompkins Ave., Bay 31st, East 40th, 66th, 70th, 72nd, and 90th Sts.; recurbing 6th Ave.; grading, curbing and flagging Delaware Pl.

N. Y., New York—July 2, by J Miller, pres. Manhattan Boro, Municipal Bldg., repaving Spruce and Dey Sts., granite blocks, 78th and 112th Sts., sheet asphalt.

New Jersey—July 9, by State Hy. Comn., Trenton, sheet asphalt paving Rahway Ave. in Elizabeth, Union Co.; rein.-con. paving Bluff Rd.—Anderson Ave., and Broad Ave. —Glenn Rd., both in Bergen County. A. L. Grover, ch. clk.; adv. this issue.

N. J., Belleville—July 3, by Purchasing Agent Essex Co., Court House, Newark, storm drain in Rutger St. at Washington Ave.; also paving 25 mi. Rutgers St., 30-80 ft., 10 in. rein.-con. and granite block on 6 in. concrete, here. $36,000. W. A. Stickel, Court House, Newark, engr.

N. J., Bloomfield—See "Sewers."

N. J., Keyport—July 9, by T. L. Smith, mayor, and Boro Council, concrete paving Maple Pl. J. T. Hopkins, special boro engr.; adv. this issue.

N. J. Nutley—July 3. by G. C. Bergen, purch. agt. Essex Co. (Newark) improving 1.14 mi. Franklin Ave., here, 3 in. sheet asphalt or 2½ in. asphalt block on 6 in. concrete, also storm drain on above street. $130,000. W. A. Stickel, Court House, Newark, engr. Noted May 3, under Newark.

N. J., Nutley—See "Railways under New Jersey."

N. J., Plainfield—July 16, by Common Council, curbs, gutters, laying sewers and bituminous macadam pavement. J. J. Carroll, city clk.; adv. this issue.

Pa., Bolivar—July 14, by Boro. Council, rein.-con. paving 3,000 ft. 2nd and Market Sts., 24 ft. $25,000. W. M. Wynn and B. R. Hebrank, boro. engrs.

Pa., Pottsville—July 17 (change of date) grading, curbing and paving portions of several streets. J. H. Strauch, city engr.; adv. this issue. Noted May 24.

Pa., Steelton—July 5, grading, curbing and paving South 4th and Highland Sts. H. R. Rupp, 114 Walnut St., boro. secy.; adv. this issue.

Md., Baltimore—July 5 by Bd. Awards, Contr. 240-NA, 11,330 sq.yd. old granite block redressed and relaid. R. K. Compton, 214 East Lexington St., chn. paving comn.

Va., Richmond—July 9, at office A. J. Saville, dir. Pub. Wks., paving Broad St.; adv. this issue.

West Virginia — July 24, by State Rd. Comn., Charleston, grading and bituminous macadam paving Projects 3151 C and 48, Boone Co., Projects 3162 and 50, Clay Co.; concrete paving Projects 3176 and 3114 B and D, Brooke Co.; grading and concrete paving Project 3252 A, Pleasants Co., Project 3186, Preston Co.; brick paving Projects 3252 and 3089 Hancock Co., grading and waterbound macadam paving Project 3197 B, Tyler Co. and Project 3013, Hardy Co.; grading Project 3237, Mason Co.; constructing Five Mile Bridge 857, Project 3138, Mason Co.; concrete arch, Project 2064, Ohio Co. E. B. Carskadon, secy.; adv. this issue. Noted June 21.

Georgia—July 6, by State Hy. Dept., East Point, paving 74,544 sq.yd. Albany-Thomasville Rd., 1½ in. asphalt on 1½ in. binder course, Albany Co.; topsoiling 1,963 cu.yd. Elberton-Royston Rd., Federal Aid Project 330, Elbert Co.; surfacing 66,307 sq.yd. Waycross-Folkston Rd., 3 in. penetration macadam, Ware Co.

Florida—July 10, by State Rd. Dept., Tallahassee, constructing and improving 7 mi. Rd. 5, Project 564, Charlotte Co. W. F. Cocke, state highway engr.

Fla., Vero—July 11, by F. E. King, mayor, improving various streets, 19,700 cu.yd. sub-grading, 101,000 sq.yd. waterbound macadam paving, asphalt surface treatment, 65,000 lin.ft. concrete curbing, etc. $200,000. Carter & Damerow, Vero, engr.

Alabama—July 6, by W. S. Hardin, connected with State Highway Dept., Montgomery, grading and paving 11 mi. Marion and Browns Station Rd., 20 ft., Marion and Dallas Counties. W. S. Keller, state highway engr.

Miss., Laurel—July 9, by Mayor and Bd. Comrs., paving, etc., various streets. J. H. Pace, street comr.; adv. this issue.

Miss., Mayersville—July 2, by Hy. Comrs. 5th Supervs. Dist., Issaquena Co., gravel surfacing 13 mi. road, 30,000 ton gravel f.o.b. Grace and Glen Allen. W. L. Thompson, 324 Weinberg Bldg., Greenville, engr.

Louisiana—July 11, by State Hy. Dept., Baton Rouge, grading, constructing bridges and gravel surfacing 9.237 mi. Burnside-Hope Villa Highway, State Project 130, Ascension Parish; 4.64 mi. Monroe-Rayville Highway, Federal Aid Project 118, Ouachita Parish; 2.44 mi. Rayville-Monroe Highway, Federal Aid Project 119, Richland Parish. J. M. Fourmy, state highway engr.

Tennessee—July 6, by State Hy. Dept., Nashville, surfacing, etc., 10.7 mi. road, bituminous macadam on limestone, 16 ft., Robertson Co. Former bids rejected. J. G. Creveling, comr. Noted June 14.

Ky., Louisville—July 3, by Bd. Pub. Wks., waterbound macadam or brick paving various streets and alleys, mainly on Walnut, 35th and 37th Sts. To exceed $25,000.

O., Circleville—July 10, by N. R. Huston, dir. Pub. Serv., sandstone curbing and vitr. brick paving 5,338 sq.yd. Ringgold Pike. $26,000.

O., Dayton—July 2, by Dept. Pub. Serv. paving 4,500 sq.yd. Grafton Ave., vitr. brick $21,201; 1,500 sq.yd. concrete on 2 alleys, $6,000. I. E. Houk, city engr.

O., Grandview Heights (Columbus P. O.) —July 7, by E. Gross, village clk., grading and asphaltic concrete paving 11,876 ft. Parkway N, Parkway Dr., Timberman Rd., Ridgeway Pl., Mulford, Thomas, Holly, Norton, Dover, Glenn and 2nd Aves., $170,637; two driveways with park between on Northwest Blvd., 1,900 ft., single and 2,975 ft. double driveways, each 22 ft., $99,796. Burgess & Nipel, 223 East Broad St., Columbus, engrs. Noted Apr. 12.

Michigan—July 3, by State Hy. Dept., Lansing, grading 14.654 mi. Federal Aid Project 73, Sects. A, B, D and E. 115,384 cu.yd. earth excav., etc. F. F. Rogers, Monroe Co., state comr.

Michigan—July 6, by State Hy. Dept., Lansing, grading and surfacing 5.227 mi. Federal Aid Project 104, Mason Co., 55,199 sq.yd. concrete, 22,748 cu.yd. earth excav. F. F. Rogers, state comr.

Michigan—July 9, by State Hy. Dept., Lansing, fine grading and surfacing 0.568 mi. Federal Aid Project 35, Sect. F, Jackson Co., 4,380 sq.yd. asphalt, 837 sq.yd. concrete, 2,850 lin. ft. concrete curb and gutter, etc. F. F. Rogers, state comr.

Michigan — July 9, by State Hy. Dept., Lansing, grading and surfacing 1.131 mi. State Trunk Line Rd. 55-4, Sect. A, 13,295 sq.yd. concrete, 5,016 cu.yd. earth excav. F. F. Rogers, comr.

Michigan—July 10, by State Hy. Dept., Lansing, grading and surfacing 1.94 mi. State Trunk Line Rds. 11-48 and 13-45, Petoskey Co., 20,510 sq.yd. asphalt, concrete or bituminous concrete, 7,686 cu.yd. earth excav.

Michigan—July 11, by State Hy. Dept., Lansing, grading and surfacing 5.977 mi. Federal Aid Project 102, Sect. A, Antrim Co., 56,571 sq.yd. gravel, 51,188 cu.yd. earth excav.

Michigan—July 12, by State Hy. Dept., Lansing, grading and surfacing 53,676 sq. yd. Federal Aid Project 121, Macomb Co.; 14,819 sq.yd. State Trunk Line Rds. 53-2 and 53-7 Sect. A, Romeo Co., asphalt, concrete or bituminous concrete. F. F. Rogers, state comr.

Mich, Scottsville—July 6, by State Hy. Dept., Lansing, grading and surfacing 0.512 mi. State Trunk Line Rd. 11-37, 5,055 sq.yd. asphalt, concrete or bituminous concrete, etc.

Ill., Chicago — July 2, at office H. A. Zender, supt. Pub. Serv. Cook Co., paving with (a) bituminous concrete with binder course (b) without binder course (c) cement concrete 1,798 ft. Sect. 99A-15 D, Route 1-C, New Trier Twp. (a) $15,230 (b) $14,409 (c) $12,069; 2,095 ft. Sect. 91-B-15D, Route 34, Proviso Twp. (c) $13,720; 700 ft. Sect. 73B-15D, Route 23, Orland Twp. (c) $5,239; 2,639 ft. Sect. 166-15D, Route 29, Worth Twp., (a) $34,258 (b) $32,454 (c) $27,314; 3,952 ft. Sect. 156-15D, Route 51, Thornton Twp. (a) $41,324 (b) $39,455 (c) $34,124; 7,975 ft. Sect. 165-15D, Route 20, Worth Twp. (a) $107,471 (b) $102,017 (c) $86,467; 9,379 ft. Sect. 29A-15D, Route 20, Worth Twp. (a) $76,793 (b) $72,572 (c) $60,539.

Ill., La Grange—July 15 for 14,000 sq.yd. concrete paving. $60,000. E. Hancock, 2007 Ogden Ave., Chicago, engr.

Ill., Mascoutah—Receiving bids concrete paving Railway Ave. and Market St., $30,000. Consoer Eng. Co., 140 South Dearborn St., Chicago, engrs.

Ill., Western Springs—July 15, for 160,000 sq.yd. concrete sidewalks. $50,000. E. Hancock, 2007 Ogden Ave., Chicago, engr.

Michigan—July 2, by State Hy. Dept., Lansing, grading and surfacing 13,724 sq.yd. State Trunk Line Road 17-6, Sect. A, Ypsilanti Co., 6,056 sq.yd. State Trunk Line Road 17-N, Sect. B, Ann Arbor Co., 46,330 sq.yd. Federal Aid Project 74, Sect. D, and 17,447 sq.yd. State Trunk Line Road 65-2, both Washtenaw Co., all with asphalt, concrete or bituminous concrete. F. F. Rogers, state comr. Noted June 21.

Wis., Edgerton—July 9, by G. Blanchard, clk., concrete paving 16,055 sq.yd. Victoria and North 3rd Rds., Randolph, Blaine, West and High Sts., $50,000-$60,000. A. W. Ely, 29 West Milwaukee St., Janesville, engr.

Minn., Fergus Falls—July 6, by H. J. Collins, city clk., improving various streets, 17,000 sq.yd. rein.-con., vibrolithic concrete, bitulithic, asphaltic concrete, vitr. brick or wood block pavement, resetting 3,190 lin.ft. old curb, 1,043 lin.ft. straight curb, 420 lin.ft. circular curb, etc. $50,000. S. A. Siverts, Jr., 600 Jewelers Exch. Bldg., Minneapolis, engr.

Minn., East Grand Forks—July 9 (change of date), by A. N. Briggs, village clk., improving various streets, about 42,000 sq.yd. rein.-con., bitulithic and 4 grades of asphaltic concrete, $110,000. Bids on an additional 8,000 sq.yd. for 5th and 6th Sts., will probably be asked later. L. P. Wolff, 1000 Guardian Life Bldg., St. Paul, engr. Noted May 31.

Minn., St. Paul—July 9. by G. J. Ries, aud. Ramsey Co., Project 23-54, 16,110 cu.yd. earth excav., 16,588 cu.yd. overhaul, 38,240 sq.yd. 1 course 7½ in. rein.-con. pavement, alternate on 37,000 sq.yd. asphaltic concrete Class B wearing surface, 37,000 sq.yd. concrete base, and 4,740 lin.ft. curb and gutter, etc., $100,000; Project 23-62, Larpenteur Ave., 1,460 cu.yd. excav., 2,754 cu.yd. overhaul, 5,946 sq.yd. 1 course rein.-con. pavement, $15,000.

Kan., Emporia—July 6, by Lyons Co., paving 21,148 sq.yd. roads, brick or concrete.

Neb., Lincoln—July 5, by J. P. Morgan, clk., Lancaster Co., surfacing 9.68 mi. Havelock Co. line Rd., 136,294 yd. gravel.

Missouri — July 6, by State Hy. Dept., Jefferson City, grading 30.473 mi. roads in Stone, Clinton, Dent, Marion and Shelby Counties; grading and paving 2.925 mi. in Ralls and Lafayette Counties; grading and graveling 7.38 mi. highways in Warren, Perry, St. Francois and Pike Counties; grading and concrete paving 25.422 mi. roads in St. Louis, Mercer, Daviess, De Kalb, Franklin, Gasconade, Osage and Iron Counties; graveling 2.358 mi. road in St. Charles Co.; concrete block paving State Project Route 2, Sect. 34 A, Howard Co. B. H. Piepmeier, state highway engr.

Mo., Kansas City—July 9, by L. Koehler, engr., Court House, resurfacing 124,616 sq. yd. Spring Branch Rd., new tar cushion top, for Jackson Co.

New Mexico — July 18, by State Hy. Comn., Santa Fe, grading and surfacing 5.871 mi. Federal Aid Project 36, Sandoval Co., 10,907 cu.yd. concrete, etc.; 0.721 mi. Federal Aid Project 118, Bernalillo Co., 1,859 cu.yd. concrete 13:5 mix, 7.589 lin.ft. concrete curb and gutter, 12:4 mix, 13,388 cu.yd. on course crushed stone, etc.; 3.099 ous concrete wearing surface, or 2 in. warrenite bitulithic, etc.; 15.981 mi. Federal Aid Project 43, Torrance Co., 7,520 cu.yd. gravel; 12,321 mi. Federal Aid Project 77, Torrance Co, 57,564 cu.yd. Class 1 and 2 excav., 14,759 cu.yd. one course gravel, etc.; 10.523 mi. Federal Aid Project 94, Union Co., 18,282 cu.yd. Class 1 excav., 16,793 cu.yd. one course crushed stone, etc.; 3.099 mi. Federal Aid Project 91-B, Colfax Co., 4,943 cu.yd. one course gravel, etc., also small bridges. J A. French, state highway engr.

Tex., Ft. Davis—July 9, by R. Barnet, judge Jeff Davis Co., grading, etc., 6.07 mi. State Highway 12, 795.9 cu.yd. concrete, 18,165 cu.yd. roadway, 24,179 cu.yd. borrow, 1,250 cu.yd. loose and 1,000 cu.yd. solid rock excav., 72,143 lb. reinforcing. $38,250. P. B. Probst, co. engr.

Okla., Sayre—July 5, by J. T. Means, city clk., grading and paving 7 blocks Bway., Walnut and Main Sts., 13,200 sq.yd. concrete, 3,825 lin.ft. curbing, etc. $56,331. V. V. Long & Co., 1300 Colcord Bldg., Oklahoma City, engrs. Noted May 24.

Okla., Weleetka—July 5, by W. W. Griffin, clk., grading and paving 3 blocks Main St., 3,700 sq.yd. vertical fibre brick, 3,000 lin.ft. concrete curbing, etc., $29,000. V. V. Long & Co., 1300 Colcord Bldg., Oklahoma City, engrs.

Okla., Wynnewood—July 2, by J. H. Boozer, city clk., grading and paving 5 blocks Commercial Ave., 6,500 sq.yd. vitr. brick. $32,000. V. V. Long & Co., 1300 Colcord Bldg., Oklahoma City, engrs. Noted May 17.

Colo., Denver—July 3, by Dept. Impvts. & Parks, grading and gravel surfacing 107,000 sq.yd. in North Side Impvt. Dist. 32. $146,084. A. K. Vickery, City Hall, city engr.

Streets and Roads (Continued)

Washington — July 10, by State Hy. Comn., Olympia, grading and surfacing with crushed gravel 6.9 mi. Chelan-Okanogan Highway, Riverside to Omak, Okanogan Co., and 6.3 mi. Inland Empire Highway, Pomona to Selah, Yakima Co. J. Allen, state highway engr.

Wash., South Bend—July 15 by City Comrs., paving Main St. et al., 13,240 sq.yd. 6 in. concrete. $58,516. H. A. Gibbs, South Bend, engr.

Calif., Marysville — July 3, by Supervs. Yuba Co., grading 12,000 lin.ft. Bullards Bar Rd., mostly hard packed earth with some loose rock. J. R. Meek, co. surv.

Quebec—July 6, by J. L. Boulanger, minister Dept. of Roads, Quebec, gravel surfacing 45,904 ft. Richmond-Tamasha Highway, in Richmond. G. Henry, Dept. of Roads, Quebec, engr.

BIDS RECEIVED

Rhode Island — State Bd. Pub. Rds., Providence, June 22, rein.-con. paving 11,340 cu.yd. Federal Aid Project 18, Contr. 2305, from A. D. Bridges Sons, Hazzardville, Conn., $8.15 per cu.yd., total $232,605. Noted June 14.

N. Y., Binghamton—Paving with (1) concrete (2) rein.-con. (3) bitulithic (a) Newton Ave. (b) Charles St. (c) Mygatt St., from Clark Constr. Co., Binghamton, (1a) $6,655 (2a) $7,180; Municipal Constr. Co., Binghamton, (3a) $7,321 (3b) $6,551 (3c) $21,469.

N. Y., Brooklyn—E. Riegelmann, boro pres., Boro Hall, June 20, grading, curbing and flagging (1) Coney Island Ave. (2) Kingshighway (3) 76th St. (4) 77th St. (5) 81st St., curbing and flagging where necessary on (6) Lefferts Ave., sheet asphalt paving (7) Newport St. (8) Osborn St. (9) Tehama St., from E. J. Galway, (1) $6,536; H. and B. Contg. Co., (2) $85,764; F. Persicano, 350 Fulton St., (3) $5,919; L. Mangeri, 190 31st St., (4) $5,080 (5) $3,342; Galco Contg. Co., (6) $5,071; Borough Asphalt Co., 1301 Metropolitan Ave., (7) $3,392 (8) $13,735 (9) $10,327. Noted June 14.

N. Y., Brooklyn—Park Bd., Municipal Bldg., New York, June 21, grading, curbing and sheet asphalt paving Fort Hamilton Parkway, here, from Brooklyn Alcatraz Asphalt Co., 407 Hamilton Ave., $107,281. Noted June 14.

N. Y., Lockport—F. Krull, clk., Niagara Co. June 19, macadamizing 4.6 mi. Coomer Rd. in Newfane, from Staple, Mumm & Beals, Buffalo, $90,439, engrs. est. $85,669; paving 5 mi. Military Rd. in Niagara, from Read Coddington Eng. Co., Niagara Falls, gravel and concrete, $25,537, stone and concrete $24,257. Noted May 17.

N. Y., New York—Park Bd., Municipal Bldg., June 21, repaving Mosholu Ave., Van Cortland Park, from B'way to Golf Links Rd., from Interboro Asphalt Co., 2306 Creston Ave., $69,954. Noted June 14.

N. Y., New York—H. Bruckner, pres. Bronx Boro, 3rd and Tremont Aves., June 21, repaving (1) White Plains Rd. (2) Jerome Ave. (3) Jerome Ave. (East 176th St.) (4) Melrose Ave. (5) Boston Rd., paving (6) Tiebout Ave. all foregoing granite blocks, (7) East 172nd St. (8) West 238th St., both bituminous concrete, (9) Charlotte St., sheet asphalt, grading, building inlets and receiving basins in (10) Godwin Terrace, grading, laying sidewalks, crosswalks and curbing (11) Cruger Ave. (12) East 157th St., grading, regrading, etc. (13) Bryant Ave., from Casper Helbock, Inc., Harlem River and 150th St., (1) $[illegible]; Leonard Paving Co., 233 Bway., (2) $153,764; Asphalt Constr. Co., 208 Bway., (3) $290,491 (4) $137,499; R[illegible] Co., 124 West 121st St., (5) $26,394; C. D. Beckwith, Inc., 2875 Bway., (6) $[illegible]; Brewster Constr. Co., Harlem River and 150th St., (7) $9,264 (8) $19,519 (9) $[illegible]; Spedeo Contg. Co. (10) $4,557; Spadaro & T[illegible], 31[illegible] East Tremont Ave., (11) $5,863; M. Del Balso, 660 East [illegible] (12) $20,749; P. J. Kearns Contg. Co., [illegible] Creston Ave., (13) $11,437. Noted June 14.

N. Y., New York—J. Miller, pres. Manhattan Boro, Municipal Bldg., June 21, changing park strips on Park Ave., [illegible] 34th to 39th Sts., from P. T. [illegible] Co., 154 Nassau St., $68,[illegible]. Noted June 14.

N. Y., Salamanca—From C. N. [illegible], Olean, paving with (a) brick (b) [illegible] Kent Ave. (a) $19,308 (b) $14,837, East Clinton St. (a) $14,[illegible] (b) $11,[illegible] [illegible] St. (a) $4,914 (b) $3,691.

N. Y., Syracuse—Bd. Contr. [illegible] June 18, paving 1 mi. West [illegible] from J. H. Gallup [illegible] $65,879, bituminous concrete $[illegible].

N. J., Trenton—Mercer Co. [illegible] crete paving 1.7 mi. [illegible] Fleckner, 1601 Nottingham Way [illegible]. Noted June 7.

BRIDGE—ASTORIA, ORE.

Bids were opened by State Highway Comn., Salem, Apr. 17, for constructing bridge over Lewis and Clark Rivers on Roosevelt Highway, (A) Pacific Bridge Co., foot of East Salmon St., (awarded contract); (B) M. Trieweiler; (C) Parker & Banfield. Contractors all of Portland. The unit bids were as follows:

	A	B	C
2,000 cu.yd. excavation	$9.90	$12.56	$16.00
14,900 lin.ft. piling	.52	.716	.58
12,500 lin.ft. approach piling	.43	.41	.47
6,500 lin ft. protection piling	.43	.43	.40
840 cu yd. sealing concrete	23.30	17.25	16.00
830 cu yd. class A concrete	23.70	26.00	26.00
100 cu.yd. class B concrete	20.00	24.00	30.00
180 cu yd. concrete counterweight	17.80	16.50	20.00
88,000 lb. reinforcing bars	.0575	.052	.055
280,000 lb. structural steel	.095	.11	.125
70,000 lb. machinery	.39	.375	.37
710 lin ft. trestle superstructure, cap and girder 20 ft. wide, 1-8 ft. sidewalk on brackets	16 00	16.40	17.00
75,000 ft. b m. lumber	58 00	70.00	75.00
*Electric control, full magnetic, 440-220-110 volts	8,240.00	8,339.00	8,200.00
Electric control, full magnetic, 220-110 volts	6,884.00	7,951 00	7,450.00
Electric control, semi-magnetic, 440-220-110 volts	7,215 00	7,371.00	7,250 00
Electric control, semi-magnetic, 220-110 volts	6,455.00	7,158.00	7,010.00
200 lin.ft. submarine cable	3.25	3.60	2 65
2 pier houses	625.00	650.00	1,050.00
Machinery room (lump sum)	225.00	1,083.00	800 00
Plumbing (lump sum)	400.00	404.00	500.00
2 gates	740.00	766.00	750.00
Fog bell (lump sum)	125.00	175.00	150 00
150 balance blocks, 1 cu ft. concrete	1.00	1.50	1.00
550 sq.ft gunnite protection	1.25	1.30	2.00
Extended totals	$170,837	$177,973	$184,573

*Accepted.

Pa., Ebensburg—Supervs. Susquehanna Twp., c/o H. T. Jones, controller Cambria Co., paving 3.25 mi. road from Emeigh Run to Plattsville, 16 ft., one course rein.-con. and hillside brick on concrete, from J. L. Elder, Ebensburg, $208,634. Noted June 14.

Alabama—See "Bridges."

Alamaba—State Hy. Dept., Montgomery, grading and gravel surfacing 23.655 mi. road from Demopolis to Linden and Millers, Marengo Co., from W. K. Saulsbury & Co., 1322 South 19th St., Birmingham, $368,031. Noted June 7.

Kentucky—State Hy. Dept., Frankfort, grading 7.767 mi. Stanton-Campton Rd., State Project 4, Sect. C, Powell Co., using cement rubble and concrete pipe, from Costello Bros., Henson Bldg., Knoxville, Tenn., $77,184, concrete masonry and concrete pipe from Codell Byars & Co., Winchester, $86,185; grading 6.088 mi. Pikesville-Shelby Creek Rd., State Project 6, Sect. C, Pike Co., from Sutton Constr. Co., Ashland, using concrete pipe $106,239, vitr. pipe $109,497; surfacing with waterbound macadam 4.995 mi. Lexington-Harrodsburg Rd., State Project 47, Sect. A, Jessamine Co., from W. Lutes & Co., Lexington, $117,477, surface treating above road from R. B. Tyler & Co., 114 South 4th St, Louisville, $5,909.

Ohio—Dept. Highways and Pub. Wks., Columbus, June 19, grading, bridging and paving roads with (1) brick (2) plain concrete (3) bituminous macadam asphalt (4) bituminous macadam tar (5) rein.-con. (6) brick, macadam foundation (7) brick, concrete foundation (8) sheet asphalt (9) Kentucky rock asphalt (a) 0.514 mi. Sect. "D" **Piqua-St. Marys Rd.**, Auglaize Co. (b) 3.523 mi. Sect. "D" **Dayton-Greenville Rd.**, Darke Co. (c) 0.474 mi. Sect. "Aracaman [illegible]" **Dayton-Greenville Rd.**, Darke Co. (d) [illegible] mi. Sect. "K" **Washington-London Rd.**, Fayette Co. (e) 4.393 mi. Sect. "G" **Portsmouth-Columbus Rd.**, Franklin Co. (f) 2.148 mi. Sect. "R" **Portsmouth-Columbus Rd.**, Franklin Co. (g) 0.606 mi. Sect. "D-1" **Woodsfield-Clarington Rd.**, Monroe Co. (h) 5.785 mi. Sects. "G and L" **Mt. Gilead-Galion Rd.**, Morrow Co., (i) 3.925 mi. Sect. "D" **Eaton-Hamilton Rd.**, Preble Co. (j) [illegible] mi. Sect. "[illegible]" **Eaton-Greenville Rd.**, Preble Co. (k) 1.596 mi. Sect. "P" **Cleveland-Massillon Rd.**, Stark Co., (l) 3.374 mi [illegible] **Bowling Green-Waterville Rd.**, Wood Co., from [illegible] Co., Wapakoneta, (1a) $19,239 (1b) $139,[illegible] J. E. [illegible] & Sons, [illegible] (2a) $15,[illegible] (3a) $18,[illegible] (4a) $[illegible] (6d) $[illegible]; E. and O. [illegible] (5b) $[illegible] (5h) $[illegible] W. H. [illegible] (7d) [illegible] J. L. [illegible], Worthington, (3e) [illegible] (7e) $[illegible] (6f) [illegible]

Ohio—Dept. Highways and Pub. Wks., Columbus, June 22, grading, bridging and paving (1) 5.736 mi. **Sect. "M-1" Athens-Pomery Rd.**, Athens Co. (2) 3.241 mi. **Sect. "G-1" Springfield-Xenia Rd.**, Clark Co. (3) 2.548 mi. Sect. "G 2" **Springfield-Xenia Rd.**, Clark Co. (4) 1.532 mi. Sect. "S" **Wellsville-Salineville Rd.**, Columbiana Co. (5) 3.001 mi. Sect. "M" **Toledo-Angola Rd.**, Fulton Co. (6) 4.33 mi. Sect. "F" **Springfield-Xenia Rd.**, Greene Co. (7) 2.5 mi. Sect. "H" **Springfield-Xenia Rd.**, Green Co. (8) 0.975 mi. Sect. "I" **Roundhead-McGuffey Rd.**, Hardin Co. (9) 3.402 mi. Sect. "A" **Urbana-West Jefferson Rd.**, Madison Co. (10) 2.79 mi. Sect. "C" **Youngstown-Lisbon Rd.**, Mahoning Co. (11) 4.109 mi. Sect. "O" **Medina-Norwalk Rd.**, Medina Co. (12) 2.351 mi. Sect. "T-1" **Akron-Youngstown Rd.**, Portage Co. (13) 3.066 mi. Sect. "T-2" **Akron-Youngstown Rd.**, Portage Co. (14) 5.084 mi. Sects. "S-1" and "U-1" **Ohio River Rd.**, Scioto Co. (15) 0.557 mi. Sect. "E" **Cleveland-Sandusky Rd.**, Erie Co. (16) 1.954 mi Sect. "A" **Washington-Bloomington Rd.**, Fayette Co. (17) 4.5 mi. Sect. "H-2" **Columbus-Washington C. H. Rd.**, Franklin Co. (18) 1.761 mi. Sect. "H" **Ohio River Rd.**, Hamilton Co. (19) 5.791 mi. Sect. "C" **Newark-New Lexington Rd.**, Licking Co. (20) 2.615 mi. Sect. "B" **Minerva-Sandyville Rd.**, Carroll Co. (21) 1.002 mi. Sect. "E" **Archbold-Fayette Rd.**, Fulton Co., with (a) brick (b) rein.-con. (c) bituminous macadam, asphalt (d) bituminous macadam, tar (e) concrete (f) bituminous concrete (g) waterbound macadam (h) bitoslag (i) warrenite bitulithic; grading (22) 0.695 mi. Sects. "F" and "[illegible]" **Jackson-Pomeroy Rd.**, Jackson Co., concrete bridge on (23) Sect. "Lisbon" **Lisbon-Salineville Rd.**, Columbiana Co., (24) Sect. "B" **Delaware-Marysville Rd.**, Delaware Co., steel superstructures and concrete substructures on (25) Sect. "D" **Celina-Greenville Rd.**, Darke Co., from H. E. Pratt Constr. Co., Mt. Blanchard, (1a) $303,866 (1c) $251,283 (1d) $251,[illegible] [illegible] Constr. Co., Pomeroy, (1b) $297,617; D. M. Roach, Defiance, (2b) $93,136 (3b) $70,462; C. V. Rector, Lima, (2d) $74,[illegible] (3d) $[illegible]; F. A. [illegible] & Sons, Painesville, (4e) $60,619; LaBo[illegible] & [illegible] (5b) $[illegible] (11b) $28,405; E. L. Reeb, Lima, (5c) $92,347; [illegible] & [illegible], Van Wert, (5d) $77,902; Weeks Constr. Co., Dayton, (6c) $[illegible] (6d) $[illegible] (7c) $[illegible] (7d) [illegible] (6b) $[illegible] (9b) $[illegible] [illegible] (8b) $[illegible] (11b) [illegible] (9a) $[illegible] (10a) $[illegible] (11b) $135,449; P. T. McCourt, Akron, (12f) $[illegible] (12f) $[illegible] [illegible] town, (12b) $[illegible] (13b) [illegible] Bldg., [illegible]

Streets and Roads (Continued)

ley, 204 Goldberg Bldg., Canton, **(20a)** $131,526; W. McKinnis, Jackson, **(22)** $10,036; Cox & Heslep, Kensington, **(23)** $10,004; Independent Constr. Co., Lorain, **(24)** $8,350; Hinton & Smalley, Celina, **(25)** $14,533. Noted June 21.

O., Euclid—Grading and laying (1) concrete or (2) stone sidewalks on Bliss Rd., from F. B. Stein, Euclid, (1) $43,084; Ohio Quarries Co., Citizens Bldg., Cleveland, (2) $53,929.

Tex., Gonzales—Gonzales Co., grading and gravel surfacing 3.66 mi. State Highway 29, 19,255 cu.yd. roadway and 17,491 cu.yd. borrow excav., 668.3 cu.yd. concrete, 70,277 lb. reinforcing, from D. H. Buchanan, Temple, $35,570; 11,657 cu.yd. gravel furnished by county. Engrs. est. $48,120. Noted June 7.

Calif., Hanford—Paving portions 5th, Irwin and Phillips Sts., etc., 1½ in. warrenite bitulithic or 4 in. bituminous, from California Constr. Co., 58 2nd St., San Francisco, $74,703.

Calif., Los Angeles—Grading and paving road between Coast Blvd. and Hyperion Sewage Plant, 63,766 sq.ft. concrete, 32,132 yd. excav., from W. D. McCray, Amer. Bank Bldg., $34,400. Noted May 24.

Calif., Madera—From Thompson Bros., G and Divisadero Sts., grading, concrete curbing, guttering and bituminous paving Yosemite Ave., $38,146; 6th and B Sts., $35,223. Noted June 14.

Calif., San Diego—Common Council improving Julian and Marcy Aves., from California Constr. Co., Union Bldg., 215,171 sq.ft. 1½ in. asphaltic concrete on 2½ in. bituminous at $0.163, etc., total $35,152. Noted Apr. 12.

Que., Montreal—Asphalt surfacing, 2 in. thick, **(1)** 4,200 sq.yd. Lebrin St. **(2)** 4,400 sq.yd. Mercier St. **(3)** 1,858 sq.yd. St. Hubert St. **(4)** 8,050 sq.yd. Esplanade Ave. **(5)** 3,400 sq.yd. Chomedy St.; asphalt surfacing, 3 in. thick **(6)** 4,005 sq.yd. Jeanne Mance St. **(7)** 5,738 sq.yd. Ryde St. **(8)** 6,700 sq.yd. St. Charles St. **(9)** 6,500 sq.yd. Knox St. **(10)** 11,214 sq.yd. Eadie St., from B. Brault, Ltd., 2855 Rosemont Blvd., **(1)** $20,460 **(2)** $21,980 **(6)** $15,050; Quinlan, Robertson & Janin, Ltd., 52 Duluth Bldg., **(5)** $19,815 **(7)** $23,360 **(8)** $25,590 **(9)** $24,222 **(10)** $51,124; Sicily Asphaltum Paving Co., 60 St. Viateur St., **(3)** $8,964 **(4)** $29,570.

CONTRACTS AWARDED

Massachusetts—State Hy. Comn, Boston, sand and asphalt surfacing 8 mi. highway through Edgartown and Tisbury, to M. F. Roach, East Bridgewater, $142,484. Noted June 7.

R. I., Ashland—Water Supply Bd., City Hall, Providence, relocating Plainfield Pike by means of 65 ft. causeway across Scituate Reservoir, here, 5,000 sq.yd. dry earth and 2,000 cu.yd. dry rock excav., 230,000 cu.yd. borrow, 10,000 cu.yd. broken stone, 28,000 cu.yd. rip rap, 4,000 bbl. cement, 120,000 lb. steel and 3,000 cu.yd. rein.-con. for culvert, to T. F. McGovern, 95 Main St., Southbridge, Mass., $288,400. Engrs. est. $250,000. Noted June 21.

N. Y., Batavia—Bitulithic macadamizing Hutchins and South Liberty Sts., to O. Costich Co., Rochester, $18,043 and $22,962 respectively.

N. Y., Brooklyn — E. Riegelmann, boro pres., Boro Hall, to Brooklyn Alcatraz Asphalt Co., 407 Hamilton Ave., curbing and asphalt paving Bay 22nd St. $3,557, 16th Ave. $25,628, East 10th St. $18,763, Highlawn Ave. $17,384; to Uvalde Asphalt Paving Co., 1 Bway., New York, Farragut Rd. $9,722, Stoddart Pl. $2,693, 7th Ave. $4,278, Delemere Pl. $12,570, 54th St. $18,414; to Cranford Co., 52 9th St., Ave. L $4,399, 56th St. $9,316, 58th St. $9,419, 78th St. from 15th to 16th Aves., $8,512, 78th St. from 17th to 18th Aves. $9,179, 83rd St. $10,768, Bay 35th St. $19,224, East 15th St. $10,332, 61st St. $10,006, 75th St. $12,348; to Borough Asphalt Co., 1301 Metropolitan Ave., Louis St. $12,303, Ovington Ave. $16,694; to Hale Contg. Co., 1250 Jefferson St., Bergen Pl. $4,817, Ave. L $6,540, 17th Ave. $2,756, 54th St. $3,175, 73rd St. $6,590; to Cleveland Trinidad Paving Co., Flushing, East 8th St. $26,609, East 9th St. $10,701. Noted June 14.

N., Y, Lockport—F. Krull, clk. Niagara Co., paving 3.744 mi. Creek Rd. in Youngstown, concrete, to W. C. Rich, Youngstown, $82,324; 2.86 mi. Sect. 3 Lockport Rd., in Pendleton and Cambria, stone, 4.107 mi. Town Line Rd., concrete, 4.162 mi. Sect. 2 Creek Rd., in Pendleton, concrete, and resurfacing 1.47 mi. Saunders Settlement Rd., in Cambria, to L. H. Gipp Constr. Co., Buffalo, $95,788, $80,973, $139,944 and $40,583 respectively; 601 mi. Main St. in Middleport, to J. D. Meahl, Cambria, $23,230. Noted May 17.

N. Y., Long Island City—M. E. Connolly, pres. Queens Boro, Queens Subway Bldg., to Uvalde Asphalt Paving Co., 1 Bway., New York, sheet asphalt paving Havemeyer St. $17,905, 107th St. $19,085, curbing, laying sidewalks and sheet asphalt paving Roosevelt Ave. $11,315, Beach 117th St. $22,050, Beach 122nd St. $45,535; to Kennedy & Smith, 15 Amity St., Flushing, 107th St. $9,470. Noted June 14.

N. Y., New York—J. Miller, pres. Manhattan Boro, Municipal Bldg., sheet asphalt repaving 57th, 12th and 15th Sts., to W. J. Fitzgerald, 547 West 45th St., $32,974, $11,797 and $14,913 respectively; 6th and 7th Sts., to Sicilian Asphalt Paving Co., 41 Park Row, $52,213 and $20,582 respectively. Noted June 21.

N. Y., Perry—Concrete paving 3 streets, to Oatka Eng. Co., Warsaw, $46,459. Engrs. est. $50,000.

N. J., New Brunswick — Middlesex Co. concrete paving ⅛ mi. road from Jamesburg to Englishtown, to H. N. Scott, Cranbury, $49,757; 1.8 mi. road in Plainsboro, to Hill Constr. Co., 132 Hulme St., Mt. Holly, $38,723; 1 mi. Main St. in Milltown, to Utility Constr. Co., 5 Spring St., $59,692.

Maryland—State Rds. Comn., Baltimore, 9,000 sq.yd. concrete, 3,400 cu.yd. excav., Contr. D-30, Dorchester Co., to Smith & Renshaw, East New Market, $26,674; 9,350 sq.yd. concrete, 5,300 cu.yd. excav., Contr. F-64, Frederick Co., to L. R. Waesche, Thurmont, $33,232; 17,850 sq.yd. concrete, 4,000 cu.yd. excav., Contr. Ce-45, Cecil Co., to G. R. Abbott & Sons, 3307 Bateman Ave., Baltimore, $54,793; 3.520 sq.yd. concrete, Contr. 125-A, Montgomeary Co., to Corson & Gruman, 33rd and K Sts., Wash., D. C., $11,757; 2.04 mi. of 3 ft. concrete shoulders, Contr. A-3-A, Allegany Co., to T. D. Claiborne Co., Garrett Bldg., Baltimore, $27,088. Noted June 21.

W. Va., Moundsville—Marshall Co. grading 3 mi. Moundsville Rd, to Wetzel Constr. Co., New Martinsville, $37,062.

Florida — State Rd. Dept., Tallahassee, constructing road between Florida East Coast R.R. and Deer Park, Project 584, Oceola Co., repressed brick laid on edge, to Noll & Noll, Crescent City, $40,691. Noted June 7.

Fla., Bradentown—Comrs. Manatee Co., paving with 9 in. compacted shell 15 mi. road on Terra Ceia Island, to C. A. Rowlett, Palmetto, $37,000; grading and paving with 8 in. compacted rock 27 mi. Road C, Miakka Special Road and Bridge Dist., to H. R. Curry, Bradentown, $56,618. Noted June 7.

Fla., Sarasota—Surfacing 9th St. and East Ave., asphalt block flat on sand and grouted with asphalt, to J. W. Crawford, Sarasota, $1.70 per sq.yd., total about $25,000.

La., Cedar Grove—To Jones Constr. Co., Slaughter Bldg., Dallas, Tex., improving various streets, 54,345 sq.yd. plain concrete $2.40 per sq.yd., excav. $0.63, single gutter $0.62, standard curb and gutter $0.90, etc., total $176,484. Noted May 10.

Tennessee—Concrete paving 14.7 mi. Federal Aid Project 69, Madison Co., 18 ft., to H. D. Hays Constr. Co., Worthington, Ind., $484,000, bridges over 20 span $105,000; grading and burnt slate surfacing 21.2 mi. State Project 114, Grundy Co., 16 ft., to Brown Contg. Co., Chattanooga, $199,000; grading, surfacing, etc., 2.2 mi. bituminous macadam on hand placed course stone base, Montgomery Co., to Moore Constr. Co., Capital Blvd., Nashville, $130,000; treating surface with oil on 13.24 mi. road, and macadam surfacing on hand placed base course on 12.06 mi., both Overton Co., 16 ft., to B. Williams, Murfreesboro, $35,000 and $157,000 respectively. Noted June 14.

Tenn., Jacksboro—Campbell Co. surfacing 8 mi. various roads, bituminous macadam, to J. F. Marcum Constr. Co., Knoxville, $150,000.

Ohio—Dept. Highway and Pub. Wks., Columbus, grading and paving 3.827 mi. Sect. "A-2" Bridgeport-Cadiz Rd. and 3.523 mi. Sect. "A-3" Bridgeport-Cadix Rd., both Belmont Co., Kentucky rock asphalt, to E. L. Reeb, Lima, $172,068 and $149,405 respectively; 0.448 mi. Sect. "Hillsboro" Milford-Hillsboro Rd., and 0.448 mi. Sect. "Hillsboro" Hillsboro-Washington C. H. Rd., both Highland Co., brick, to W. E. Ringwald, Chillicothe, $22,585 and $20,900 respectively; 1.125 mi. Sect. "F" West-Union-Bainbridge Rd. and 0.761 mi. Sect. "Sinking" West Union-Bainbridge Rd. and Sect. "Springs" Hillsboro-Piketon Rd., both Highland Co., waterbound macadam, to C. O. Baldwin, Hillsboro, $25,614 and $12,154 respectively; 2.552 mi. Sect."T"Mansfield-Norwalk Rd., Huron Co., rein.-con., to N. B. Putnam, Van Wert, $68,595; 2,923 mi. Sect. "N" Elyria-Twinsburg Rd., Lorain Co., rein.-con., to Patterson Constr. Co., Lorain, $85,632; 0.576 mi. Sect. "P" Medina-Norwalk Rd., Medina Co., rein.-con., to Hill & Hill, Elyria, $20,823; grading, etc., 2.38 mi. Sect. "J" Mansfield-Millersburg Rd., Holmes Co., to D. G. Watson, Malinta, $14,864. Noted June 21.

Ohio—Dept. Highways and Pub. Wks., Columbus, constructing 5 mi. highway in Jackson Co., concrete, to O. M. Junk, Chillicothe, $137,974.

Ohio — Comrs. Franklin and Delaware Counties, at Columbus, grading and bituminous waterbound macadamizing 4.69 mi. Franklin-Delaware Co. Line Rd., 16 ft., to R. K. McNamara, Delaware, $71,226. Noted June 7.

O., Cleveland — Improving 2 sections of East 116th St., 4,740 lin.ft.stone curb and 4 in. tile drain gutter, 6,400 cu.yd. earth excav. and 9,200 sq.yd. vitr. brick on concrete, to A. M. Pejsa Paving Co., Euclid Heights Blvd., $62,819.

O., Columbus—W. H. Duffy, dir. Pub. Serv., grading, laying water services and sewer connections and concrete paving 517 ft. alley north of Gates St., 16 ft., and 636 ft. alley north of Reinhard Ave., 20 ft., to R. J. Dienst, 480 South 5th St., $2,759 and $6,257 respectively; 351 ft. alley west of Summit St., 20 ft., 347 ft. alley north of King Ave., 18 ft., and 400 ft. alley north of 8th Ave., 20 ft., to Columbus Contg. Co., 1481 West Broad St., $2,321, $1,987 and $2,387 respectively; 807 ft. Broderick St., 28 ft., to Yale Constr. Co., 146 Yale Ave., $3,178; 6,941 ft. 12-30 in. vitr. sewer extending over several streets and alleys from alley west of Chase Ave. to Crescent Dr., to H. E. Miller, 938 South High St., $22,976. Noted June 14.

O., Columbus — Franklin Co., grading, bridging and paving 2.78 mi. Harbord Rd., 18 ft., Sharon and Blendon Twps., oil, to D. W. Botkins & Son, 767 South 22nd St., $78,664; 1.46 mi. Borror Rd., 18 ft., Jackson Twp., waterbound macadam, to Kinnear & Baricklow, 606 Central Natl. Bank Bldg., $30,358. Noted May 24.

O., Columbus—R. W. Smith, clk. Franklin Co., waterbound macadamizing 3.13 mi. Poth Rd., 16 ft., Jefferson, Mifflin and Truro Twps., to J. C. McIntyre Co., 332 West Broad St., $51,807. Noted June 7.

O., Dayton—Montgomery Co. paving 4,300 ft. Gettysburg Ave., 20 ft., to Hoolihan & Wampler, 1406 Riverview Ave., $38,213, engrs. est. $45,000; 2,400 ft. Gettysburg Ave., 20 ft., to A. J. Kramer, Main St., $19,450, engrs. est. $26,000. Work involves 14,900 sq.yd. Kentucky rock asphalt.

O., East Liverpool—Concrete paving about 1 mi. River Rd., 18 ft., to Allison & Harris Constr. Co., East Liverpool, $48,000. Engrs. est. $50,000. Noted June 21.

O., Marion—Marion Co., sheet asphalt paving Vernon Heights Blvd., to H. P. Streicher Co., Inc., 319 Terminal Bldg., Toledo, $26,896. Engrs. est. $28,600.

O., Upper Arlington (Columbus P. O.)—E. D. Howard, village clk., to Radebaugh & Graham, 2015 Tremont Rd., Columbus, grading, laying necessary water services and sewer connections and asphalt paving 5,600 ft. Arlington Ave., 26 and 37 ft., 1,300 ft. Guilford Rd., 26 ft., 6,500 ft. Club Rd., North and South Parkways, 18 ft., 12,550 ft. Kensington and Southway Drives, Andover, Waltham, Wickford, Oxford and Westover Rds., 20 ft., $203,808. Engrs. est. $282,000. Noted June 7.

Ind., Jeffersonville—Clark Co. surfacing 4.78 mi. George Lindemeyer Rd., Oregon Twp., to Denny & Horton, c/o K. P. Barnes, co. surv., Jeffersonville, $44,808. Engrs. est. $46,776. Noted June 21.

Michigan—State Hy. Dept., Lansing, grading and surfacing 4.853 mi. Federal Aid Project 76, to T. E. Currie, 20 McGraw Bldg., Detroit, Mich., 9,506 cu.yd. earth excav. $0.55, 51,491 sq.yd. rein.-con. pavement $1.40, etc., total $88,536. State to furnish cement.

Michigan — State Hy. Dept., Lansing, grading and surfacing 3.861 mi. Assessment Dist. Rd. 408, 20,335 sq.yd. gravel, 14,065 cu.yd. earth excav., to Wade & Massey, Montrose, $37,192.

Mich., Grosse Pointe Farms—For 19,850 sq.yd. 9 in. pavement, 8,000 cu.yd. excav., 14,360 lin.ft. curbing, etc., to R. R. Moran, Grosse Pointe Farms, $90,244.

Ill., Elmhurst—Concrete sidewalks to F. Vertovec, Elmhurst. Engrs. est. $25,000. Noted Dec. 28.

Ill., Elmhurst—For 30,000 sq.yd. asphalt paving to Standard Paving Co., 326 West Madison St., Chicago. Engrs. est. $90,000.

Ill., Posen (Harvey P. O.)—Concrete sidewalks to H. Gottshalk, Homewood. Engrs. est. $70,000. Noted Apr. 12.

Ill., Rockford—Bd. Local Impvts., to Hart & Page, 110 North Court St., paving Rural St., macadam, $31,217, Alley Blk. 3, Harlem Park Subdivision, concrete, $1,423.

Wisconsin—State Hy. Comn., Madison, to Campbell Constr. Co., Minneapolis, Minn., Askeaton-Greenleaf Rd., Brown Co, 12,236 cu.yd. earth excav. $0.78, 23,308 sq.yd. concrete surfacing $1.18, etc., total $45,842, De Pere-Greenleaf Rd., Brown Co., 14,544 cu. yd. earth excav. $0.78, 23,325 sq.yd. concrete surfacing $1.48, etc., total $57,426; to

Streets and Roads (Continued)

W. E. Ule, Stevens Point, New Lisbon-Mauston-Milbourn Rd., Juneau Co., $34,273.

Wis., Elkhorn—Walworth Co., surfacing 1 mi. Sharon-Darien Rd., concrete, to Whitewater Bridge Co., Whitewater, $27,490; 4 mi. Delavan-Walworth Rd., gravel, to F. C. Wiswell, Elkhorn, $16,560. Noted June 7.

Ia., Manchester—To P. P. Smith, 1600 Washington Ave., Cedar Rapids, 2,480 cu.yd. excav. $1, 20,660 sq.yd. concrete paving $2.56.

Ia., Albia—Monroe Co., grading 10 mi. road northwest of here, 26 ft., to McAndrews & Hannah, Keokuk, 50,038 cu.yd. excav., $13,247; Elarton & Elliott, Bussey, 20,193 cu.yd., $5,299; C. O. Mitchell, 2414 Southwest 10th St., Des Moines, 43,660 cu.yd., $11,352. Noted May 24.

Ia., Eldora—Hardin Co., grading and gravel surfacing 22 mi. roads, 26 ft., to W. W. McCullough, Graettinger, 71,100 cu.yd. excav., $17,277; L. O. Kimball, Clear Lake, hauling 6,126 cu.yd. gravel $4,734; J. R. Perkins, Steam Boat Rock, hauling 3,444 cu.yd. gravel, $1,818; Christianson Constr. Co., Iowa Falls, tile labor, $894; Eldora Pipe & Tile Co., Eldora, 10,350 lin.ft. 6 in. tile, $507. Noted May 24.

Ia., Hampton—Franklin Co., gravel surfacing 12.02 mi. Federal Aid Project 171, 26 ft., to E. Davis, Hampton, 7,000 cu.yd. gravel, $1,400; W. Burman, Hampton, 5,000 cu.yd. stripping work, $1,200; H. L. Bone & Son, Royal, hauling 6,964 cu.yd. gravel, $8,675; Nelson & Melohr, Nevada, hauling, 11,789 cu.yd. gravel, $19,483. Noted May 31.

Ia., Lake City—Grading, curbing and paving Main, Center, Illinois and Washington Sts., 4,200 cu.yd. excav., 8,000 lin.ft. curb and gutter, and 19,000 sq.yd. 8 in. granite concrete, to Anderson & Empie, Tremont Blk., Marshalltown, $68,140. Noted May 24.

Ia., Osage—Mitchell Co., gravel surfacing 13.175 mi. roads west and northeast of here, 26 ft., 9,413 cu.yd. gravel, to Harrison Constr. Co., 413 Kraft Bldg., Des Moines, $27,691. Noted May 24.

Ia., Rock Rapids — Lyon Co., grading Doon-Big Sioux River Rd., 230,104 cu.yd. excav., to C. W. McNamara, Bristol, S. D., $60,012. Noted May 17.

Minn., Cloquet—For 6,246 sq.yd. paving, etc., to Nelson & Hafner, Duluth, $18,899; storm sewers, to Pastoret Constr. Co., 304 Sellwood Bldg., Duluth, $4,993. Noted June 7.

Minn., Minneapolis — Bd. Park Comrs., colored cement sidewalks on 6,500 sq.yd. Lake of Isles Blvd., south and west shores of Cedar Lake, to Andrews Paving Co., 3100 15th Ave. S, $1.42 per sq.yd.; 9,000 sq.yd. St. Anthony Blvd., to Engblom Constr. Co., 917 Plymouth Bldg., $1.42; 8,000 sq.yd. Minnehaha Parkway, to Simonson & Emstad, Albert Lea, $1.43. Noted June 14.

Minn., St. James — A. G. Countryman, aud. Watonwan Co., to J. Sampson, Faribault, Job 2301, State Rd. 12, 67,488 cu.yd. excav., 914 lin.ft. 12-36 in. corrugated metal culverts, etc., $32,061, Job 2303, State Rd. 4, 29,536 cu.yd. excav., 50,818 cu.yd. overhaul, etc., $9,416. Noted Mar. 8.

Minn., St. Paul—G. J. Ries, aud. Ramsey Co. improving Project 23-65, 2,620 sq.yd. 1 course concrete and 1,674 sq.yd. bituminous filled brick, etc., also Project 23-05, 3,523 sq.yd. 1 course concrete, etc., to Bitulithic & Contg. Ltd., 722 Globe Bldg., $17,753 and $12,151 respectively. Noted June 14.

Kan., Hiawatha—Paving 17,087 sq.yd. road, 2 in. asphaltic concrete on 5 in. concrete, etc., to J. B. Watts, Concordia, $2.36 per sq.yd., total $56,525. Noted June 7.

Neb., Norfolk—Paving 26 blocks, asphaltic concrete, to Abel Constr. Co., 318-19 Terminal Bldg., Lincoln, $2.22 per sq.yd. Noted May 1[illegible].

Ark., Camden—Paving 1½ mi. [illegible] Bradley and Clifton Sts., etc., Paving Dist. 3, asphalt and concrete, to L. H. [illegible], Camden. [illegible] est. $[illegible].

Tex., Amarillo—Paving 200 blocks, [illegible] and bituminous, to Plains Paving Co., Amarillo, $[illegible] per sq.yd.

Tex., Ft. Worth—To General [illegible] Cotton Exch., paving with 1½ [illegible] rock asphalt on 5 in. concrete [illegible] from Jennings to [illegible] Sts. [illegible] St. from Vickery to Cromwell St., [illegible] East Rosedale St. from Main to Evans Sts., $[illegible]120.

Tex., Orange—Orange Co., grading and rein.-con. paving 5.24 mi. Orange-Beaumont Rd., to F. P. McElwrath, Corsicana, $253,694. Noted Mar. 23.

Tex., Wichita Falls—Paving 3 blocks [illegible] St., brick, to Plains Paving Co., Wichita Falls, $20,[illegible]; 5 blocks Pearl St. [illegible] to L. E. Whitham, Wichita Falls, $[illegible]

Okla., Oklahoma City—Paving [illegible] streets, 22,600 sq.yd. sheet asphalt, [illegible] Paving Co., Tradesman Natl. [illegible] Bldg. $128,084.

Washington—State Hy. Comn., Olympia, to K. L. Goulter & Co., Ilwaco, surfacing 10.86 mi. Ocean Beach Highway, Nasel River to Sand Beach, Pacific Co., 8,395 cu.yd. gravel $3.45, total $28,963 and 15.94 mi. Ocean Beach Highway, Palix River to Nasel River, Pacific Co., 9,770 cu.yd. gravel $3.50, 2,880 cu.yd. crushed gravel base course $5, 1,700 cu.yd. crushed gravel top course $3.50, etc., total $56,577; Grays Harbor Constr. Co., Aberdeen, 0.54 mi. Olympic Highway, Montesano to Aberdeen, Grays Harbor Co., 5,530 sq.yd. cement $3.15, etc., total $28,370; Pentello & Palemo, Nasel, grading and surfacing 5.36 mi. Ocean Beach Highway, Nasel to Johnson's Landing, Pacific Co., 6,900 cu.yd. crushed rock surface course $3.60, 5,520 cu.yd. crushed rock top course $3.95, 6,500 cu.yd. excav. $0.95, total $54,069; J. Otteson Co., 2523 32nd St. S., Seattle, 8.28 mi. Navy Yard Highway, Union City to Holyoke Creek, Mason Co., 13,210 cu.yd. gravel surfacing $1.50, 62,010 cu.yd. earth excav., $0.42, 6,000 cu.yd. loose rock excav. $0.50, 400 cu.yd. solid rock $1.50, etc., total $77,900; H. Pederson Constr. Co., Alaska Bldg., Seattle, 2.01 mi. Sunset Highway, King Co., 1,310,300 cu.yd. overhaul $0.314, 1,790 cu.yd. gravel surfacing $1.75, 55,740 cu.yd. excav. $0.45, incl. small concrete bridge, total $53,857. Noted May 24.

Wash., Everett—Snohomish Co., concrete paving 3 mi. Everett-Mukilteo Highway, 27,000 sq.yd. concrete, 10,000 cu.yd. excav., etc., to E. J. Templeton, Everett, $64,876.

Ore., Portland—Grading and 6 in. concrete paving (1) 1,285 sq.yd. East Clay St. (2) 2,770 sq.yd. Wygant St.; 2 in. asphaltic concrete on 4 in. concrete (3) 670 sq.yd. East 27th St. (4) 2,678 sq.yd. East 65th St. (5) 3,020 sq.yd. East 66th St.; 2 in. bitulithic concrete on 4 in. concrete, (6) 1,100 sq.yd. East 56th St.; laying 4 in. concrete sidewalks, (7) 4,050 lin.ft. East 33rd St. (8) 2,000 lin.ft. East Mason St., to Hahn & Rebman, 726 North Syracuse St., (1) $1.85 (7) $0.15; A. D. Kern, 519 Lumber Exch. Bldg., (2) $1.58 (4) $1.58 (5) $1.58; Municipal Paving Plant, City Hall, (3) $1.60 (6) $1.55; J. Greeder & Co., Portland, (8) $0.16.

Calif., Eureka—Humboldt Co., constructing 5½ mi. wagon road along Redwood Creek from Briceland to State Highway, to E. Linser, Briceland, $22,000. Noted June 7.

Calif., Long Beach—Paving with 5 in. concrete and laying sewers in Belmont Heights Addition, to California Constr. Co., 58 2nd St., San Francisco, $572,460. Noted June 21.

Calif., Santa Monica—Improving Kensington Rd. between 8th St. and Beverly Ave. and portions of 7th St., to Southern Constr. Co., Kerchkoff Bldg., Los Angeles, 157,541 sq.ft. grading at $0.069, 109,467 sq.ft. oil and rock pavement $0.064, 33,282 sq.ft. walks $0.21, curbing $0.65, etc., total $33,225. Noted June 14.

Calif., Stockton — To Clark & Henery Constr. Co., 38 South Sutter St., improving Harrison St. between Washington and Main Sts., 1,305 ft. concrete curb and gutter at $1, 6,638 sq.ft. concrete sidewalks $0.20, 32,042 sq.ft. 2 in. asphaltic concrete on 2½ in. cementing gravel $0.25, etc.; Castle St., 2,581 lin.ft. concrete curb and gutter $1, 11,691 sq.ft. walks $0.20, 1,950 sq.ft. 5 in. pavement $0.17, 10,987 sq.ft. 7 in. pavement $0.23, etc.; East Weber Ave. and C St., 2,285 lin.ft. concrete curb and gutter $1, 6,608 sq.ft. cement walks $0.20, 30,122 sq.ft. 2 in. asphaltic concrete on 2½ in. asphaltic concrete $0.17, 8,469 sq.ft. 2 in. asphaltic concrete on 3 in. crushed rock $0.24, etc.; Channel St., 2,495 sq.ft. cement walks $0.20, 17,901 sq.ft. 2 in. asphaltic concrete on 3 in. cementing gravel and 3 in. asphaltic con[illegible] Noted June 14.

Ontario—[illegible] Highways Dept., Toronto, concrete paving 2⅜ mi. road from [illegible] to [illegible] & [illegible] Wellington St., London [illegible].

Ont., Guelph—[illegible] sq.yd. concrete pavement, concrete curbs [illegible]

Ont., Hamilton—[illegible] Jan. 11.

B. C., Point Grey — [illegible] Co., 419 Seymour St., Vancouver, [illegible]

Industrial Works

PROPOSED WORK

Mass., Boston—[illegible] Products Co., 53 State St., having plans prepared by [illegible] kilns, one 68x172 ft. and one 90x170 ft. waste heat dryers, all brick. $250,000.

Mass., Somerville—Fresh Pond Ice Co., 321 Washington St., plans ice house and manufacturing plant, will install conveyors, ice manufacturing and handling equipment. $50,000-$60,000.

Conn., East Hartford (branch of Hartford) McKinley Bros., 809 Main St., had plans prepared by W. F. Brooks, Lewis and Gold Sts., Hartford, 1 story, 100 x 200 ft. garage and show rooms, rein.-brick and steel, plain foundation, Main and Garvan Sts. $50,000.

Conn., Middletown — Connecticut Power Co., 335 Main St., plans 2 story power station, rein.-con., plain foundation, Water St. To exceed $40,000. Hartford Electric Light Co., 266 Pearl St., Hartford, and Stone & Webster, 147 Milk St., Boston, Mass., engrs.

Conn., West Hartford (Hartford P. O.) —Prospect Garage, Prospect Ave., having plans prepared by B. A. Sellew, 721 Main St., Hartford, 1 story, 100 x 100 ft., brick and steel garage, plain foundation. $40,000.

N. Y., Brooklyn—M. Catalbiano, c/o T. Goldstone, archt. and engr., 50 Graham Ave., having plans prepared 1 story, 100 x 100 ft., brick, steel and concrete garage, plain foundation, DeKalb Ave. $60,000.

N. Y., Brooklyn—P. Cleary, c/o L. A. Sheinert, archt. and engr., 194 Bowery, New York, having plans prepared 1 story, 100 x 125 ft., brick, steel and concrete garage, plain foundation, Coney Island Ave. $70,000.

N. Y., Brooklyn—S. Holland, c/o E. M. Adelsohn, archt. and engr., 1778 Pitkin Ave., had plans prepared 1 story, 100 x 200 ft., brick, steel and concrete garage, plain foundation, Liberty Ave. and Wyona St. $50,000.

N. Y., Cohoes — Little Falls Fibre Co., State Dam, Waterford, plans 2 story, 60 x 140 ft. brick factory, wood pile foundation, Kings Canal, here. $185,000. Engineer and architect not selected.

N. Y., New York—J. E. Eustis, c/o S. Rosenblum, archt. and engr., 51 Chambers St., soon takes bids 2 story, 125 x 165 ft., brick, steel and concrete garage, plain foundation, Fordham Rd. $85,000.

N. Y., New York — D. Salvato, c/o D. Clark, archt. and engr., 441 East Tremont Ave., had plans prepared 1 story, 110 x 115 ft., brick, steel and concrete garage, plain foundation, Morris Ave. $50,000.

N. Y., Rochester — Genesee Bridge Co., 666 Plymouth Ave., plans plant, W. Ave. $55,000. D. Hershey, mgr. Engineer and architect not announced.

Pa., Altoona—See "Buildings."

Pa., Grantville—Grantville Electric Co. plans electric light and power plant. $500,000. H. C. Stambaugh, mgr.

Pa., Pittsburgh—D. L. Clark Co., Martindale St., N. S., plans 6 story and basement, 108 x 129 ft. factory, brick, tile and rein.-con., Reedsdale St. Engineer or architect not selected.

Pa., Rouseville—Penn-American Refinery plans to rebuild portion of plant destroyed by fire. $100,000. Architect not announced.

Pa., Warren—Conewango Refining Co., North Warren Ave., plans to rebuild 1 story filter and tool house, brick and steel, recently destroyed by fire. $100,000. Private plans. Noted May 17.

D. C., Wash.—T. Medford, archt., 1631 3rd St., N.W., preparing plans show room and garage, 14th near Q St., N.W. $200,000. Owner's name withheld.

N. C., Rocky Mount—Rocky Mount Mfg. Co., having plans prepared by Lockwood, Greene & Co., Piedmont Bldg., Charlotte, 3 story 76 x 81 ft. yarn mill, mill construction, steel [illegible]

Ala., Flint—[illegible] plans development and erection of plant for [illegible] ity, near here. $150,000.

O., Canton—Canton Metal Products Co., [illegible]

O., Dayton—[illegible] by Schenk & Williams, Mutual Home Bldg., [illegible] factory, plain foundation. $175,000. Noted Jan. 18.

O., East Liverpool—[illegible]

O., Massillon—[illegible] C. G. Ierbruck, G. D. Harter Bank Bldg., Canton. [illegible]

O., Toledo—[illegible] Co., [illegible]

Industrial Works (Continued)

Ind., Kendallville—McCray Refrigerating Co. having plans prepared by A. M. Strauss, 701 Schoaff Bldg., Ft. Wayne, 1 story, 75 x 220 ft. addition, brick and steel. $50,000.

Mich., Menominee—Marinette & Menominee Paper Co., 2311 Riverside Ave., Marinette, Wis., plans 2 story paper mill, brick and concrete, plain foundation, here. Engineer and architect not selected.

Ill., National City (Venice P. O.)—Armour & Co., National Stock Yards, will rebuild 6 story smoke-house, rein.-con. and brick, recently destroyed by fire. $500,000. Private plans.

Wis., Appleton—Valley Automobile Co., 726 College Ave., plans 4 story and basement, brick and concrete garage, plain foundation, Morrison St. $60,000.

Wis., Madison—University of Wisconsin, Administration Bldg., plans 1 story, 50 x 90 ft., coal storage plant, brick, rein.-con. and steel, plain foundation. $40,000. M. E. McCaffery, secy. Engineer and architect not selected.

Wis., Milwaukee—Milwaukee Lumber Co., 1271 Midland Ave., having plans prepared by Gurda & Gurda, 448 Mitchell St., 2 story, 30 x 100 ft., brick and timber garage, plain foundation, Midland Ave. $40,000.

Wis., New London—M. J. Heinz plans 2 story, 30 x 80 ft. vulcanizing shop, brick, concrete and steel, plain foundation. $40,000. Engineer and architect not selected.

Wis., Oshkosk—J. Danke, c/o Winnebago Dairy Products Co., 332 Main St., having plans prepared by Auler & Jensen, F. R. A. Bldg., 2 story, 48 x 84 ft., creamery and 1 story, 30 x 58 ft., stable, brick and concrete, plain foundations, Main St. $40,000.

Wis., Racine—F. Applegate, 1043 Washington Ave., having plans prepared 1 story, 60 x 105 ft., garage and repair shop, brick, rein.-con. and steel, plain foundation, Washington St. $55,000. Private plans.

Ia., Shenandoah—Election soon to vote on $175,000 bonds for electric light and power plant. R. L. Keltner, Shenandoah, engr.

Kan., Kansas City—Darley Boiler Wks. Co., 923 North 3rd St., had plans prepared 1 story and part basement, 400 x 600 ft. factory. $100,000. Private plans.

Kan., Kansas City—Kansas City Refining Co., 2nd St. and Troup Ave., plans to improve present plant, build larger storage tank and miscellaneous improvements. $100,000. Private plans.

N. D., Minot—K. Kulaas, rejected bids June 4, 2 story and basement, 80 x 150 ft., brick and rein.-con. garage, $45,000. I. L. Rush, Minot, archt. Noted June 7.

Mo., St. Louis—Famous Barr Co., 6th and Olive Sts., plans 2 story and basement, 300 x 500 ft., rein.-con. warehouse and garage, plain foundation, Spring Ave. $200,000. Engineer and architect not announced.

Mo., Stockton—G. B. Steward, Stockton, soon takes bids hydro-electric plant southeast of here, on Sac River, 130 ft. spillway, 10 ft. high, 2 turbines, 18 mi. transmission line from here to Fairfax, etc. $50,000. Russell & Axon, 404 McDaniels Bldg., Springfield, engrs.

Tex., Dallas—C. E. Barglebaugh & Co., archts. and engrs., Medical Art Bldg., soon takes bids 7 story and basement, 140 x 150 ft. factory and 2 story warehouse, brick, stone and concrete, plain foundations, Jefferson, McKinney and Caruth Sts., for Brown Cracker & Candy Co., Jefferson and McKinney Sts. $1,000,000. Noted Apr. 19.

Tex., Ft. Worth—South West Portland Cement Co., Two Republics Bldg., El Paso, takes bids about Sept. 14, cement mill, rein.-con., along tracks Houston & Texas Central R.R., here. $1,500,000. O. J. Binford, Two Republics Bldg., El Paso, engr. Noted May 24.

Tex., Ft. Worth—Texas Steel Co., South Hemphill St., making plans converting old plant into modern steel rolling mill. $100,000-$200,000. R. J. F. Foster, mgr. and engr.

Tex., Gordon—Lone Star Gas Co., Amer. Exch. Bank Bldg., Dallas, having plans prepared and soon takes bids casinghead gasoline plant. $150,000. J. C. Brokaw, c/o owner, ch. engr.

Wash., Seattle—Rainier Corp., headed by G. I. C. Barton, 5648 Alke St., recently organized with $3,000,000 capital stock will lease old plant of Seattle Brewing and Malting Co., Georgetown, here, and convert same into packing plant and cannery, will expend $300,000 for remodeling.

Calif., Los Angeles—Los Angeles Herald, 136 South Bway., having plans prepared by Morgan, Walls & Morgan, Van Nuys Bldg., 2 story and part basement, 153x270x325 ft., publishing plant and store building, rein.-con. and brick, Pico and Figueroa Sts.

Calif., Petaluma—J. A. Kenney, 3rd and J Sts., plans 95x100 ft. warehouse and load-

SEWER—NEW JERSEY

Bids were opened by Dept. Sts. & Pub. Impvts., Jersey City, May 1, for Sect. 3 of trunk sewer from Dover to Boonton, for Rockaway Valley Watershed, (A) C. F. Goeringer Constr. Co., 51 South Washington St., Wilkesbarre, Pa., (awarded contract); (B) J. L. Sigretto, Bernardsville. The unit bids were as follows:

	A	B
290 ft. 10-in. vitrified tile pipe, 0-6 ft.	$3.85	$3.00
1,710 ft. 10-in. vitrified tile pipe, 6-8 ft.	4.60	3.15
60 ft. 10-in. vitrified tile pipe, 8-10 ft.	5.50	3.35
10 ft. 10-in. vitrified tile pipe, 10-12 ft.	6.30	4.50
320 ft. 12-in. vitrified tile pipe, 0-6 ft.	4.20	3.50
1,500-ft. 12-in. vitrified tile pipe, 6-8 ft.	5.00	3.80
300 ft. 12-in. vitrified tile pipe, 8-10 ft.	5.80	4.50
40 ft. 12-in. vitrified tile pipe, 10-12 ft.	7.00	4.50
10 ft. 15-in. vitrified tile pipe, 6-8 ft.	5.55	4.00
820 ft. 15-in. vitrified tile pipe, 8-10 ft.	6.60	5.00
400 ft. 15-in. vitrified tile pipe, 10-12 ft.	7.50	5.50
20 ft. 15-in. vitrified tile pipe, 12-14 ft.	8.80	6.00
10-ft. 18-in. vitrified tile pipe, 6-8 ft.	6.30	6.00
300 ft. 18-in. vitrified tile pipe, 8-10 ft.	7.40	6.50
210 ft 18-in. vitrified tile pipe, 10-12 ft.	8.60	7.00
10 ft. 18-in. vitrified tile pipe, 12-14 ft.	10.00	8.00
70 ft. 20-in. vitrified tile pipe, 0-6 ft.	7.60	6.50
20 ft. 20-in. vitrified tile pipe, 6-8 ft.	8.80	7.00
2,240 ft. 20-in. vitrified tile pipe, 8-10 ft.	10.20	7.50
540 ft. 20-in. vitrified tile pipe, 10-12 ft.	11.50	8.00
10 ft. 20-in. vitrified tile pipe, 12-14 ft.	12.75	8.00
280 ft. 22-in. vitrified tile pipe 0-6 ft.	8.00	7.00
270 ft. 22-in. vitrified tile pipe, 6-8 ft.	9.30	7.50
670 ft. 22-in. vitrified tile pipe, 8-10 ft.	10.25	8.00
810 ft. 22-in. vitrified tile pipe, 10-12 ft	12.00	8.00
160 ft. 22-in. vitrified tile pipe, 12-14 ft.	13.25	8.00
260 ft. 22-in. vitrified tile pipe, 14-16 ft.	14.75	8.00
70 ft. 22-in vitrified tile pipe, 16-18 ft.	17.00	18.00
10 ft. 22-in. vitrified tile pipe, 18-20 ft.	20.00	18.00
10-ft. 33-in. segment block 0-6 ft.	13.20	14.50
170 ft. 33-in. segment block, 6-8 ft	15.00	14.90
2,120 ft. 33-in. segment block, 8-10 ft.	17.00	17.50
1,080 ft. 33-in. segment block, 10-12 ft	19.00	18.90
10 ft. 33-in. segment block, 12-14 ft.	21.00	19.00
10 ft. 33-in. monolithic sewer, 0-6 ft.	14.00	18.85
170 ft. 3.3-in. monolithic sewer, 6-8 ft.	17.00	19.37
2,120 ft. 33-in. monolithic sewer, 8-10 ft	20.00	22.75
1,080 ft 33-in. monolithic sewer, 10-12 ft	23.00	24.57
10 ft. 33-in. monolithic sewer, 12-14 ft.	24.00	24.70
25 ton cast iron pipe	125.00	150.00
50 type A manholes, 0-8 ft.	175.00	125.00
14 type B manholes, 0-8 ft.	175.00	125.00
100 ft. manhole extra depth, 8 ft. +	18.00	10.00
175 M.ft.B.M. sheeting lumber	85.00	90.00
25 M.ft.B.M. foundation lumber	85.00	90.00
1 M.ft.B.M. timber piles	200.00	100.00
20 cu.yd. 1-2-4 concrete (class A)	24.00	25.00
100 cu.yd. 1-3-5 concrete (class B)	20.00	25.00
5,000 cu.yd. rock excavation	4.50	10.00
20 cu.yd. extra excavation	3.50	5.00
1—12-in. gate valve	300.00	75.00
1—12-in flap valve	100.00	75.00
100—5-in. deep house connection	8.00	6.00
500 ft.—5-in. house connection	2.00	3.00
Extended totals using segment block	$211,676	$213,833
Extended totals using monolithic pipe	$222,734	$231,987

SEWER AND SEWAGE DISPOSAL WORKS—NEW JERSEY

Following are lowest three bids opened by Dept. Sts. & Pub. Impvts., Jersey City, May 1, for Sect. 1 of trunk sewer from Dover to Boonton, and sewage disposal works, for Rockaway Valley Watershed, (A) J. L. Sigretto, Bernardsville, (awarded contract); (B) A. A. Johnson Corp., Queens Blvd. & Van Brunt St., Long Island City, N. Y.; (C) C. F. MacEvoy Co., 141 Commerce St., Newark. The unit bids were as follows:

	A	B	C
22,500 cu.yd earth excavation and backfilling trunk and pipes	$2.40	$2.40	$2.90
8,700 cu.yd. rock excavation	2.40	10.00	6.00
1,700 cu.yd. earth embankment—trunk only	.90	1.62	1.00
47,000 ft. 4-in. tile pipe	.36	.24	.25
100 ft. 5-in. tile pipe	.48	.32	.31
800 ft. 8-in. tile pipe	.72	.55	.75
6,500 ft. 10-in. tile pipe	1.80	.70	.90
2,000 ft. 12-in. tile pipe	2.10	1.20	1.04
5,800 ft. 15-in. tile pipe	2.70	1.90	1.50
150 ft. 18-in. tile pipe	3.60	2.80	2.09
150 ft. 20-in. tile pipe	3.60	3.00	2.49
50 ft. 22-in. tile pipe	4.80	3.90	3.10
2,800 ft. 24-in. tile pipe	6.00	5.00	5.00
2,100 ft. 27-in. tile pipe	8.40	7.50	7.50
2,100 ft. 27-in. monolithic sewer	10.92	13.00	10.00
50 ft. 33-in. segment block	8.40	7.85	12.00
50 ft. 33-in. monolithic sewer	10.92	16.90	11.75
5,200 ft. 36-in. segment sewer	9.60	9.35	12.80
5,200 ft. 36-in. monolithic sewer	12.48	19.00	12.50
5,600 ft. 39-in. segment sewer	11.04	10.30	13.00
5,600 ft. 39-in. monolithic sewer	14.35	21.00	13.30
560 ton c.i. pipe-bell and spigot	120.00	150.00	130.00
70 ton c.i. pipe-flanged	180.00	150.00	198.00
20 acres clearing and grubbing	.01	1,400.00	115.00
54,000 cu.yd. earth excavation plant structure	2.70	2.00	1.25
52,000 cu.yd. fill and embankment at plant	.01	.50	.60
10 acre soil and seed	120.00	470.00	891.00
12,000 sq.yd. sodding	1.20	.40	1.00
5,500 sq.yd. macadam roadway	1.50	1.30	2.00
10,500 ft. concrete curb and gutter	2.40	.80	2.00
1,000 sq.yd. macadam walk	.48	.90	2.00
10,500 cu.yd. 1-2-4 concrete (class A)	13.68	21.86	18.14
640 cu.yd. 1-3-5 concrete (class B)	13.68	21.36	16.10
450,000 lb. reinforcing steel	.078	.06	.06
220 cu.yd. brick masonry	36.00	65.00	40.00
500 cu.yd. rubble masonry	12.00	9.45	25.00
1,000 sq.yd. stone paving	4.80	1.75	4.02
180,000 lb. iron castings	.084	.10	17
24,000 lb. machined iron castings	.204	175	25
35,000 lb. miscellaneous w.i. and steel	.204	20	.15
4,000 lb. galvanized w.i. pipe	.12	.50	.24
6—1-in. gate valves	3.60	1.50	3.06
6—1½-in. gate valves	4.80	2.46	4.31
26—2-in. gate valves	7.38	3.86	5.76
6—3-in. gate valves	15.00	9.45	9.98

	A	B	C
15—4-in. gate valves	18.00	18.50	13.13
9—6-in. gate valves	30.00	31.10	32.41
5—8-in. gate valves	42.00	48.31	46.52
5—10-in. gate valves	60.00	72.40	69.93
30—12-in. gate valves	78.00	91.00	93.09
2—16-in. gate valves	138.00	174.00	181.13
2—4-in. sluice gates	36.00	36.00	68.94
23—12-in. sluice gates	150.00	160.00	120.65
1—18-in. sluice gate	216.00	210.00	170.63
1—12-in. flap valve	90.00	80.00	70.14
8—16-in. flap valves	120.00	106.50	85.89
5—6-in. shear gates	32.40	29.70	32.41
5—10-in. shear gates	62.40	52.80	53.15
12—4-in. hydrants	78.00	65.36	66.70
28 valve stands	18.06	40.00	19.64
48 special valve stand heads	18.00	11.00	53.76
21 valve boxes	14.40	12.00	13.10
60 M.ft.b.m. lumber in trench	90.00	90.00	103.50
10 M.ft.b.m. plank or timber piles	90.00	100.00	121.00
4 M.ft.b.m. finished woodwork	.09	.20	.1265
1 V-notch weir and recorder	1,200.00	1,000.00	1,000.00
1 floating outlet pipe	240.00	500.00	350.00
2 control for contact bed	4,200.00	3,287.00	3,615.00
20,000 cu.yd. crushed stone for contact	4.20	5.00	5.66
126,000 ft. half tile drains for contact	.18	.18	.25
25,000 lb. asphalt joint filler	.045	.14	.18
27,500 cu.yd. filter sand	1.80	1.60	4.00
18,000 cu.yd. gravel	3.60	4.00	4.60
8 appurtenances for sand filters	1,200.00	1,911.00	2,703.00
1 industrial track switch and dump cars	960.00	785.00	730.00
630 ft. industrial railroad track—straight	1.08	1.07	2.02
1 gas collector and appurtenances	480.00	450.00	400.00
1 gas holder	960.00	1,000.00	825.00
1 chlorinator	1,800.00	1,500.00	1,415.00
1 appurtenance for sterilizing plant	720.00	4,500.00	2,524.00
3 superstructures—siph. ch. and contact bed	2,820.00	7,700.00	3,036.00
Superstructure—sterilizing plant	8,400.00	8,200.00	10,570.00
1 electric line and outlet light	.	14,000.00	9,760.00
Extended totals using tile and segment block sewer	$1,065,471	$1,254,971	$1,291,804
Extended totals using monolithic concrete sewer	$1,104,401	$1,377,073	$1,292,122

Industrial Works (Continued)

ing wharves, steel and stucco. To exceed $40,000. Engineer and architect not selected. Bay Transport Co., Pier 38, San Francisco, lessee.

Ont., Cornwall—Howard Smith Paper Co. Ltd., plans 1 and 2 story, 180 x 200 ft. and 52 x 100 ft. additions to paper mill, rein.-con. and brick. Private plans.

Ont., St. Catharines—See "Buildings."

BIDS DESIRED

N. J., Verona—July 6, by Essex Mountain Sanitorium, brick, steel and concrete boiler house, plain foundation. $150,000. Guilbert & Bettelle, 2 Lombardy St., Newark, archts. and engrs.

Pa., Glassmere — Cruikshank Eng. Co., engrs., 5th Ave. Arcade, Pittsburgh, receiving bids 3 story and basement, 105 x 123 ft. factory, for Allegheny Plate Glass Co., here. $150,000.

Ill., Chicago — L. G. Hallberg & Co., archts., 116 South Michigan Ave., receiving bids 6 story, 217 x 241 ft. factory addition, fireproof, Lincoln and George Sts., for Stewart-Warner Speedometer Co., 1312 South Michigan Ave. $750,000.

Wis., Fond du Lac—Stepnoski & Mehner, archts., Forest Ave., taking bids 1 story, 56 x 106 ft., brick and concrete garage, plain foundation, for J. [illegible], 22 Rees St. $[illegible]

Wis., Madison — W. Brueski, 2805 East Washington Ave., taking bids 2 story, 50 x 90 ft., garage and repair shop, brick, rein.-con. and steel, plain foundation. $40,000. Private plans.

Wis., Madison—Schmidt Bros. Co., c/o A. J. Schmidt, 2611 Monroe St., taking bids 1 story, 60 x 125 ft. garage and repair shop, brick, rein.-con. and steel, plain foundation. $40,000. Private plans.

Wis., Milwaukee—July 2, by H. T. Schramek, archt., 808 South Pierce St., 1 story, 110 x 125 ft., brick and concrete addition to garage, plain foundation, for M[illegible] Auto Repair Co., 2431 State St. $[illegible]

Calif., San Francisco — [illegible] & Jacobus, archts., 511 5th Ave., New York City, receiving bids 1½ story rein.-con. factory, on block bounded by Mariposa, [illegible], Bryant and Florida Sts., for [illegible] Co., 1964 Bryant St. To exceed $[illegible]

CONTRACTS AWARDED

R. I., North Providence (Providence P. O.)—Mackie Worsted Yarn Co. [illegible] factory, here, to Famigliette Constr. Co., Charles St., Providence. $[illegible]

Conn., Hartford — Connecticut [illegible] 53 Hoadley Pl., 2 story, 50 x 100 ft. [illegible] 150 ft. brick and timber warehouse, [illegible] foundation, Huntley Pl., to C. P. Waterman, 43 Farmington Ave. Archts. est. $75,000. Noted June 7.

N. Y., Olean—Vacuum Oil Co., [illegible] Exchange St., Rochester, boiler and [illegible] plant, here, to Havens Constr. Co., [illegible] $93,000.

Pa., Pittsburgh—Baltimore & Ohio R.R., Baltimore and Charles Sts., Baltimore, Md., 2 story and basement, 30 x 100 ft. [illegible] house, brick, concrete and steel, [illegible] Liberty Sts., here, to France Bros. & Haigley, 19 West Franklin St., Baltimore, Md.

Md., Hagerstown—See "Buildings."

Ky., Louisville—Standard Sanitary Mfg. Co., 6th and A Sts., 1 story, 56 x 75 ft. and 102 x 150 ft., foundry buildings, concrete and steel, 6th and Shipp Sts., to Platoff & Bush, 122 West Liberty St., $70,000. Noted Apr. 19.

O., Cleveland—Benesch, Federman & Co., 5432 Bway., 2 story, 50 x 60 ft., brick, steel and concrete garage and warehouse, 5316 Barkwill Ave., to Super-Built Constr. Co., Union Bldg. Archts. est. $40,000.

O., Cleveland—Standard Oil Co. of Ohio, East Ohio Gas Bldg., two 1 story steam power plants, 1 at 2800 Bway. and other at East 65th St. along tracks of Erie R.R., both brick, steel and concrete, to James Stewart Co., 30 Church St., New York City.

O., Cleveland—Standard Oil Co. of Ohio, East Ohio Gas Bldg., 2 story, 92 x 165 ft. cooperage factory, brick and rein.-con., East 65th St. along tracks of Erie R.R., to James Stewart Co., 30 Church St., New York City. Archts. est. $150,000.

O., Cleveland—A. N. Jeavons, 806 Champlain Ave., N.W., 2 story and basement, 70 x 142 ft., brick and rein.-con. factory, 1633 East 40th St., to D. Lindhorst Constr. Co., 1602 Holmden Ave. Archts. est. $100,000.

O., Cleveland—B. J. Russell, 10539 Euclid Ave., 1 story, 90 x 115 ft., brick and steel factory, 22nd St. and Marion Ave., to S. W. [illegible] Co., [illegible] Euclid Ave. Archts. est. $40,000. Klein & Paterson Body Co., c/o owner, lessee. Noted May 24.

Mich., Detroit—[illegible] Motorbus Co., Terminal and Eddie Aves., 1 story, brick, steel and concrete garage, plain foundation, Tireman Ave., to Bryant & Detwiler Co., 2336 Dime Bank Bldg., $75,000.

Mich., Detroit—Pub. Lighting Comn., [illegible] for new power plant, to Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. $[illegible] Noted May 24.

Mich., Menominee—Lloyd Mfg. Co., North State St., 3 story, 100 x 400 ft., rein.-con. factory, [illegible] foundation, to H. J. [illegible] Co., Cartney Bank Bldg., Green Bay, Wis. Archts. est. $[illegible]

Ill., Chicago—[illegible] & Sons, [illegible] North Kilpatrick Ave., second unit 3 story, [illegible] $90,000. Noted Aug. 31.

Ill., Chicago—[illegible]

Ill., Chicago—[illegible]

Wis., [illegible]—[illegible] Food Co., c/o F. [illegible]

Wis., Hilbert—C. F. Lawler, 1 and 2 story, and basement, 46 x 80 ft., garage and repair shop, brick, rein.-con. and steel, plain foundation, to Appleton Constr. Co., Odd Fellows Bldg., Appleton. Archts. est. $40,000.

Wis., Milwaukee — Chicago & Northwestern Ry., 226 West Jackson Blvd., Chicago, coaling station, timber, plain foundation, to Roberts & Schaefer Co., 400 North Michigan Ave., Chicago. $45,000.

Wis., Milwaukee—O. R. Pieper Co., 192 Bway., 2 story, 60 x 110 ft., brick and timber addition to warehouse, to H. Schmitt & Son, 430 Farwell Ave. Archts est. $60,000.

Wis., Milwaukee—Rockwell Mfg. Co., 572 Park St., 1 story, 72 x 100 ft. dyn kiln, brick, tile and concrete, plain foundation, to W. W. Oeflein, 86 Michigan St. Archts. est. $40,000.

Wis., Neenah—Valley Paper Mills, 145 West Wisconsin Ave., 1 story, 80 x 500 ft. main building, 95 x 116 ft. warehouse, 1 story, 130 x 144 ft. finishing room, 1 story, 60 x 160 ft. and 50 x 125 ft. power house and filtration plant, brick and concrete, plain foundations, to Appleton Constr. Co., I. O. O. F. Bldg., Appleton. Noted Mar. 1.

Minn., Minneapolis—C. F. Haglin & Sons Co., 226 Lumber Exch., will build 2 story and basement, 135 x 170 ft. warehouse, and 1 story, 100 x 170 ft. garage, brick and concrete, Laurel Ave. near Bryant Ave., by day labor. Hewitt & Brown, 1200 2nd Ave. S., archts.

Minn., Minneapolis—C. Lindley, 622 Nicollet Ave., general contract 1 story, rein.-con. and brick garage, 1415 Hennepin Ave., to M. Schumacher, 39 Dell Pl. Total cost $45,000.

Minn., Minneapolis — Royal Wet Wash Laundry Co., 140[illegible] Plymouth Ave., will build 2 story and basement, 88 x 140 ft., brick and concrete laundry addition, by day labor. $45,000. Liebenberg & Kaplin, 617 McKnight Bldg., archts. Noted July 13.

Minn., St. Paul—State Bd. Control, Capitol, general contract 3 story and basement dairy, rein.-con., brick, tile and stone, at College of Agriculture, University of Minnesota, to Louis Fleisher Co., 504 Plymouth Bldg., Minneapolis, $156,000. Noted June 21.

Minn., St. Paul—St. Paul Gas Light Co., 6th and Cedar Sts., power house, 2,500 kva. steam turbo electric power plant, 100 x 225 ft. generating plant and 60 x 150 ft. pulverizing building, both steel and concrete on island in Mississippi River, to Siems, Helmers & Schaffner, 514 Guardian Life Bldg. This corrects report in March 22 issue.

Kan., Wichita—W. A. Dyle, Rock Island St., 2 story, 60 x 120 ft., rein.-con. and brick factory, concrete pile foundation, at 112-114 Mosley Ave., to G. Seidhoff, Broadview Hotel. $40,000.

Ont., Brantford—Brandon Shoe Co., factory to P. H. Secord & Sons, Brantford. Est. cost $75,000. Noted May 10.

Buildings

PROPOSED WORK

Mass, Hyannis — High School — School Com. plans 3 story, 100 x 125 ft., Main St., $150,000. F. T. Bowles, chn. Engineer and architect not selected.

R. I., Providence — Gymnasium — Pub. Buildings Dept., plans 4 story, 100 x 100 ft., rein.-con. and brick, Spring St. $200,000 W. E. Hartwell, City Hall, archt.

Conn., Hartford — Apartment — Golden-Storrs Co., archts., 1127 Main St., prepared plans 3 story, 120 x 120 ft., brick, plain foundation, Windsor Ave. and Westland St. $[illegible] [illegible]

N. Y., Binghamton—[illegible] brick and stone, Washington and Court Sts. $165,000. Engineer and architect not announced.

N. Y., Brownsville—[illegible] foundation [illegible] Newark, N. J., [illegible]

N. Y., Brooklyn—[illegible] Ave. [illegible]

N. Y., Buffalo—[illegible]

N. Y., Canton—[illegible] 2 story, 77 x 127 ft., [illegible]

N. Y., Corona—[illegible]

Buildings (Continued)

James Co., archts. and engrs., 342 Madison Ave., New York, 2 story, brick and stone, plain foundation, Jackson and 103rd Sts. $400,000.

N. Y., Friendship—School—Bd. Educ. plans new brick school. $150,000. Engineer and architect not selected.

N. Y., New York—Apartment— J. Axelrod, c/o G. F. Pelham, archt. and engr., 200 West 72nd St., having plans prepared 4 story, brick, steel and stone, plain foundation, East 84th St. $150,000.

N. Y., New York — Apartment — Della Penna & Erickson, archts. and engrs., 344 East 149th St., preparing plans 6 story, 80 x 85 ft., brick, steel and stone, plain foundation, Topping Ave. $150,000. Owners name withheld.

N. Y., New York—Apartment—P. Starrett, c/o J. E. R. Carpenter, archt. and engr., 598 Madison Ave., having plans prepared 14 story, 100 x 150 ft., brick, steel and stone, plain foundation, Park Ave. and 65th St.

N. Y., New York—Apartment Hotel—E. Margolies, 19 East 33rd St., had plans prepared by E. De Rosa, archt. and engr., 110 West 40th St., 12 story, 110 x 125 ft., brick, steel and stone, plain foundation, 3-11 West 47th St., Noted May 3.

N. Y., New York—Loft—Amer. News Co., 11 Park Pl., having plans prepared by R. G. Cory, archts. and engrs., 30 Church St., 10 story, 150 x 175 ft., brick, steel and stone, plain foundation, Warwick and Dominick Sts.

N. Y., New York—Office and Store—M. M. Watanson, c/o M. Zipkes, archt. and engr., 25 West 43rd St., having plans prepared 4 story, 50 x 75 ft., brick, steel and stone, plain foundation, Nassau St. $300,000.

N. Y., Portchester — Y.M.C.A., 2 West 45th St., New York City, plans brick, steel and stone, Pearl St., here. $250,000. Engineer and architect not selected.

N. Y., Rochester—Apartment—J. Joroslow, 176 Meigs St., plans 3 story, 61 x 97 ft., brick, Milburn and Berkley Sts. $150,000. Engineer and architect not announced.

N. J., East Orange —Hospital—Homeopathic Hospital, c/o Crow, Lewis & Wick, archts. and engrs., 200 5th Ave., New York City, having plans prepared 6 story, brick, steel and stone, plain foundation, here. $450,000.

N. J., Lawrenceville—School—Lawrenceville Preparatory School plans class room and administration building. $275,000. J. Dixon, 108 West State St., Trenton, pres. trustees. Engineer and architect not selected.

N. J., Newark—High School—Bd. Educ., City Hall, Broad St., having plans prepared by Guilbert & Bettelle, archts. and engrs., 2 Lombardy St., brick, stone and steel, plain foundation, South Orange Ave. and South 12th St. $750,000.

N. J., Trenton —Home — Widows' and Single Women's Home, Spring St., plans brick, steel and concrete addition. $150,000. J. O. Hunt, 219 East Hanover St., archt.

Pa., Altoona—Exchange—Bell Telephone Co., Broad and Vine Sts., Phila., plans 3 story and basement, 90x120 ft., brick, steel and concrete, office, warehouse and garage, Industrial Ave., here. $150,000. C. H. Cassidy, 2814 Broad Ave., archt.

Pa., Altoona—Store—M. Lenson & Sons, 1007 14th St., plans 3 story and basement, 28x140 ft., brick, steel and concrete, Union Ave. $150,000.

Pa., Ferndale (Johnstown P. O.)—High School—Bd. Educ. rejected bids 2 story and basement, brick and steel, here. $150,000. J. E. Adams, archt., Nemo Bldg., Johnstown, revising plans. Noted May 24.

Pa., Johnstown—High School—Bd. Educ. takes bids this summer for Central High School, 3 story and basement, 200 x 210 ft., rein.-con., brick and steel, Somerset St. $500,000. J. E. Adams, Nemo Bldg., archt. E. L. Tilton, Phila., associated archt. Noted Mar. 22.

Pa., Johnstown—School—Bd. Educ. had plans prepared by J. E. Adams, Nemo Bldg., and takes bids this summer, 3 story and basement, 40 x 100 ft. brick and steel addition to Hudson St. School. $150,000. W. Wenn, secy.

Pa., Johnstown—Store—Penn Traffic Co., Johnstown, having plans prepared by Hunting-Davis Co., Century Bldg., Pittsburgh, 5 story and basement, 79 x 87 ft. addition, brick, steel and tile, Washington St. $350,000.

Pa., Sharon—Club—Loyal Order of Forresters 292, having plans prepared by W. H. Crosby, Reno St., Oil City, for clubhouse, Main St. $155,000.

W. Va., Montgomery — Bank — Montgomery Natl. Bank having plans prepared by Hoggson Bros., 485 5th Ave., New York City, 2 story and basement, 24 x 90 ft., stone and granite. $200,000.

N. C., Charlotte—Courthouse, etc.—City and Mecklenburg Co. election July 28, to vote on $900,000 bonds for 12 story, courthouse, jail and office. M. E. Boyer, Jr., Trust Bldg., archt. Noted Mar. 15.

Ga., Atlanta — Office — Atlanta Realty Corp., Hurt Bldg., having plans prepared by H. Tallant, engr., 70 East 45th St., New York City, 17 story, 90 x 166 ft., steel and brick, plain foundation, Ivy St. $900,000.

Ga., Macon—Auditorium—City having plans prepared by Swartwout, archt., 18 West 34th St., New York City, for auditorium.

Fla., Miami—Office and Store—Tatum Bros., 214 12th St., having plans prepared by Kiehnel & Elliott, Miami, 10 story, 60 x 152 ft., rein.-con., East Flagler St. and 2nd Ave. $500,000.

Miss., Meridian—Y. M. C. A. plans to construct building. $150,000. C. W. Hayward, chn.

La., Lafayette — Orphanage — St. Marys Orphanage, c/o J. B. Jeanmard, bishop, had plans prepared by A. Bendernagel, Whitney Central Bldg., New Orleans, three 2 story and basement, brick and concrete. $150,000.

La., Shreveport—Hotel—Youree Hotel, Market and Texas Sts., plans 4 story, brick and concrete addition. $150,000.

Tenn., Memphis — Church — Episcopal Church had plans prepared by Hanker & Cairns, Madison Ave. Bldg., Gailor Memorial, 3 story, white stone, Poplar Ave. $250,000.

Tenn., Memphis—Church—First Methodist Church, Poplar Ave., had plans prepared by H. T. McGee, Madison Ave. Bldg., 2 story, brick and stone, Poplar and North 2nd Sts. Conducting campaign to raise $150,000 funds.

Tenn., Memphis—Hotel—Southern Hotel Co., Inc., 257 South Main St., having plans prepared by W. W. Ahschlanger, Inc., 65 East Huron St., Chicago, 12 story, 200 x 342 ft., containing 600 rooms, roof garden, dining halls, convention halls, lobby, 40 stores on ground floor, etc. $4,250,000.

Tenn., Memphis—Schools, etc.—St. Mary's School, 714 Poplar St., had plans prepared by E. L. Harrison, U. & P. Bank Bldg., three 2 and 3 story schools, incl. gymnasium, assembly hall, dining hall, apartments, etc. $150,000.

Ky., Lexington—City Hall and Auditorium—City Hall Building Comn. having sketches made by F. L. Packard, Hayden Bldg., Columbus, O., 3 story, concrete, brick and stone. $300,000.

Ky., Louisville — Apartment — Doric Apartment Co. having plans prepared by Joseph & Joseph, Francis Bldg., 8 story, 150 x 200 ft. addition, brick, Willow Ave. $750,000.

Ky., Louisville—High School—Bd. Educ. plans 4 story high school in West End, suburb of Louisville. $500,000. Engineer and architect not selected.

Ky., Winchester—School—Bd. Educ. having plans prepared by R. M. Bates, Watts Bldg., Huntington, W. Va., 2 story, brick, Colby Park. To exceed $150,000.

O., Canton—Mercantile and Office—H. H. Ink, Fulton Rd., plans 6 story, 60 x 150 ft., fireproof, 6th and Market Sts. $200,000.

O., Cleveland — Commercial — Welworth Realty Co., c/o L. N. Gross Co., 1241 West 3rd St., having plans prepared by Christian, Schwarzenberg & Gaeda, archts and engrs., 1900 Euclid Ave., 2 or 4 story, 92 x 195 ft., brick, steel and concrete, Euclid Ave. and East 30th St. $200,000.

O., Cleveland—School—Bd. Educ., East 6th St. and Rockwell Ave., plans 2 story, brick, steel and concrete addition to Jefferson School, West 130th St. $200,000. W. R. McCornack, East 6th St. and Rockwell Ave., archt.

O., Dayton—Hospital—Miami Valley Hospital, Apple St., having plans prepared by Schenk & Williams, Mutual Home Bldg., 5 story and basement, 80 x 200 ft., brick and stone, plain foundation. $500,000. Noted Mar. 22.

O., Steubenville — Theatre — Tri State Amusement Co. having plans prepared by C. H. Crane, 542 Griswold St., Detroit, Mich., 2 story and basement, 150 x 180 ft., brick, steel and terra cotta, 4th and Adams Sts. $500,000.

Mich., Detroit — Apartment — Kohner & Seeler, archts., 405 Kresge Bldg., preparing plans 4 story and basement, 100 x 108 ft., brick and steel, plain foundation, Lawton Ave. $150,000. Owner's name withheld.

Ill., Chicago—Apartment—E. P. Doerr, 1226 Madison Park Ave., plans two 3 story, 36 x 165 ft., fireproof, 4817-29 Lake Park Ave. $300,000. W. P. Doerr, 28 East Jackson Blvd., archt.

Ill., Chicago—Apartment—H. Miller, c/o J. K. Neebe, archt., 2532 Aubert Ave., plans 3 story, fireproof, Harrison and Leman Sts. $150,000.

Ill., Chicago—Apartment—Olsen & Urbain, archts., 155 North Clark Sts., preparing plans 3 story and basement, 150 x 150 ft., fireproof, Blaine and North Sacramento Sts. $200,000. Owner's name withheld.

Ill., Chicago—Apartment-Hotel—H. Minkus, c/o Leichenko & Esser, archts., 38 South Dearborn St., plans 12 story, 194 x 302 x 500 ft., fireproof, Albion St., North Shore Dr. and Lake Michigan, $3,000,000.

Ill., Chicago—Store, Office, etc.—D. S. Klafter, archt., 64 West Randolph St., preparing plans 2 story 150 x 310 ft., store, office, theatre and apartment, fireproof, Fullerton and Crawford Sts. $750,000. Owner's name withheld.

Wis., Appleton—Bank — Citizens Natl. Bank, College Ave. and Oneida St., having preliminary plans prepared by Coolidge & Hodgson, 134 South La Salle St., Chicago, 5 story, 52 x 90 ft. and 20 x 50 ft. additions, brick, concrete and stone, plain foundation. $150,000.

Wis., Beloit—City Hall—Had plans prepared and soon takes bids 2 story and basement, 80 x 100 ft., brick, concrete and steel, plain foundation. $150,000. F. A. Carpenter, Brown Blk., Rockford, Ill., archt. Noted June 14.

Wis., Green Bay—Hospital—State Bd. Control, Madison, plans 4 story, rein.-con., brick and steel addition, plain foundation here. $150,000. F. Crocker secy. Engineer and architect not selected.

Wis., Madison—Church—Grace Episcopal Church, c/o H. H. Trumpkin, 116 West Washington Ave., plans 2 or 3 story, brick, rein.-con. and steel, plain foundation, Carroll St. $150,000. Engineer and architect not selected.

Wis., Merrill—Theatre—Business—Merrill Amusement Co., having plans prepared by Wisconsin Eng. & Constr. Co., archts. and engrs., 512 3rd St., Wausau, 1 and 2 story, 54 x 120 ft., brick and concrete, plain foundation. $150,000.

Wis., Waupun—Hospital—State Bd. Control, Madison, plans 3 story, brick, rein.-con. and steel, plain foundation at State prison here. $150,000. F. Crocker secy. Engineer and architect not selected.

Ia., Marion—Jail and Court House—Linn Co. plans jail and court house. $750,000. G. A. Senninger, aud.

Minn., Luverne—School—Voted $350,000 bonds 3 story and basement, 68 x 120 ft., rein.-con., brick, tile and stone. Tyrie & Chapman, 1200 2nd Ave. S., Minneapolis, archts.

Minn., Minneapolis—Auditorium—Authorized $3,000,000 bonds for auditorium. Engineer and architect not selected.

Neb., Falls City—Hotel—Fall City Hotel Co. had plans prepared by J. H. Craddock, 315 South 15th St., Omaha, 4 story and basement, 92x130 ft., rein.-con., brick and stone. $150,000. Noted May 24.

Mo., Kansas City—High School—C. A. Smith, archt., 601 Finance Bldg., takes bids about Aug. 15, 4 story and part basement, 150 x 290 ft., rein.-con., brick, steel and stone. 48th and Paseo Sts., for Bd. Educ. $1,400,000. Noted Jan. 18.

Mo., Kansas City—School—C. A. Smith, archt., 601 Finance Bldg., takes bids about July 20, 2 story and basement, 60 x 140 ft., rein.-con., brick steel and stone addition to Bristol School, Maywood St., for Bd. Educ. $180,000. Noted May 17.

Mo., Kansas City—Schools—C. A. Smith, archt., 601 Finance Bldg., takes bids about July 10, 2 story and basement, 60 x 140 ft. addition to Mt. Washington School, $190,000, also constructing Shiloh School, 1 story and basement, 150 x 200 ft., 70th and Askew Sts., $280,000, both rein.-con., brick steel and stone for Bd. Educ. Noted May 17.

Mo., St. Louis—School—Xenia Theological Seminary, Washington and Trinity Aves., plans rein.-con. and brick buildings, plain foundations, Trinity Ave. $700,000. Engineer and architect not announced.

Mo., St. Louis—Store—Stix, Baer & Fuller Co., 6th and Washington Sts., plans 8 story, 105 x 160 ft., rein.-con., brick and steel, concrete pile foundation, Lucas Ave. $2,000,000. Engineer and architect not announced.

Mo., St. Louis — Store and Office — E. Freund, 2735 Cherokee St., plans 3 story and basement, 88 x 145 ft., rein.-con. and brick, plain foundation, Grand Blvd. $150,000. Engineer and architect not announced.

Tex., Corsicana—Office—L. C. Polk and associates plan 5 story and basement, brick and concrete, plain foundation. $150,000. Engineer and architect not announced.

Tex., Greenville—Courthouse—Hunt Co. election July 21, to vote on $400,000 bonds, 4 story, brick and concrete. O. P. Mc-

Buildings (Continued)

Whirter, co. judge. Architect not announced.

Okla., Tulsa—Jail—Voted $150,000 bonds for jail. Engineer and architect not selected.

Okla., West Tulsa (Tulsa P. O.)—Hotel—Moss Hotel had plans prepared by C. P. Nieder, Empress Theatre Bldg., Oklahoma City. 4 story and basement, 48 x 140 ft., rein.-con., brick, steel and stone. $150,000.

Colo., Denver — Office — J. A. Ferguson, U. S. Natl. Bank Bldg., having plans prepared by Fisher & Fisher, U. S. Natl. Bank Bldg., 5 story, 125 x 125 ft., addition to present 7 story building, 17th and Champa Sts.

Wash., Olympia—Capitol—State Capitol Comn., rejected bids constructing main portion Legislative Building of Capitol (exclusive of dome). Will readvertise. Total cost $5,000,000 or $6,000,000. Wilder & White, Wash., D. C., archts. Bebb & Gould, Securities Bldg., Seattle, associated archts. Noted June 21.

Calif., Covina — Dormitories — Masonic Home, East Badillo St., soon takes bids 2 story, rein.-con. and brick. $150,000. Train & Williams, Western Mutual Life Bldg., Los Angeles, archts.

Calif., Los Angeles — Apartment — A. C. Blumenthal, Loew State Bldg., plans 12 story, probably rein.-con., Hollywood Blvd. $1,000,000.

Calif., Los Angeles — Apartment Hotel San Francisco syndicate having plans prepared by Walker & Eisen, Pacific Finance Bldg., 10 story, concrete and steel, Wilshire Blvd. $850,000.

Calif., Los Angeles—Club—Southern California Athletic & Country Club having plans prepared by E. Bergstrom, Citizens Natl. Bank Bldg., 13 story and basement, 150 x 200 ft., steel, Wilshire Blvd. $2,000,000.

Calif. Los Angeles—Institutional—Plaza Community Church, c/o Train & Williams, archts., Western Mutual Life Bldg., had plans prepared 4 story and basement, hospital, club, office and auditorium, rein.-con Los Angeles St. $150,000.

Calif., Los Angeles—Loft—L. Conrad, et al., 166 West Pico St., plans loft, rein.-con., probably 12 story, Los Angeles and 7th Sts to exceed $250,000. Engineer and architect not selected.

Calif., Los Angeles—Store—See "Industrial Works."

Calif., Oakland—Church—First Congregational Church, 12th and Clay Sts., plans church, fireproof, 26th and Harrison Sts. $200,000. R. A. Leet, ch. building com.

Calif., Oakland—Store and Office—Owl Drug Co., 611 Mission St., San Francisco, plans 6 story, fireproof, 16th St. and Telegraph Ave. To exceed $150,000.

Calif., Santa Monica—Church and Rectory—Church of St. Augustine by the Sea, having plans prepared by Allison & Allison, Hibernian Bldg., church and rectory, brick. $150,000 or more.

Ont., Ford—School—Public School Bd. having plans prepared by Nichols & Sheppard, Windsor, 2 story and basement, brick, steel and terrazo. $210,000.

Ont., Haileybury — Hotel — N. [illegible] plans to rebuild Matabanic Hotel d[illegible] by fire last year concrete and br[illegible] rooms probably 3 story and basement. Engineer and architect not selected.

Ont., Oakridge—School—School Bd. S. S. 12, plans 2 story and basement, rein.-con. and brick. $1[illegible]. Engineer and architect not selected.

Ont., St. Catharines—Terminal—Niagara, St. Catharines & Toronto Electric Ry. plans passenger and freight terminal, brick, concrete and steel, Welland Ave., Balfour and General Sts. $250,000-$300,000. R. L. Harrison, St. Catharines, ch. engr.

Ont., Toronto—Church—St. M[illegible] All Angels Church, St. Clair and [illegible]dale Aves., plans 1 story and [illegible] rein.-con. and brick. St. Clair Ave. [illegible] 666. W. J. Brain [illegible] Ave. [illegible] Engineer and architect not [illegible].

Ont., Toronto—Hospital—Home [illegible] curables, Bloor St. having plans [illegible] by E. J. Lennox, 362 Bay St. [illegible] rein.-con. and brick. Bloor St. [illegible]

Ont., Toronto—School—Bd. [illegible] College St. having sketches [illegible] Dyson 155 College St. 2 story [illegible] brick and steel, 20 rooms [illegible] of Yonge St. $[illegible]

Ont., Toronto—School—Hap[illegible] Jarvis St. plans concrete and [illegible] acre site, at Stop 17, Yonge St. [illegible] Engineer and architect not selected.

BIDS DESIRED

N. Y., Syracuse—High School—[illegible] by Bd. Contr. & Supply [illegible] High School 2 story and basement [illegible]

200 ft., brick, steel and stone, Fellows Ave. $650,000. Former bids rejected. A. L. Brockway, 3rd Natl. Bank Bldg., engr. Noted June 7.

N. J., Bloomfield—High School—July 5, by Bd. Educ., 4 story, 25 x 140 ft., brick and stone addition, Broad St. $225,000. J. F. Capen, 207 Market St., Newark, archt. J. O. C. Gibbons, 207 Market St., Newark, engr. Noted June 21.

Pa., Pittsburgh—School—July 5, by Bd. Educ., Fulton Bldg., 2 story and basement, rein-con., brick, stone and tile, Boggs Ave. $150,000. S. F. Heckert, Bessemer Bldg., archt. Noted Apr. 26.

Pa., Pittsburgh—School—July 21 by Bd. Educ., Fulton Bldg., 2 story and basement, brick, stone, tile and rein.-con., Bonvue Ave. $225,000. L. Stevens, Century Bldg., archt. Noted Feb. 15.

Tenn., Nashville—Hospital, etc.—July 16, by J. H. Kirkland, chancelor of Vanderbilt University, 337 x 458 ft., hospital and laboratory, also nurses' home, power plant and laundry, brick and rein.-con., on campus. $2,000,000. Coolidge & Shattuck, 122 Ames Bldg., Boston, archts.

Ky., Louisville—Office—July 2, by Avery Building & Loan Assn., 525 West Market St., 3 story, 100 x 150 ft., 515 17 West Market St. $150,000. Noted May 10.

O., Athens—High School—July 6, by W. Alicot, secy. Bd. Educ., 2 story and basement, rein.-con. and brick, plain foundation. $250,000. W. B. Ittner, 911 Locust St., St. Louis, Mo., archt.

O., Athens—School—July 7, by W. Alicot, secy. Bd. Educ., 1 story and basement, brick, plain foundation. $150,000. W. B. Ittner, 911 Locust St., St. Louis, Mo., archt.

O., Cleveland — Apartment — H. Abrams, 13340 Forest Hill Ave., taking bids 4 story, brick and timber, East 160th St. and Cornell Rd. $150,000. M. Weis, 617 Union Bldg., archt.

O., Dover—Theatre and Lodge—July 16, by G. A. Ebeling, archt., Newman-Stern Bldg., Cleveland, 4 story, 50 x 150 ft., brick, steel and concrete, here, for Dover Pythian Castle Co. $150,000. Noted May 31.

O., Logan—Court House— July 20, by Hocking Co., brick, concrete and stone. $250,000. F. L. Packard, New Hagden Bldg., Columbus, archt. Noted Feb. 22.

Mich. Detroit — Apartment — Williams Bros., archts., 1111 Kresge Bldg., taking bids and open same about June 30, 4 story and basement, 80 x 80 ft., brick, plain foundation, Lee Pl. and Wilson Ave., for G. Copelans, c/o architects. Noted Dec. 14.

Ill., Chicago—Apartment—Olsen & Urbain, archts., 155 North Clark St., receiving bids 4 story, 200 x 200 ft., fireproof, Arlington St., near Clark St. $300,000. Owner's name withheld.

Ill., Chicago—Apartment—W. C. Presto, archt., 111 West Washington St., receiving bids 3 story, 100 x 125 ft., fireproof, Kedzie St. near Montrose Ave. $150,000. Owner's name withheld.

Wis., Milwaukee—Store—July 2, by Herbst & Kuenzli, archts., 114 Grand Ave., remodeling and building 3 story and basement, 62 x 80 ft., brick and timber addition, plain foundation, for Kuenzelmann-Esser Co., 460 Mitchell St. $150,000.

Wis., Milwaukee—Store—M. Tullgren & Sons, archts., 425 East Water St., taking [illegible] ft., brick and tile, plain foundation, Wells St., [illegible]

Kan., Coffeyville—Auditorium—July 1, by T. W. Williamson & Co., archts., 312 Central [illegible] Topeka, [illegible] story and basement, 115x172 ft. rein.-con and stone for city. $175,000. Noted June 7.

Kan., Leavenworth—High School—July 2, by C. A. Smith, archt., 602 Finance Bldg., [illegible] 120 x 170 ft., rein.-con., brick and stone for [illegible]

Okla., Holdenville—Lodge—July 10, by [illegible] $150,000. Tonini & Bramblet, Terminal Bldg., Oklahoma City, archts.

Okla., Pawhuska—Hotel—July 16, by [illegible] and E. Forsblom, archt., 310 Sedgwick [illegible]

Calif., Los Angeles—[illegible]

BIDS RECEIVED

N. Y., New York—[illegible]

St., $1,185,000; P. S. 73, 3 story, brick, steel and stone, plain foundation, West 166th St. and Woodycrest Ave., from G. Colon & Co., 81 East 125th St., $395,903. Noted June 14.

La., Shreveport—Office—D. Ricou, Merchants Bldg., (1) 4 story, (2) 6 story, 120 x 150 ft., Milam and Marshall Sts., from J. E. Johnson Constr. Co., Amicable Bldg., Waco, Tex., (1) $290,777; Standard Constr. Co., Woolworth Bldg., Houston, Tex., (2) $380,800.

O., Akron—Hospital—Summit Co., Court House, June 18, hospital addition, Springfield Lake, near here, from Clemmer & Johnson Co., 406 Metropolitan Bldg., $155,586. Noted Dec. 7.

Minn., St. Paul—School—Bd. Educ., City Hall, June 18, 3 story and basement, rein.-con., brick, tile and stone, 14th and Jackson Sts., from Lindstrom & Anderson, 206 Bremer Arcade, $184,704. Noted June 14.

Calif., Huntington Beach—School—Huntington Beach High School Dist., brick school, general contract from A. Johnson, Union Bank Bldg., Los Angeles, $178,537. Noted Feb. 1.

Calif., Stockton—City Hall—Constructing city hall, fireproof, on block bounded by El Dorado, Center, Fremont and Lindsey Sts., general contract from H. S. Williams, 180 Jessie St., San Francisco, $398,000; plumbing also heating and ventilating from Miller-Hayes Co., 125 North California St., $15,277 and $28,570 respectively; mechanical equipment (incl. electric work, plumbing and heating), from E. L. Gneckow, 647 East Main St., $62,280. Noted June 14.

CONTRACTS AWARDED

Me., Belfast—High School—School Comn., 3 story, 135 x 147 ft., rein.-con. and brick, to Forgione & Romano Co., 36 Walnut St., Portland, $150,000. Noted May 10.

N. H., Manchester—Theatre—S. James, 3 story, 100 x 150 ft., brick and steel, Lowell St., to C. A. Golden, 64 Concord St., $225,000.

Mass., Northampton—Theatre—Goldstein Bros. Amusement Co., Broadway Theatre, Springfield, 2 story, 80 x 125 ft., brick and steel, King St., here, to Atlas Constr. Co., Broadway Theatre Bldg., Springfield. Archts. est. $150,000. Noted Mar. 29.

N. Y., Brooklyn—Apartment—Machold Building Co., c/o McCarthy & Kelley, archts. and engrs., 159 Remsen St., will build 4 story, 100 x 140 ft., brick, steel and stone, plain foundation, Ocean Ave., by day labor. M. Bleecher, pres.

N. Y., Brooklyn—Apartment—M. Sarnoff, c/o E. M. Adelsohn, archt. and engr., 1778 Pitkin Ave., 4 story, 50 x 100 ft., brick, steel and stone, plain foundation, Park Pl., by day labor. $200,000.

N. Y., Bronxville — Apartment — Village Investment Co., c/o Bates & How, archts. and engrs., 35 West 38th St., New York City, will build 6 story, brick, steel and stone, plain foundation, here, by day labor. $400,000.

N. Y., Fairport—High School—General contract 2 story and basement, 135 x 166 ft., brick, terra cotta, concrete and steel, to P. G. Hauck, 503 Cox Bldg., Rochester, $158,570. Noted Apr. 19.

N. Y., New York—Apartment—J. Perlbinder, c/o C. Kreymborg, archt. and engr., 2534 Marion Ave., will build 6 story, brick, steel and stone, plain foundation, West 167th St., by day labor. $300,000.

N. Y., New York—Exchange—New York Telephone Co., 15 Dey St., 30 story, brick, steel and concrete, West, Barclay, Washington and Vesey Sts., to Marc Eidlitz & Son, Inc., 42 East 42nd St. Archts. est. $11[illegible]

N. Y., New York—[illegible] St. Corp., 1[illegible] West 42nd St., [illegible] story, 65 x [illegible] ft. brick, steel and stone, plain foundation [illegible] Bros., 130 West 42nd St. Archts. est. $5,000,000.

Pa., Dormont—[illegible]

Pa., Johnstown—[illegible]

Md., Hagerstown—Office, etc.—Western [illegible]

Fla., Miami Beach—[illegible] rein.-con. and tile, plain and [illegible]

Buildings (Continued)

Fla., West Palm Beach — Theatre — C. Kettler, 3½ story, rein.-con. and steel, plain foundation, Narcissus and Myrtle Sts., to H. C. Daniels, West Palm Beach, $200,000.

Ky., Bowling Green—High School—Bd. Educ., 2 story and basement, brick, to Forbes Mfg. Co., Hopkinsville. Est. cost $250,000.

Ind., South Bend—Apartment—Washington & Colfax Realty Co., Palace Theatre Bldg., 2 story and basement, brick and timber, plain foundation, to R. Reisinger & Co., 464 Oakland Ave., Milwaukee. Archts. est. $325,000.

Mich., Sault Ste. Marie—Hospital –Chippewa Co. Memorial Hospital, 3 story and basement, brick and concrete, plain foundation, general contract to Marshall N. Hunt, 651 Bingham St., $105,869. Archts. est. $150,000. Noted May 24.

Ill., Chicago—Bank and Office—Illinois Merchants Trust Co., 112 West Adams St., 21 story, fireproof, Jackson and La Salle Sts., to H. Erickson Co., 139 North Clark St. Archts. est. $5,500,000.

Ill., Chicago—Office—Chicago Tribune, Madison and Dearborn Sts., 20 story, 100 x 300 ft., fireproof, Austin St. and Michigan Ave., to R. C. Wieboldt Co., 1534 West Van Buren St. Archts. est. $7,000,000. Noted Dec. 7.

Ill., Chicago—Store, Office and Bank—Washington Park Natl. Bank, 730 East 63rd St., 4 story, 100 x 122 ft., preproof, Cottage Grove Ave. and 63rd St., to Person Constr. Co., 1546 East 75th St. $300,000.

Wis., Janesville — Theatre—H. T. Jones, 107 North Front St., 2 story, 112 x 144 ft., brick, rein.-con. and steel, plain foundation, South Franklin St., to E. Pautz, 808 Center St. Archts. est. $150,000. Noted May 31.

Wis., La Crosse—Schools—School Bd., 3 story and part basement, 114 x 157 ft., Lincoln Grade School, and 1 and 2 story, 140 x 206 ft. vocational school, brick, tile and concrete, plain foundations, to Grahn & Bathhurst, 638 Plymouth Bldg., Minneapolis, $176,940 and $138,900 respectively. Noted Mar. 1.

Wis., Manitowoc—Hotel—Hotel Manitou 5 story and basement, 52 x 100 ft., L shape, brick, tile and concrete addition, plain foundation, Franklin St., to T. Stark & Co., 130 Muskego Ave., Milwaukee. Archts. est. $150,000.

Wis., Milwaukee—Theatre and Office—Saxe Amusement Enterprises, 204 11th St., 4 story and basement, 125 x 150 ft., brick and concrete, plain foundation, to E. Grether, 1121 2nd St. Archts. est. $400,000. Noted May 17.

Minn., St. Paul—Store and Office—Barrett & Zimmerman, Prior and University Aves., general contract 2 story and basement, 54 x 165 x 180 x 230 ft., brick, concrete and stone, to Carlsted Bros., 542 Builders Exch., Minneapolis. Total cost $150,000. Noted Jan. 25.

Kan., Arkansas City—Store and Office—G. H. Gassman, 801 North 3rd St., will build 5 story and basement, 49 x 100 ft., rein.-con., stone, brick and terra cotta, by day labor. $200,000. T. W. Williamson & Co., 312 Central Natl. Bank Bldg., Topeka, archts. Noted June 7.

Kan., Emporia — Bank and Office — Citizens Natl. Bank, 5 story and basement, 43 x 130 ft., brick and concrete, to Vaughn Constr., W. O. W. Bldg., Omaha, $225,000. Noted May 24.

Kan., Topeka — Office — Trinity Benefit Assn., 3 story and part basement, 100 x 130 ft., rein.-con. and tile, to F. M. Spencer & Son, 10th and Van Buren Sts. Archts. est. $200,000.

Neb., Lincoln—Hospital—City, 4 story and basement, 54 x 264 ft., rein.-con. brick and stone, 7th and Sewell Sts., general contract, to E. Rokahr & Sons, 1743 South 24th St., $218,615. Noted Feb. 8.

N. D., Minot—Hospital—Trinity Lutheran Hospital Assn., general contract 5 story and basement, 38 x 120 ft., rein.-con., brick, tile and stone, to S. Olsen, Minot, $105,000. Noted Apr. 26.

Ark., Pine Bluff — Theatre — Saenger Amusement Co. general contract theatre, to Stewart McGehee Constr. Co., Kahn Bldg., Little Rock, $162,000.

Calif., Glendale—Bank and Office—Security Trust & Savings Bank, 500 South Spring St., Los Angeles, 6 story, brick and steel, Bway., general contract to J. V. Neil Co., I. W. Hellman Bldg., Los Angeles, $230,000. Noted June 7.

Que., Montreal — School — Protestant School Bd., Belmont St., 3 story, Rielle St., general contract to J. Sheaver & Co., St. Patrick St., $228,111; plumbing and heating to J. Tweedle & Co., 163 Lagch St., $60,484.

Ont., North Bay—Office—Temiskaming & Northern Ontario Ry., 3 story and basement, 600 x 100 ft., rein.-con., brick and stone, Regina St., general contract to Hill, Clarke & Francis, New Liskeard. Engrs. est. $150,000. Noted June 7.

Federal Government Work

PROPOSED WORK

N. Y., New York—Nurses' Quarters—U. S. Veterans' Bureau, Arlington Bldg., Wash., D. C., rejected bids construction complete, incl. mechanical equipment, nurses' quarters at U. S. Veterans' Hospital, Bronx, here. Will readvertise. Noted May 24.

Va., Norfolk—Heating Mains—Spec. 4840—Bureau Yards & Docks, Navy Dept., Wash,. D. C., rejected bids heating mains at Navy Yard, here. Noted June 21.

Tex., Ft. Worth—Helium Plant—U. S. Government, Wash., or c/o A. G. Olson, commander U. S. Helium Plant, Decatur Rd., had plans prepared enlarging and improving helium plant, incl. new machinery, here. W. I. Wicks, U. S. Bureau Mines, engr.

Tex., Galveston—Seawall Extension—U. S. Engineer, Galveston, plans 2,850 ft. rein.-con. extension to east end of seawall. L. M. Adams, dist. engr.

Calif., San Diego—Barracks—Spec. 4765—Bureau Yards & Docks, Navy Dept., Wash., D. C., rejected bids barracks buildings at Naval Base, here. Noted June 14.

Calif., San Diego—Roads—Spec. 4766—Bureau Yards & Docks, Navy Dept., Wash., D. C., rejected bids roads, walks, curbs and grading at Naval Operating Base, here. Noted June 7.

Calif., San Diego—Service Extensions—Spec. 4764—Bureau Yards & Docks, Navy Dept., Wash., D. C., rejected bids service extensions to Marine Barracks A-1 and C-2, at Naval Base, here. Noted May 31.

Panama—Towers—Spec. 4858—Bureau Yards & Docks, Navy Dept., Wash., D. C., plans dismantling towers at St. Petersburg, Fla., and re-erecting same here.

BIDS DESIRED

Md., Baltimore—Dredging—July 31, at office U. S. Engineer, dredging in Queenstown Harbor, Md.; adv. this issue.

D. C., Wash.—Intake Chamber, etc.—July 20, at office U. S. Engineer, 250 Old Land Office Bldg., Items a, b and c being intake chamber, cut and cover conduit and tunnel respectively of water supply conduit for Dist. of Columbia; adv. this issue.

Minn., Duluth — Removing Superstructure, etc.—July 3, at office U. S. Engineer, Custom House, removing superstructure and replacing stone riprap, West Breakwater, Upper Entrance Keweenau Waterway, Mich.

Tex., Galveston—Dredging—July 21 at office U. S. Engineer, Galveston, dredging in Texas City Channel; adv. this issue.

Washington—Bridge—July 2, by C. H. Goodwin, ch. engr. U. S. Natl. Park Serv., at office Superintendent of Park, Longmire, 198 ft. steel cable highway span, in Ranier Natl. Park.

California—Bridges—July 3 by C. H. Sweetser, dist. engr., U. S. Bureau Pub. Rds., Mills Bldg., San Francisco, Pine Creek Bridge, three 40 ft. concrete girders and Alviso Creek Bridge, two 40 ft. girders on concrete piers and abutments, in Santa Barbara Co. Noted May 17.

BIDS RECEIVED

R. I., Providence—Dredging—U. S. Engineer, Providence, dredging in Harbor, from Morris & Cummings Dredging Co., 17 State St., New York City, $0.154. Noted May 24.

N. Y., Geneva—Remodeling—Treas. Dept., Wash., D. C., remodeling and enlarging U. S. Post Office, here, from Pearce Bros., Inc., 220 West 42nd St., New York City, $14,958. Noted May 31.

D. C., Wash.—Generators, etc.—Chief of Engineers, U. S. A., 2825 Munitions Bldg., seven 150 kw. and 30 kw. Diesel generating sets complete with auxiliaries, etc., from Pacific Diesel Engine Co., 2896 Glascock St., Oakland, Calif., $125,650.

Ky., Dawson Springs—Recreation Building, etc.—U. S. Veterans' Bureau, Arlington Bldg., Wash., D. C., recreation building and officers' quarters, here, (1) work complete, from J. C. Miller, Campbellsville, (1) $117,000 (2) $2,500 (3) $11,000 (4) $51,000 (180 days). Noted May 18.

Mich., Marquette—Breakwater—U. S. Engineer, Custom House, Duluth, Minn., repairs to breakwater, here, from Tidorocher Co., Detour, $62,379. Noted May 31.

Washington—Road—C. H. Purcell, dist. engr., U. S. Bureau Pub. Rds., Post Office, Portland, Ore., grading and surfacing 2.5 mi. Randle-Yakima Highway, Ranier Natl. Forest Rd., Lewis Co., from Lucich & Co., Seattle, 9,700 cu.yd. rock excav. $1.40, 15,700 cu.yd. earth excav. $0.65, 5,500 cu.yd. surfacing $2.85, 300 cu.yd. maintenance gravel or broken stone $2.70, etc., total $46,380. Noted May 31.

Calif., San Diego—U. S. Engineer Office, Central Bldg., Los Angeles, dredging from United Dredging Co., Central Bldg., Los Angeles, Area D, 75,000 cu.yd. $0.225 and Area E, 430,000 cu.yd. $0.229. Noted May 18.

CONTRACTS AWARDED

R. I., Providence—Dredging—U. S. Engineer, dredging in Duck Island Harbor, Conn., to Columbia Dredging Co., 30 Church St., New York City, $36,800. Noted June 14.

N. Y., New York—Dike—U. S. Engineer, 616 Army Bldg., 3,400 ft. timber dike north of Shooters Island, New York and New Jersey, to Rhodes & Manvel, Inc., 90 West St., $75,786. Noted May 10.

N. J., Lakehurst—Hangar—Spec. 4849—Bureau Yards & Docks, Wash., D. C., balloon hangar here, to Donnell-Zane Co., 233 Bway., New York City, $5,118 (12 days).

Pa., Phila.—Dredging—U. S. Engineer, 815 Witherspoon Bldg., dredging in Delaware River, Phila. Harbor, 201,000 cu.yd. excav., maximum allowable overdepth 84,000 cu.yd., to Amer. Dredging Co., Mariner and Merchant Bldg., $68,340. Noted June 14.

Md., Perryville—Piping—Treas. Dept., Wash., D. C., installing underground steam piping, etc., at U. S. Veterans' Hospital, here, to Enterprise Steam and Hot water Heating Co., 600 North Howard St., Baltimore, Md., $18,625. Noted May 31.

D. C., Wash. — Laboratory — Bureau of Standards, high tension laboratory, to C. A. Hofferberth Constr. Co., Woodward Bldg., $11,340.

Fla., Pensacola—Bulkhead—Spec. 4837—Bureau Yards & Docks, Navy Dept., Wash., D. C., replacing bulkhead at Naval Air Station, to C. H. Turner, 17½ South Palafax St., $31,994 (240 days). Noted June 7.

Mich., Port Huron—Dredging—U. S. Engineer, Detroit, dredging Black River Channel, here, to Port Huron Sulphite & Paper Co., Port Huron, $12,700.

Minn., St. Cloud—Hospital—Spec. 4828—Bureau Yards & Docks, Navy Dept., Wash., D. C., hospital group for U. S. Veterans Hospital, here, to Carter-Halls-Aldinger Co., Ltd., Minneapolis, Minn., Item 6, construction of buildings, pipe tunnels and covered walks, $422,837; H. Kelly & Co., Plymouth Bldg., Minneapolis, plumbing, and drainage, $112,500. Noted June 21.

Panama—Towers — Spec. 4858 — Bureau Yards & Docks, Navy Dept., Wash., D. C., dismantling towers at St. Petersburg, Fla. and erecting same at La Palma, C. Z., to Donnell-Zane Co., 233 Bway., New York City, $2,078. Noted June 7.

Miscellaneous

PROPOSED WORK

Conveyors etc.—Somerville, Mass.—See "Industrial Work."

Car Barns, etc.—Meriden, Conn.—Connecticut Co., 127 Church St., New Haven, plans car barns, etc., brick, plain foundation, Capitol Ave., here. To exceed $150,000. Private plans.

Sea Wall, etc—Greenwood, Miss.—Making plans sea wall left bank Yazoo River, $15,000; also 28,000 lin.ft. single light lamp post system. W. S. Hawkins, engr.

Power Line Extensions, etc.—Lenoir City, Tenn.—Tennessee Electric Power Co., Hamilton Natl. Bank Bldg., Chattanooga, recently purchased plant here and will provide additional service, line extensions, transformers, etc. $25,000.

Automatic Signal System — Kentucky — Louisville & Nashville R.R. Co., 10th St. and Bway., Louisville, plans equipping and installing automatic signal system from Louisville to Nashville, 187 mi. long. $1,000,000. W. H. Courtenay, ch. engr.

Fill—Ohio—See "Streets and Roads."

Stadium—Youngstown, O.—Bd. Educ., 20 West Wood St., rejected bids June 20, 1st

Miscellaneous (Continued)

unit of South High Stadium, consisting of 17 tiers, 398 ft. long, rein.-con. seats. $30,000. New plans will be prepared. Noted Dec. 14.

Transmission Line—Beaver Dam, Wis.—Wisconsin Light Power & Heat Co., Gay Bldg., Madison, plans 10 mi. high voltage transmission line along Beaver Dam Highway. $25,000. Engineer not selected.

Retaining Wall, etc.—Cedar Rapids, Ia.—See "Bridges."

Units, Gates, etc—Marinette, Wis.—Menominee & Marinette Light & Traction Co. having plans prepared for excavation of tail race, additional vertical units and additional flood and sluice gates. Mead & Seastone, Journal Bldg., Madison, engrs.

Power Unit, etc.—Peshtigo, Wis.—North Eastern Power Co., 559 Marshall St., Milwaukee, having plans prepared new 4,000 kva. unit in power plant and strengthening old dam incl. new abutments, gates, etc., here. $50,000. Mead & Seastone, Journal Bldg., Madison, engrs.

Transmission Line—Stockton, Mo.—See "Industrial Works."

Pipe Line, etc.—Corsicana, Tex.—Humble Oil Co., Great Southwestern Life Bldg., Dallas, plans 20 steel storage tanks, each 80,000 gal. capacity, also pipe line. $500,000. Private plans.

Underpass—Ft. Worth, Tex.—City plans underpass on 4th St. under Rock Island R.R. tracks. $75,000. D. L. Lewis, city engr.

Levee — Waxahachie, Tex.—Ellis Co. Levee Dist. 11, plans to reclaim 1,500 acres, levees on North Side of Chambers Creek. $52,000. W. H. Stovall, co. judge.

Electroliers—Fresno, Calif.—Had plans prepared furnishing and installing 155 electroliers with appurtenances in portions of Kerchoff Ave., Huntington Blvd., etc., c.i. and steel standards with single globe and lamp, set on concrete foundations, 2 ft. deep, 2 ft. wide, conduit to be galvanized metal tubing containing wire conductors. To exceed $25,000. W. Stranahan, city engr.

Loading Wharves—Petaluma, Calif.—See "Industrial Works."

River Levee—Sacramento, Calif.—H. G. Denton, city clk., takes bids about July 5, constructing river levee, concrete revetment. To exceed $75,000. A. Givan, city engr.

Piers—San Francisco, Calif.—State Bd. Harbor Comrs., Ferry Bldg., having preliminary plans prepared 3 piers, from 285 ft. to 350 ft. wide and from 1,200 to 1,500 ft. long, with sheds 115 ft. wide. F. G. White, Ferry Bldg., ch. engr.

Subway—San Francisco, Calif.—State Bd. Harbor Comrs., Ferry Bldg., having preliminary plans prepared for subway extending from Ferry Loop with terminals at Merchant and Mission Sts., distance of 2 city blocks. To exceed $25,000. F. G. White, ch. engr.

Power Development—Montreal, Que.—Canadian Paper Board Co., Seigneurs St., plans developing 800 hp., partly water turbines and balance steam driven electric generators, on Lachine Canal. $200,000. Kerry & Chace, Confederation Life Bldg., Toronto, engrs.

Bathing Pool—Hamilton, Ont.—City plans concrete bathing pool with sterilization equipment in Dundurn Park. $25,000. W. L. McFaul, city engr.

Power Development — Bancroft, Ont.—Bancroft Light, Heat & Power Co. plans development of 2,500 hp. at High Falls on Madawaska River, about 50 ft. head. $300,000. Private plans.

Transmission Line — Toronto, Ont.—Hydro Electric Power Comn. of Ontario, 190 University Ave., plans 3½ mi. 110,000 volt steel tower transmission line along waterfront from Humber River to Strachan Ave. $75,000. F. A. Gaby, ch. engr.

BIDS DESIRED

Asphaltic Cement, etc.—New York, N. Y.—July 2, by J. Miller, pres. Manhattan Boro. Municipal Bldg., 600,000 gal. asphaltic cement 15,000 cu.yd. asphalt wearing surface sand and 200,000 wood paving blocks.

Timber—Webb, N. Y.—July 20, by [illegible] Control Comn., at office State Engineer, 158 State St., Albany, purchasing and removing merchantable timber and [illegible] upon state land around shores of [illegible] Reservoir, [illegible] Regulating Dist., at office Water Control [illegible] 158 State St., Albany, clearing [illegible] able timber and timber growth from land around and above existing [illegible] voir, etc., here. [illegible] Black River Regulating Dist., [illegible] issue.

Underground Return Lines—New York, N. Y.—July 2, by Dept. Pub. [illegible] Municipal Bldg., renewing and repairing underground return lines, on Randalls Island. B. S. Coler, comr.

Landing—New Orleans, La.—July 5, by Bd. Port Comrs., 200 New Court Bldg., furnishings and erecting Poland St. landing. Contr. A involves 216 tons structural steel framing for shed (requisition E. D. 13,554); Contr. B 4,550 sq.ft. steel rolling doors (requisition E. D. 13,455).

Power Equipment, etc.—Taylorville, Ill.—July 16, by T. E. Hobson, mayor, and Bd. Aldermen, complete power plant equipment and distribution system; adv. this issue.

Pier—San Diego, Calif.—July 11, by City Council, constructing portion of mole type pier project, incl. concrete wharves, also sides and ends of pier wall. $300,000. F. G. White, Ferry Bldg., San Francisco, engr. Noted Apr. 4.

BIDS RECEIVED

Portland Cement—St. Paul, Minn.—H. W. Austin, city purch. agt., June 18, 253 bbl. Portland cement, for Dept. Pub. Wks., from Corning-Donohue Brick Co., 614 Ryan Bldg.; Minnesota Lime & Cement Co., Marshall Ave. and Albert St.; Speakes Co., Griggs and Fuller Sts.; Stiefel Material Co., 501 Concord St.; St. Paul Builders Material Co., 605 Ryan Bldg., Thompson Yards, Inc., 2694 University Ave., all above bid $2.70 per bbl. without sack, delivered, subject to 2 per cent discount for payment within 10 days. Noted June 14.

Sandstone Blocks—St. Paul, Minn.—H. W. Austin, city purch. agt., 800 sq.yd. sandstone blocks for Dept. Pub. Wks., from Sandstone Quarries Co., 510 Plymouth Bldg., Minneapolis, $2.74 per sq.yd., f.o.b. cars St. Paul. Noted June 14.

CONTRACTS AWARDED

Tower—Hartford, Conn.—Fuller Brush Co., 647 Main St., 4 story tower, brick veneer and steel, to R. G. Bent Co., 183 Ann St., $46,000. Noted May 24.

Paving Blocks—New York, N. Y.—Bd. Purch., Municipal Bldg., creosoted wood paving blocks, to W. J. Fitzgerald, 347 West 45th St., $22,565. Noted June 14.

Subway Changes—New York, N. Y.—Transit Comn., 49 Lafayette St., June 21 making changes in subway structure at Bway. incidental to widening of West 32nd St. and constructing ventilation flue at West 32nd St. and Bway., Routes 4 and 36, Manhattan Boro, from Benedetto & Sanssez, Franklin St., Astoria, $29,500. Noted June 14.

Structural Steel—Louisville, Ky.—Louisville & Nashville R.R. Co., 10th St. and Bway., in market for 150 tons structural steel for bridge work to be done by day labor. $9,000-$10,000. W. H. Courtenay, ch. engr.

Grade Separation—Detroit, Mich.—Grand Trunk Ry., Brush St. Terminal, grade separation on Dequindre St. line from Orleans to Fort Sts., incl. excavation and construction of bridges at intersections of railroad with Jefferson Ave., Larned and Congress Sts., to W. E. Lennane, 2631 Woodward Ave., $341,535. Noted Jan. 18.

Granite, etc.—Detroit, Mich.—To Wisconsin Granite Co., 11 South La Salle St., Chicago, 500,000 granite blocks $106 per M, 10,650 cu.yd. crushed granite f.o.b. Detroit, $4.64 per cu.yd., total $102,416.

Wharf and Dock—Detroit, Mich.—Pub. Lighting Comn., Atwater St., E., rein.-con. wharf and dock, at site of proposed lighting plant, to Grelling Bros. 100 Blk. E. Walnut St., Green Bay, Wis., $417,400. Noted June 7.

Dike, etc. — Biron, (Wisconsin Rapids P. O.), Wis.—[illegible] Water Power & Paper Co., Wisconsin Rapids, 2 mi. dike, 100,000 cu.yd., approximately 10,000 cu.yd. rip rap, 10,000 cu.yd. rock excav., in con- [illegible], to Road [illegible] Wisconsin Rapids.

Athletic Stadium—Madison, Wis.—University of Wisconsin, addition to athletic stadium, rein.-con. and steel, to G. Nelson, [illegible]

Roof—Milwaukee, Wis.—[illegible] bago St., $67,974.

Mechanical Equipment, etc. — Denton, [illegible]

[illegible] Lighting System—Tex., Edgewood [illegible]

Grain Elevator—Ft. Worth, Tex.—Ft. [illegible]

OFFICIAL PROPOSALS

Bids: July 9.

State Highway Work

Trenton, N. J.

Notice is hereby given that sealed bids will be received by the State Highway Commission of New Jersey for the construction of the following:

Route No. 1, Section No. 12, Rahway Avenue, Elizabeth, in the County of Union. Estimated 3,360 cu.yds. of excavation, and 24,550 sq.yds. of sheet asphalt pavement on a 6-in. concrete base.

Bids will be received at the Assembly Chamber, State House, Trenton, New Jersey, on Monday, July 9th, 1923, at 11:00 a.m., Standard Time, and opened and read immediately thereafter.

Route No. 10, Section No. 1C, Bluff Road-Anderson Avenue, in the County of Bergen. Estimated 1,865 cu.yds. of earth excavation, 3,500 cu.yds. of rock excavation, and 6,870 sq.yds. of double line eight-inch (8-in.) reinforced concrete pavement.

Bids will be received at the Assembly Chamber, State House, Trenton, New Jersey, on Monday, July 9th, 1923, at 11:15 a.m., Standard Time, and opened and read immediately thereafter.

Route No. 10, Section No. 2, Broad Avenue-Glenn Road, in the County of Bergen. Estimated 7,476 cu.yds. of excavation, and 17,825 sq.yds. of double line eight-inch (8-in.) reinforced concrete pavement.

Bids will be received at the Assembly Chamber, State House, Trenton, New Jersey, on Monday, July 9th, 1923, at 11:30 a.m., Standard Time, and opened and read immediately thereafter.

Drawing, specifications and form of bid, contract and bond for the proposed work are on file in the office of the State Highway Department, Trenton, New Jersey, and may be inspected by prospective bidders. Plans will be furnished on deposit of Ten Dollars ($10.00) upon application to the State Highway Department, 9th floor, Broad St. Bank Building, Trenton, New Jersey. Bids must be made on the standard proposal forms in the manner designated therein, and as required by the 1922 specifications, same to be enclosed in sealed special addressed envelopes bearing the name and address of bidder and the name and section of the route on the outside, and must be accompanied by a certified check drawn to the order of the Treasurer of the State of New Jersey for not less than ten per cent (10%) of the amount of the bid, provided that the said certificate check shall not be less than $500.00 nor more than $20,000.00 and be delivered at the above place on or before the hour named. Copies of the standard proposal form and special addressed envelopes will be furnished on application. Bids not enclosed in special envelopes will be considered informal and will not be opened.

Each bidder must accompany his bid with a certificate from a surety company duly authorized to do business in this State, stating that such surety company will provide said bidder with a bond in such sum as is required in and in accordance with the provisions of the said specifications, conditioned for the faithful performance of the provisions of the contract and specifications. Each bidder must also accompany his bid with a Statement of Equipment properly filled out.

By order of the State Highway Commission.

A. LEE GROVER,
Chief Clerk.

Bids: July 17 (date extended).

Paving

Pottsville, Pa.

Sealed proposals will be received by the [illegible] July 17, 1923, for paving and improving [illegible] right to [illegible]

[illegible]
City Engineer.

OFFICIAL PROPOSALS

OFFICIAL PROPOSALS

(Continued from page 393)

Bids: August. 7.

Neches River Bridge

Beaumont, Tex.

Sealed proposals addressed to B. B. Johnson, County Judge, Jefferson County for the construction of the proposed Neches River Bridge at Beaumont, Texas, will be received at the office of the County Judge, at Beaumont, until 11 o'clock, A.M., Tuesday, August 7, 1923, and then publicly opened and read.

DESCRIPTION OF WORK TO BE DONE

Furnishing of materials for and construction of a 122 ft. single leaf bascule span with necessary electrical operation devices and gasoline auxiliary; two 150 ft. steel approach trusses; nine 33 ft. concrete girder spans; fivve 35 ft. concrete girder spans and approximately 2,000 ft. of 19 foot span creosoted timber trestle. Foundation of bascule and approach trusses to be concrete piers on timber piling; concrete piles for 33 ft. concrete spans; concrete bents on timber piles for 35 ft. concrete spans, and creosoted timber piles for timber spans.

Bids will be considered as follows: (1) For the entire project if accompanied by a certified or cashiers check for twenty-four thousand dollars ($24,000.00); (2) For steel superstructure if accompanied by certified or cashiers check for eight thousand ($8,000.00) dollars; (3) Concrete substructure for steel superstructure if accompanied by certified or cashiers check for eight thousand ($8,000.00) dollars; (4) For combined concrete and timber spans if accompanied by certified or cashiers check for eight thousand ($8,000.00) dollars. These certified or cashiers checks must be made payable without recourse to the order of B. B. Johnson, County Judge of Jefferson County, as a guarantee that the bidder, if successful will enter into contract and make bond in accordance with requirements of the specifications. The right is reserved by the party of the first part to reject any and all proposals or to waive all technicalities.

Detailed plans and specifications may be seen at the office of A. C. Love, County Engineer, Beaumont, Texas, and at the office of the State Highway Department, Austin, Texas. Copies may be obtained from the County Engineer by payment of $7.50.

Proposals shall be submitted in sealed envelopes and marked "Bids for the construction of the Neches River Bridge at Beaumont, Texas."

All bids receieved will be retained by the County.

Bids: July 20.

Purchase of Merchantable Timber

Albany, N. Y.

Sealed bids for the purchase of the merchantable timber and salable wood upon the lands of the State of New York to be flowed by the enlargement of the Stillwater Reservoir on the Beaver River in the Town of Webb, Herkimer County, N. Y., will be received by the Water Control Comission at its office in the office of the State Engineer, 158 State St., Albany, N. Y., until one o'clock p.m., Standard Time, on the twentieth day of July, 1923; all bids and proposals will be publicly opened and read at the time and place aforesaid.

This contract will include the purchase and removal of the merchantable timber and salable wood upon the State land around the shores of the existing Stillwater Reservoir lying below a contour line approximately 19 feet higher than the crest of the spillway of the existing Stillwater Dam and above the flow line of the existing reservoir. The area to be lumbered includes about 3160 acres of state land.

The land will be divided into two sectipns, designated as Section I and II.

Section I will comprise all the State land to be flowed lying west of the east line of the middle one-third of Township 5, John Brown's Tract, and will contain approximately 1000 acres.

Section II will comprise all the State land to be flowed lying east of the east line of the middle one-third of Township 5, John Brown's Tract and will contain approximately 2160 acres.

Separate bids must be made for each section, but a bidder may bid on either or both sections.

Maps of the reservoir, regulations for lumbering and contract forms may be seen at the office of the Water Control Commission and the Conservation Commission at Albany, N. Y., and at the office of the Board of the Black River Regulating District, Watertown, N. Y. Copies of the maps, forms and regulations may be obtained from the Water Control Commission upon request.

Every bid must be accompanied by a certified check upon a National or New York State Bank payable to the Water Control Commission for five per centum (5%) of the amount of the bid.

The Commission reserves the right to reject any or all bids and to again advertise for further bids.

STATE OF NEW YORK
WATER CONTROL COMMISSION

Bids: August 1st.

Concrete Arch Bridge

Binghamton, N. Y.

Sealed proposals for the construction of a five-span reinforced concrete arch bridge will be received by the Board of Contract and Supply (Orrin J. Pickering, Secretary), Municipal Building, Binghamton, New York, until three o'clock in the afternoon of Wednesday, August 1st, 1923.

The work covers the bridge, its approaches and all appurtenances such as paving, curbing and lighting. The work includes among its items approximately 11,600 cu.yds. of concrete (not including pavement base), 9500 sq.yds. of paving and 310 tons of metal reinforcement. This list of items is not complete but is merely given to indicate the size of the job.

Proposals must be on forms furnished by the City. Plans, specifications and proposal sheets may be secured from the City Engineer until July 25th. Applications for such plans and specifications must be accompanied by $25. in cash or by a certified check for like amount. This deposit will be returned to all who bid on the work and also to all who do not bid but who return the plans and specifications in good order not later than July 30th.

Bidders must examine the site either personally or by an authorized representative at least seven days before the receipt of bids.

Each proposal must be accompanied by a deposit equal in amount to five per cent of the bid in cash or by a certified check for a like amount. The successful bidder will be required to give a surety company bond and to enter into a contract with the City of Binghamton for the performance of the work.

Board of Contract and Supply of the
City of Binghamton, N. Y.
By W. EARL WELLER.
City Engineer.

Bids: July 26.

Hydraulic Dredging

New Orleans, La.

Sealed proposals will be received by the Board of Commissioners of the Port of New Orleans at their office, Suite 200 New Court Building, until 3:00 P.M., Thursday, July 26, 1923, and then publicly opened for hydraulic dredging from 750,000 to 1,500. 000 cubic yards in the Inner Harbor Navigation Canal between the Lock and Louisville and Nashville R.R. Bridge.

A deposit of $1,000.00 in cash or certified check is required with each proposal.

A bond to the amount of fifty per cent (50%) of the sum bid is required with notarial contract.

Specifications and proposal forms are on file in the office of the Supervisor of Purchases, at No. 1 Canal Street, New Orleans, Louisiana. Complete sets will be furnished to prospective bidders on deposit of $10 which will be refunded to depositors who submit proposals or return sets in good condition.

The right is reserved to reject any or all bids and to waive informalities.

J. H. WALSH.
General Manager.

Bids: July 10.

Sewer System and Appurtenances

Essex Junction, Vt.

Sealed proposals, properly endorsed, for building a sewer system and appurtenances in the Village of Essex Junction, Vermont will be received by the Trustees of the Village of Essex Junction at the office of Allen Martin, Village Clerk until two p.m. July 10, 1923. at which time they will be publicly opened and read.

All proposals must be made on the blanks furnished by the Trustees and enclosed in a plain sealed envelope addressed to Village Trustees, Essex Junction, Vt. and endorsed "Proposal for Sewer System."

Each proposal must be accompanied by a certified check for one thousand (1000) dollars, made payable to the Treasurer of the Village of Essex Junction, Vt. The certified checks of the unsuccessful bidders will be promptly returned to them and that of the successful bidder when he has signed the contract and executed the bond.

A bond acceptable to the Trustees for fifty (50) per cent of the lump sum bid will be required of the successful bidder when the contract is signed.

The proposed system calls for approximately six miles of sewers from 6" to 27" in diameter.

Plans and Specifications may be obtained at the office of Allen Martin, Village Clerk, Essex Jct., Vt.

A deposit of ten (10) dollars will be required for each set of plans and specifications, which will be returned if the plans and specifications are returned to the Village Clerk by July 20, 1923.

The Trustees reserve the right to reject any or all bids.

L. A. EVANS.
President.

Bids: July 12.

Bridge

Fort Wayne, Ind.

Notice is hereby given that the Board of County Commissioners of Allen County, Indiana, will receive sealed proposals or bids at the Auditor's office in Allen County, Indiana, until 10 o'clock A. M. on the 12th day of July, 1923, for the erection and construction of a bridge over the Maumee River at Columbia Street, Fort Wayne, Indiana.

Plans and specifications and profiles have been adopted by the Board of Commissioners and are now on file in the office of the County Auditor for the inspection of bidders.

Plans and specifications can be had on application to Orin M. Darling, County Engineer, Fort Wayne, Indiana.

Bids must be accompanied by a good and sufficient bond equal to double the amount of the bid, as required by law and the necessary affidavits required by law in the State of Indiana, in such cases made and provided.

Bonds signed by two or more freeholders and residents of the county, or by a properly authorized and qualified bonding or surety company, will be accepted by the board.

Bidders must submit their proposals, bids and affidavits on blank forms to be furnished by the County Auditor on application.

The Board of Commissioners reserves the right to reject any and all bids.

By order of the County Commissioners of Allen County, Indiana.

A. J. BAKER.
GUST F. HILGEMAN,
T. J. SHEEHAN.
Board of County Commissioners,
Allen County, Indiana.

Attest:
JOHN H. JOHNSON. Auditor.
Allen County, Indiana

Bids: July 5.

Bridge

Freehold, N. J.

Notice is hereby given that sealed bids will be received by the Board of Chosen Freeholders of the County of Monmouth for the construction of Bridge No. Mn-30, Water St., Englishtown, consisting of one 36′ skew span with I beams encased in concrete, a 30′ reinforced concrete roadway, two 6′ sidewalks and concrete abutments on a timber pile foundation, and opened and read in public at the rooms of said board, Court House, Freehold, New Jersey, on July 5th, 1923, at 11:00 a.m., daylight saving time.

Drawings and specifications for the proposed work, prepared by George K. Allen, Jr., County Engineer, have been filed in the office of said Engineer at 60 Broad street, Red Bank, New Jersey, and may be inspected by prospective bidders during business hours. The standard proposal form is attached to the specifications, copies of which will be furnished on application to the Engineer.

Plans and specifications will be furnished to prospective bidders upon payment of ten dollars ($10.00), which amount will be refunded upon return of plans and specifications before the time specified for the opening of bids.

Bids must be made on the standard proposal forms in the manner designated therein and required by the specifications, must be enclosed in sealed envelopes, bearing the name and address of the bidder and name of proposed work on the outside, addressed to the Board of Chosen Freeholders of the County of Monmouth and must be accompanied by a certified check for a sum not less than ten (10) per cent of the amount bid on the work, payable to the order of the County Treasurer and a surety company certificate stating that said surety company will provide the bidder with the required bond, and must be delivered at the place and before the hour above named.

The Board of Chosen Freeholders of the County of Monmouth reserves the right to reject any or all bids if deemed to the best interests of the County so to do.

By order of the Board of Chosen Freeholders of the County of Monmouth.

BRYANT B. NEWCOMB, Director.

ATTEST:
CHARLES E. COLE, Clerk.
Freehold, N. J., June 6th, 1923.

Bids: July 9.

Concrete Pavement

Keyport, N. J.

Notice is hereby given that sealed bids will be received by the Mayor and Borough Council of the Borough of Keyport for the construction of a concrete pavement on Maple Place extending from the concrete State Highway known as Broad St., Westerly to the concrete County Road known as Broadway and opened and read in public at the Borough Hall, Keyport, N. J., on July 9, 1923, at 8 p.m.

Drawings and specifications for the proposed work, prepared by John T. Hopkins, Special Borough Engineer, have been filed in the office of the Borough Clerk, located in the Borough Hall in Keyport, N. J., and may be inspected by prospective bidders during business hours. The standard proposal form is attached to the specifications, copies of which will be furnished on application to the Borough Clerk.

Plans and specifications will be furnished to the prospective bidders on payment of ten dollars ($10.00), which amount will be refunded upon return of plans and specifications before the time specified for the opening of the bids.

Bids must be made on the standard proposal forms in the manner designated therein and required by the specifications, must be enclosed in sealed envelopes, bearing the name and address of the bidder and name of proposed work on the outside, addressed to the Mayor and Borough Council of the Borough of Keyport and must be accompanied by a certified check for a sum not less than ten (10) per cent of the amount bid on the work, payable to the order of the Borough Collector and a surety company certificate stating that said surety company will provide the bidder with the required bond, and must be delivered at the place and before the hour above named.

The Mayor and the Council of the Borough of Keyport reserves the right to reject any or all bids if deemed to the best interests of the Borough so to do.

By order of the Mayor and Council of the Borough of Keyport.

THOS L. [illegible]
Mayor.

Attest
ELSIE OSBORN, Clerk.
Keyport, N. J., June 5, 1923.

Bids: July 18.

Delaware River Bridge

CONTRACT NO. 7
ANCHORAGE CABLE BENTS

Philadelphia, Pa.

Sealed proposals for the construction of the Anchorage Cable Bents of the bridge over the Delaware River connecting the City of Philadelphia, Pa., and the City of Camden, N. J., will be received by the Delaware River Bridge Joint Commission at Room 806 Widener Building, Philadelphia, Pa., until 1:30 o'clock p.m., Eastern Standard Time, July 18, 1923, when they will be publicly opened and read. The contract will be awarded, or all bids rejected, within fourteen days after bids are opened. The right is reserved to reject any or all bids.

The two anchorages on which the anchorage cable bents are to be erected are located in the area bounded by Delaware Avenue, Race, Front and Summer Streets in Philadelphia, and immediately north of Pearl Street and about 472 feet west of Delaware Avenue in Camden. The work will include the furnishing, fabricating, painting and erecting of the steel anchorage cable bents complete as shown in the contract drawings, ready to receive the cables. The work comprises approximately 1,900 tons o steel work, and must be completed within a period of nine months.

Bids must be made upon the blank proposal form, which, together with specifications, bond and contract form, and contract drawings, may be obtained at the office of the Joint Commission, upon deposit of $25.00, which deposit will be refunded upon the receipt of bid or upon the return in good condition of the copies so taken.

Each proposal must be accompanied by a certified check for Twenty-five Thousand Dollars, drawn upon a national or state bank or trust company having an office either in Philadelphia or Camden, and payable to the Delaware River Bridge Joint Commission, and surety's consent must be shown. The bidder or bidders to whom the contract is awarded will be required to give bond in the sum of fifty per cent of the amount of the contract.

DELAWARE RIVER BRIDGE JOINT COMMISSION,
GIFFORD PINCHOT, Chairman,
JOSEPH K. COSTELLO, Secretary.

Bids: July 2.

Dam Construction

Beacon, N. Y.

Sealed proposals will be received by the City Council at its office No. 525 Main Street, Beacon, N. Y. at eight (8) o'clock p.m., Daylight Saving Time, July 2nd, 1923, for the construction of Dam at Melzingah Reservoir, Beacon, N. Y., which proposals will be opened by the Mayor or presiding officer on that day and time or on such subsequent day as the council may adjourn for that purpose.

No proposal shall be considered unless accompanied by the written consent of two sureties, conditioned that if the proposal be accepted, they will execute and deliver a bond with the bidder in a penalty to be fixed by the council conditioned for the construction of the work at the price and upon the terms proposed, according to the plans and specifications therefor, within such reasonable time as the council may [illegible] and [illegible] approval of the Commissioner of Public Works as the specifications shall provide.

[illegible] bidders are requested to visit the site of the proposed work in order to [illegible] as to the scope and [illegible]

[illegible] form of proposal [illegible] Main Street [illegible] of George W. Krieger, Jr., Consulting Engi[illegible]

[illegible]

[illegible] of Public Works.

Bids: July 10

Drainage Ditch a
Improvement

DISTRICT NO. 6

Ottumwa,

In the Matter of the Cedar Creek L age District No. 6, of Wapello Cou Iowa, and Drainage Ditch and impro ment therein:

Notice is hereby given that in pursuance of an order of the Board of Supervisors of Wapello County, Iowa, made on May 17, 1923, sealed bids will be received by the undersigned for said Board up to Two o'clock p.m. on July 10, 1923, at the Court House, Ottumwa, Ia., but not later, for the construction of said Drainage Ditch and improvement in said Drainage District No. 6, of Wapello County, Ia., in accordance with the approved plans, profiles, specifications, and contract in blank form for bids, and bond therefor, on file in my office; said work thereof being described as follows, and having the approximate estimated amount and quantities as specified, but which may be found to be either more or less on final measurement:

The beginning point of said Ditch and Improvement is at E. of CM. & ST. P. R. RY. bridge No. 1-352 in N. W. ¼, S. W. ¼, Sec. 21-Highland Twp. 73-R 13 W. and ending at the E. ¼ Cor. S. E. ¼ Sec. 36-Highland Twp., a distance of 4.47 miles, divided into sections as follows:

Sec. A-1—34,966 cu.yds. Start work on or before Nov. 1, 1924. Completed by Dec. 1, 1924.

Sec. B-2—38,541 cu.yds. Start work on or before Sept. 1, 1924. Completed by Nov. 1, 1924.

Sec. C-3—30,904 cu.yds. Start work on or before Aug. 1, 1924. Completed by Sept. 1, 1924

Sec. D-4—43,822 cu.yds. Start work on or before June 15, 1024. Completed by Aug. 1, 1924.

The estimated quantity of material to be excavated in said entire Ditch is 148,233 cu. yds. of excavation. This work consists in cutting a continuous channel as located, which channel is 10 feet in width at the bottom, and side slopes shall be one foot horizontal to one foot vertical; side slopes shall be left smooth and uniform, and bottom of channel shall be brought to proper grade elevation and left smooth and uniform, and with an approximate depth of 9½ feet; right of way 125 feet in width from place of beginning to CM. & ST. P. Bridge in Sec. 27-73-13 and 150 feet in width from there to the end.

Bids will be submitted for the entire work; and the price must be stated in both words and figures, and permission will not be granted to amend or withdraw any bid after filing with the County Auditor. Maps plans, profiles, specifications, and form for bids, contracts, etc., are on file in my office, and at the office of Brown & Cook, Engineers, Ottumwa, Iowa, and can be examined. The Board will award contract to the lowest responsible bidder therefor; but the right is hereby expressly reserved by said Board to reject any or all bids and to readvertise the letting of said work; and no bid will be considered unless on the approved form for bids furnished by the undersigned.

All bids must be signed with the recognized name of the Contractor or firm who expects to do the work if awarded the contract, and each bid must be accompanied by a certified check of some reputable bank, in the sum equal to ten per cent. of the amount of the bid, (but not to exceed $10,000.00), drawn in favor of the County Auditor of Wapello County, Iowa, as a guarantee [illegible] the bidder will within ten days from the date of notice thereof, enter into said con[illegible] for, or deposit cash, as provided by law in the sum of twenty-five per cent of esti[illegible]

[illegible]

uly 10.

Drainage Ditch and Improvement

DISTRICT NO 4

Ottumwa, Ia.

In the Matter of the Cedar Creek Drainage District No. 4, of Wapello County, Iowa, and Drainage Ditch and improvement therein:

Notice is hereby given that in pursuance of an order of the Board of Supervisors of Wapello County, Iowa, made on May 17th, 1923, sealed bids will be received by the undersigned for said Board up to Two o'clock p.m., on July 10, 1923, at the Court House, Ottumwa, Ia., but not later, for the construction of said Drainage Ditch and improvement in said Drainage District No. 4, of Wapello County, Iowa, in accordance with the approved plans, profiles, specifications, and contract, in blank form for bids, and bond therefor, on file in my office; said work thereof being described as follows, and having the approximate estimated amount and quantities as specified, but which may be found to be either more or less on final measurement:

The beginning point of said Ditch and Improvement is at West ¼ Cor. N. W. ¼ Sec. 31-Competine Twp. 73-r 12 W. and ending in the S. E. ¼ Sec. 13 Pleasant Twp. 72-r. 12 on the Wapello Jefferson County Line, a distance of 7.23 miles divided into sections as follows:

Sec. E-5—42,636 cu.yds. Start work on or before May 1st, 1924. Complete by June 15, 1924.

Sec. F-6—42,129 cu.yds. Start work on or before Mch. 15, 1924. Completed by May 1, 1924.

Sec. G-7—43,643 cu.yds. Start work on or before Feb. 1, 1924. Completed by March 15, 1924.

Sec. H-8—37,654 cu.yds. Start work on or before Dec. 20, 1923. Completed by Feb. 1, 1924.

Sec. I-9—35,204 cu.yds. Start work on or before Nov. 15, 1923. Completed by Dec. 20, 1923.

Sec. J-10—24,258 cu.yds. Start work on or before Oct. 20, 1923. Completed by Nov. 15, 1923.

Sec. K-11—31,310 cu.yds. Start work on or before Sept. 15, 1923. Completed by Oct. 20, 1923.

The estimated quantity of material to be excavated in said entire ditch is 256,834 cu.yds. of excavation. This work consists in cutting a continuous channel as located, which channel is 12 feet in width at the bottom, and side slopes shall be one-half foot horizontal to one foot vertical; side slopes shall be left smooth and uniform, and bottom of channel shall be brought to proper grade elevation and left smooth and uniform ,and with an approximate depth of 10½ feet; right of way 100 feet in width.

Bids will be submitted for the entire work; and the price must be stated in both words and figures, and permission will not be granted to amend or withdraw any bid after filing with the County Auditor. Maps, plans profiles, specifications, and form for bids, contracts, etc., are on file in my office, and at the office of Brown & Cook, Engineers, Ottumwa, Iowa, and can be examined. The Board will award contract to the lowest responsible bidder therefor; but the right is hereby expressly reserved by said Board to reject any or all bids and to readvertise the letting of said work; and no bid will be considered unless on the approved form for bids furnished by the undersigned.

All bids must be signed with the recognized name of the Contractor or firm who expects to do the work if awarded the contract, and each bid must be accompanied by a certified check of some reputable bank, in the sum equal to ten per cent, of the amount of the bid, (but not to exceed $10,000.00), drawn in favor of the County Auditor of Wapello County, Iowa, as a guarantee of good faith in entering on said contract, and if awarded the contract for said work, the bidder will within ten days from the date of notice thereof, enter into said contract therefor and execute said Bond therefor, or deposit cash, as provided by law in the sum of twenty-five per cent of estimated cost of said work so let by such contract. The checks of unsuccessful bidders will be returned to them respectively as soon as award is made. All provisions of present Drainage Laws of Iowa are made a part of all said contracts.

All bids must be sealed and marked on the outside of envelope: **Bid for Contract** on Cedar Creek Drainage Ditch, No. 4, and addressed to Fred W. Prosser, County Auditor, Ottumwa, Wapello County, Iowa. The bids will be opened at Two o'clock p.m., on July 10, 1923, in the office of the Board of Supervisors, in Court House at Ottumwa, Iowa, and the contract, if awarded will be awarded by the said Board as soon as practicable thereafter on said date.

Witness my hand and seal this day of May, 1923.

FRED W. PROSSER,
County Auditor of Wapello Co., Ia.

Bids: July 17.

Water Works, Sewers, Street Improvements

Deland, Fla.

Sealed proposals will be received by the Board of Bond Trustees of the City of Deland, Florida, at the City Hall, for furnishing material and constructing water works improvements, sanitary and storm sewer systems and street improvements in and for the City of Deland, Florida, until 4 p.m., July 17, 1923, at which time they will be opened and read publicly.

The work includes the furnishing of all labor, material machinery and equipment of every kind necessary to construct approximately 95,000 square yards of brick, concrete, or bituminous pavements with necessary curb, gutter and appurtenances, approximately 2½ miles of storm drains 12 to 24 inches with accessories. Approximately 12 miles sanitary sewers 6 to 18 inches with accessories, approximately 8 miles water mains 4 to 10 inches with specials, three pumps, two pump houses, one generator unit and accessories, all complete and in accordance with plans and specifications on file at the office of the Engineers and the City Clerk.

Each bid must be accompanied by a certified check on a bank satisfactory to the Bond Trustees or Bidders Bond acceptable to Bond Trustees for five (5) per cent of the amount of the bid, drawn to the order of the City of Deland, Florida.

A bond in the sum of twenty (25) per cent of the amount of the contract with satisfactory surety executed through Deland, Florida, agency will be required for the faithful performanc of the work.

All bids will be compared on the basis of the Engineers' estimates of amount of work to be done.

Copies of the specifications may be obtained from the Engineers upon receipt of deposit of five ($5.00) dollars which will be returned on bona fide bid. Plans may be seen at the office of the Engineer at Deland or Atlanta, Georgia, or at the City Hall. Copies of plans may be obtained on the payment of twenty-five ($25.00) dollars.

The right is reserved to reject any or all bids.

This 8th day of June, 1923.

CITY OF DELAND, FLORIDA
By E. R. CONRAD,
By G. A. DREKA,
By C. L. ALLEN,
Bond Trustees.
J. B. McCrary Engineering Corporation,
Engineers, Atlanta, Georgia.

Bids: July 5.

Grading, Paving and Curbing

Steelton, Pa.

Sealed proposals will be received by the Town Council of the Borough of Steelton, Dauphin County, Pa., until 4:00 p.m. Thursday, July 5, 1923, for the grading, paving and curbing of South Fourth Street, between the southern side of Highland Street and a point two hundred and thirty two and nine-tenths feet south of the southern side of Dupont Street.

Also that portion of Highland Street, beginning at Second Street on the west, and extending along said street in an easterly direction to Fourth Street.

A certified check for 5 per cent of the amount of the bid, payable to the Treasurer of the Borough of Steelton, must accompany each and every proposal. All proposals must be sealed and addressed to the Borough Secretary, 114 Walnut St., Steelton, Pa., and have the words "Street Improvements" marked on the outside of the envelope.

Plans and specifications may be seen, and bidding blanks and all necessary information be had at the office of the Borough Secretary, 114 Walnut St., Steelton, Pa. Council reserves the right to reject any and all bids.

H. R. RUPP
Borough Secretary.

Bids: July 6.

Sewage Disposal Plant

Grove City, Pa.

Sealed proposals will be received by the Borough of Grove City, Mercer County, Pennsylvania at the Municipal Building until 7:00 p.m. on the 6th day of July 1923 for the construction work and other work incident to the builing of the Grove City Sewage Treatment Plant.

The work consists of the following main parts:

1. Distributing Manhole of Concrete.
2. Settling and Digestion Tanks.
3. Sludge Drying Beds, Glass covered.
4. 525 feet 24" Terra Cotto Pipe.
5. Necessary grading, excavation, etc.
6. Well House for water supply.
7. Other incidental work.

Plans and specifications can be obtained together with proposal sheet from Frank P. Graham, The Borough Engineer or at the office of Banks & Craig, Consulting Engineers, Telegraph Bld'g., Harrisburg, Pa.

A set of plans and specifications can be obtained by placing a deposit of $10.00 drawn to the Borough Engineer, $5.00 of which will be returned if the plans and specifications are returned within 15 days after the award of the contract.

Each bid must be accompanied by a certified check in the amount of $1000.00 payable to the order of the Borough of Grove City as a guarantee that the successful bidder will enter into contract with the Borough within fifteen days after the award of the contract. Checks will be returned to unsuccessful bidders.

The Borough reserves the right to reject any or all bids.

L. L. McKAY,
Secretary.

Bids: July 3.

Alternating Air Lock Siphons

Newton, N. J.

Notice is hereby given that sealed bids will be received by the Water and Sewer Commissioners of the Town of Newton, in the County of Sussex and State of New Jersey for the installation in the East Clinton Street sewage disposal plant, in said town, of a battery of, five (5) twelve inch (12") alternating air lock siphons to draw about two feet. Siphons to discharge into the same discharge lines, as are being used with the present apparatus, after said pipe lines have been relaid to centers as shown on the plans to be furnished by the manufacturer. Alternating siphons to be of the air lock type, with no moving parts, Air connections to be provided with three way valves for cutting out any desired number of beds, the remaining one or more siphons to operate. Siphons to handle intermittently and to discharge the contents of the dosing tank and lock against a twenty-four hour rate of 650,000 gallons.

Masonry work provided by the town, town to set apparatus and furnish and set tile wells.

Said bids will be opened and read in public at the Town Offices, over Howell's Hardware Store, Newton, N. J., July 3rd, 1923, at 6:30 p.m

The commissioners reserve the right to reject any or all bids.

ETHEL B. HARRISON,
Clerk of Board of
Water Commissioners.

Dated June 16, 1923.

Bids: July 17.

Inclosed Channel

Dunkirk, N. Y.

Sealed proposals for the construction of an inclosed channel and accessories for the diversion of Hyde Creek, in the City of Dunkirk, N. Y., will be received until 8 p.m., eastern time, July 17, 1923, and then publicly opened. The right is reserved to reject any or all bids. Plans and specifications are on file and information may be had on application to the undersigned. Specifications will be forwarded to applicants. To insure return of plans a deposit of twenty dollars ($20) is required for plans mailed, which sum will be returned to applicant upon return of plans.

H. J. HENDERSON,
City Clerk.

OFFICIAL PROPOSALS

Bids: July 9.

Bridges

Trenton, N. J.

Notice is hereby given that sealed bids will be received by the State Highway Commission of New Jersey for the following:

Construction of a steel and concrete bridge of two spans, 42 ft. 4 in. C. to C. of bearings and 34 ft. 0 in. wide, including fill approaches Cedar Creek at M. P. 41.1 on State Highway Route No. 4, in the municipality of Berkley and Lacey Townships, and the County of Ocean.

Bids for the above will be received at the Assembly Chamber, State House, Trenton, New Jersey, on Monday, July 9th, 1923, at 11:45 a.m., Standard Time, and opened and read immediately thereafter.

Construction of a reinforced concrete slab bridge of one span, 22 ft. 10 in. between neat lines and 34 ft. 10 in. wide, over Primrose Brook, at M. P. 33.7 on State Highway Route No. 16 in the municipality of Harding Township, in the County of Morris.

Bids for the above will be received at the Assembly Chamber, State House, Trenton, New Jersey, on Monday, July 9th, 1923, at 12:00 noon, Standard Time, and opened and read immediately thereafter.

Drawings, specifications and form of bid, contract and bond for the proposed work are on file in the office of Mr. John L. Vogel, Bridge Engineer, 772 Broad St., Newark, New Jersey, and may be inspected by prospective bidders. Plans will be furnished on a deposit of Ten Dollars ($10.00) upon application to Mr. John L. Vogel, Bridge Engineer, 772 Broad St., Newark, New Jersey. Bids must be made on the standard proposal form in the manner designated therein and as required by the specifications for this work, same to be enclosed in sealed special addressed envelopes, bearing the name and address of the bidder and the work bid upon on outside, and must be accompanied by a certified check drawn to the order of the State Treasurer for not less than ten per cent (10%) of the amount of the bid, provided the said certified check shall not be less than $500.00 nor more than $20,000.00, and be delivered at the above place on or before the hour named. Copies of the standard proposal form and special addressed envelope will be furnished on application to Mr. John L. Vogel, Bridge Engineer, 772 Broad St., Newark, N. J. Bids not enclosed in special envelopes will be considered informal and will not be opened.

Each bidder must accompany his bid with a certificate from a surety company duly authorized to do business in this State, stating that such surety company will provide said bidder with a bond in such sum as is required in and in accordance with the provisions of the said specifications, conditioned for the faithful performance of the provisions of the contract and specifications.

By order of the State Highway Commission.
A. LEE GROVER,
Chief Clerk.

Bids: July 16.

Paving

Plainfield, N. J.

Proposals will be received by the Common Council of the City of Plainfield, N. J. at the City Hall on Monday, July 16, 1923 at 8:30 p.m. (Daylight Saving Time) for Bituminous Macadam, Storm Sewers, etc., as follows:

18,000 sq.yds. Bituminous Macadam.
7,000 lin.ft. Concrete Curb and Gutter
2,200 lin.ft. [illegible] to [illegible] Storm Sewer
Certified check required, $5,000.00

Construction bond required, 100% of cost of work.

Copies of Plans, Specifications and Form of Proposals may be obtained at the office of the City Engineer, City Hall, Plainfield, N. J.

The Common Council reserves the right to reject any or all bids, to waive [illegible] in bids, or to accept any bid.

JOHN J. [illegible]
City Clerk

Bids: July 17.

Sewer Construction

LETTING NO. 9

Louisville, Ky.

Sealed proposals will be received by the Commissioners of Sewerage of Louisville until 12 o'clock noon July 17th, 1923, for the following sewer constuction in Louisville, Ky.

This letting embraces the following:

Napoleon Boulevard Sewer and Drain and Speed Ave. Laterals "South"

870 lin.ft. of 36" and 640 lin.ft. of 33" Drain.

990 lin.ft. of 21", 505 lin.ft. of 18", 2220 lin.ft. of 15", Vitrified Pipe Drain, 1725 lin.ft. of 12" Vitrified pipe Sewer and Drain, 3970 lin.ft. of 8" Vitrified Pipe Sewer.

Alternate bids invited on constructing 33" and 36" drain of Segment Block, Vitrified Pipe or Monolithic Concrete.

The estimated cost of this work is somewhat over $100.000.

Drawings, form of proposal, contract and specifications may be had at the office of the Commission upon the deposit of ten dollars ($10.00) to secure the return of same in good condition within thirty days.

Each proposal must be inclosed in a sealed envelope addressed to the Commissioners of Sewerage, 417 West Main Street, Louisville, Ky. and accompanied by a certified check drawn upon a state or national bank or a trust company established in the City of Louisville or the city of New York, for an amount not less than seven (7) per cent of the total amount of the accompanying proposal, payable to the Commissioners of Sewerage of Louisville or the bond executed as set forth in the information for bidders.

The right to reject any and all bids is reserved.

COMMISSIONERS OF SEWERAGE
OF LOUISVILLE.
By: MATT H. CRAWFORD,
Chairman.
J. B. F. BREED,
Chief Engineer,
P. H. HOGE, Jr.,
Sec. & Treas.

Bids: July 25.

Bridge

Bridgeport, Conn.

Sealed bids for performing the work of constructing the East Washington Avenue Bridge will be received by the East Washington Avenue Bridge Commission in the Common Council Chamber, City Hall, Bridgeport, Conn., until July 25, 1923, at 3:00 p.m. (Standard Time), at which place and time they will be publicly opened by the Commission and read. The award of the contract, if awarded, will be made by the Commission as soon thereafter as practicable.

For further information apply to City Engineer James A. McElroy.

A charge of Fifty Dollars ($50.00) will be made for copy of specifications and plans, same to be refunded on receipt of bids or return of plans.

The Commission reserves the right to reject any or all bids.

EAST WASHINGTON AVENUE
BRIDGE COMMISSION
FRANCIS P. DUNIGAN, Clerk

Bids: July 9.

Paving

Richmond, Va.

Sealed proposals will be received at this office until 12 o'clock noon, July 9, 1923, for [illegible] Vitrified Brick or Sheet Asphalt as set forth in the [illegible] will be required to [illegible] of a bona fide [illegible] of proposals can be [illegible]

A certified check for amount stated [illegible] each [illegible] reserved the [illegible]

[illegible]
[illegible] of Public Works

Bids: July 24.

Bridges and Roads

Charleston, W. Va.

Sealed proposals will be received by the State Road Commission of West Virginia at its office in Charleston, W. Va. until ten o'clock a.m. on the 24th day of July, 1923, and opened and read immediately thereafter at the Kanawha County Court House, Charleston, West Virginia, for the construction of the following bridges and sections of state road:

Projects 3151-C and 48—Boone County—2 miles of the Madison-Danville road for grading, draining and paving with Bituminous Macadam. Certified check $2400.00.

Projects 3261 and 50—Clay County—1.9 miles, South end Clay Court House & Two Mile Run for grading, draining and paving with Bituminous Macadam including additional width to be built by town together with sewers to be installed by town. Certified check $3000.00.

..Project 3138—Mason County—Five Mile

Project 3138—Mason County—Five Mile span and Three Mile Bridge No. 858 Concrete Deck Girder 35 ft. span, to be let in one contract. Certified check $1100.00.

Project 3176—Brooke County—0.8 mile of the River Road for paving with cement concrete. Certified check $2000.00.

Project 3114 B & D—Brooke County—1 mile of the River Road for paving with cement concrete. Certified check $1600.00.

Project 3253—Hancock County—3 miles of the River Road from Brooke County line to Kings Creek Bridge for paving with brick. Certified check $3000.00.

Project 3089—Hancock County—1 mile of the River Road for paving with brick. Certified check $1600.00.

Project 3252-A—Pleasants County—1.2 miles of the St. Marys-Ellenboro road for grading and cement concrete paving. Certified check $1500.00.

Project 3197-B—Tyler County—1.5 miles of the Sistersville-Middlebourne Road for grading, draining and paving with waterbound macadam. Certified check $1500.00.

Project 3186—Preston County—5 miles of the Thomas-Gnegy Church road for grading, draining and paving with Cement Concrete. Certified check $9000.00.

Project 3013—Hardy County—5.8 miles of the Oldfields-Hampshire County Line road for completion of the grading, draining and paving with waterbound macadam. Certified check $6000.00.

Project 2064—Ohio County—Springdale Culvert 8 x 10 concrete arch. Certified check $500.00.

Project 3237—Mason County—3.5 miles Lewis District toward Leon Road, for grading and draining. Certified check $2,000.00.

Proposals will be received only upon State Standard forms in accordance with plans, specifications and estimates of quantities therefor, which standard forms, plans, specifications and estimates of quantities may be obtained from the office of the Division Engineer in whose territory the proposed construction is located or from the office of the State Road Commission at Charleston, W. Va.

Each proposal must be accompanied by a certified check for the amount noted.

The right is reserved to reject any and all proposals.

THE STATE ROAD COMMISSION
OF WEST VIRGINIA
E. B. [illegible], Secretary

Bids: July 9.

Street Improvement

Laurel, Miss.

Sealed proposals will be received by the Mayor and Board of [illegible] of the City of Laurel, Mississippi, at the office of the City Clerk of said City, up until two o'clock p.m. on the 9th day of July, A. D. 1923, for constructing approximately:

[illegible] curb and gutter.
[illegible] concrete sidewalk.
[illegible] sewer.
[illegible] concrete paving.
[illegible]

[illegible] and specifications [illegible] may be obtained [illegible] of the City Clerk of the [illegible]

[illegible] Street Commissioner.

CONTRACT BONDS FOR RESPONSIBLE CONTRACTORS

The fact that the Aetna has bonded him may enable a contractor to obtain bank loans and credit from supply companies

ÆTNA CASUALTY AND SURETY COMPANY

HARTFORD, CONN.

AGENTS EVERYWHERE

OFFICIAL PROPOSALS

Bids: July 20.

Clearing Land of Unmerchantable Timber

Watertown, N. Y.

Sealed bids for clearing the lands to be flowed by the Enlargement of the Stillwater Reservoir on the Beaver River in the Town of Webb, Herkimer County, N. Y., will be received by the Board of the Black River Regulating District at the office of the Water Control Commission, Room 1000, 158 State Street, Albany, N. Y. until one o'clock p.m., Standard Time, on the 20th day of July, 1923; all bids will be publicly opened and read at the time and place aforesaid.

The work to be done consists of the clearing of the unmerchantable timber and timber growth from the land around and above the existing Stillwater Reservoir and within a contour line approximately 19 feet higher than the crest of the spillway of the existing Stillwater Dam. The area to be cleared will include about 3960 acres of land, which will be divided into two sections. Section No. 1 will include about 1400 acres and Section No. 2 about 2560 acres. Any bidder may bid upon the clearing of either one or both sections, and he may also make a separate contingent bid upon either one or both sections, which bid will be contingent upon the acceptance by the Water Control Commission of his bid for the timber upon the state land in such section or sections.

Maps of the reservoir, bidding and contract forms and specifications may be seen at the office of the Board, Watertown, N. Y., and also at the offices of the Water Control Commission and the Conservation Commission at Albany, N. Y. Copies of the maps, forms and specifications may be obtained from the Board on payment of two dollars ($2.00) which will be refunded on their return in good condition within seven days after bids are opened.

All bids must be accompanied by a certified check upon a National or State bank or trust company for five per centum (5%) of the amount of the bid and payable to the order of the Board of the Black River Regulating District.

The Board reserves the right to reject any or all bids and to again advertise for further bids.

BOARD OF THE BLACK RIVER
REGULATING DISTRICT.
By E. S. Cullings,
Secretary.

Bids: July 2.

Paving

Gardner, Mass.

Sealed proposals will be received by the undersigned until 11:00 a.m. on July 2, 1923 for the construction of approximately 4,000 sq.yds. of reinforced concrete paving at Gardner, Mass., under specifications on file in my office.

The right is reserved to reject any or all bids.

F. W. PROCTOR.
Supt. of Street,
Gardner, Mass.

Largest Circulation of Any Technical Paper

Engineering News-Record's circulation—over 30,000 weekly—is the largest of any technical paper printed. It includes among its readers practically every worthwhile contractor dealer, and manufacturer in the country who is interested in bidding on public works contracts—either local or outside of his immediate vicinity.

For Additional Proposals see pages 393, 60, 61, 62 and 63

U. S. GOVERNMENT

U. S. ENGR. OFFICE, WILMINGTON, DEL. — Sealed proposals will be received here until 11 A.M., standard time, June 30, 1923, and then opened, for constructing and delivering one steel hull for quarter boat. Further information on application.

U. S. ENGINEER OFFICE, WILMINGTON, DEL. Sealed proposals will be received here until 11 a.m., standard time, July 9, 1923, and then opened, for dredging Maurice and Cohansey Rivers, N. J. Further information on application.

U. S. ENGINEER OFFICE, Galveston, Texas. Sealed proposals will be received here until 12 M., July 20, 1923, and then opened, for dredging Houston Ship Channel, Texas. Further information on application.

U. S. ENGINEER OFFICE, P. O. Box 72, Louisville, Ky.—Sealed proposals will be received here until 2 p.m., central time, July 16, 1923, and then opened, for furnishing and delivering six steel dump scows. Further information on application.

U. S. ENGINEER OFFICE, 250 Old Land Office Building, Washington, D. C. Sealed proposals will be received here until 12 m., July 20, 1923, and then opened for the construction of items a, b and c, being intake chamber, cut and cover conduit, and tunnel, respectively, of the water supply conduit for the District of Columbia. Further information on application.

SEALED PROPOSALS will be received at the U. S. Engineer Office, 329 Custom House, New Orleans, La., until 9 a.m., July 19, 1923, and then opened for dredging in the Calcasieu-Sabine section of the Intracoastal Waterway. Further information on application.

U. S. ENGINEERS OFFICE, BALTIMORE, MD.—Sealed proposals will be received here until 1 P.M., Eastern Standard Time, July 31, 1923, and then opened, for dredging in Queenstown Harbor, Md. Further information on application .

PROPOSALS FOR ONE BELT CONVEYOR.—Office, Mississippi River Commission, First and Second District, 1006 McCall Building. Memphis, Tenn. — Sealed proposals will be received here until 11 a.m., July 10, 1923, and then opened, for furnishing and delivering one (1) Belt Conveyor. Further information on application.

UNITED STATES ENGINEER OFFICE, ST. PAUL, MINN.—Sealed Proposals will be received here until 2:00 p.m. July 31, 1923, and then opened, for constructing and delivering a steel derrick boat. Further information on application.

SEALED PROPOSALS FOR CONSTRUCTING, DELIVERING AND ERECTING TWO STEEL OIL TANKS. Office, District Engineer, Mississippi River Dredging District, Post Office Box 1017, Memphis, Tenn. Sealed proposals for constructing, delivering and erecting two steel fuel oil storage tanks at U. S. Dredge Depot, will be received here until 9:30 a.m., July 19, 1923, and then opened. Further information on application.

PROPOSALS FOR FOURTEEN STEEL BARGES.—Office, Mississippi River Commission, First and Second Districts, Room 1006 McCall Bldg., Memphis, Tenn.—Sealed proposals will be received here until 11 a.m., July 18, 1923, and then opened, for furnishing 14 steel barges. Further information on application.

PROPOSALS FOR DERRICK BOAT.—Office, Mississippi River Commission, First and Second Districts, Room 1006 McCall Bldg., Memphis, Tenn.—Sealed proposals will be received here until 11 a.m., July 19, 1923, and then opened, for furnishing one 25-ton steel derrick boat, complete. Further information on application.

U. S. ENGINEER OFFICE, GALVESTON, TEXAS.—Sealed proposals will be received here until 12 m., July 21, 1923, and then opened, for dredging in Texas City Channel, Texas. Further information on application.

POSITIONS VACANT

APPLICATIONS desired from field engineer and from carpenter foreman for opening on large reinforced concrete bridge job in Pennsylvania. Write full details of education, experience, salary expected, references, etc. P-461, Eng. News-Record, Leader-News Bldg., Cleveland, Ohio.

CIVIL ENGINEER competent to survey municipal engineering problems and to write and speak clearly. Valuable association with staff of specialists in civic agency dealing with all phases of municipal government. Salary about $3600. Bureau of Municipal Research, 1417 Sansom Street, Philadelphia.

COMPRESSED AIR—Experienced inspectors wanted on masonry tunnel construction under high air pressure. Apply in person. Passaic Valley Sewerage Commissioners, 24 Branford Place, Newark, N. J.

CONSTRUCTION superintendent wanted to take charge of building large hydro electric development. Must be fully experienced on this class of work. Only high class men need apply. Reply will be considered confidential. P-453, Eng. News-Record, Real Estate Trust Bldg., Philadelphia, Pa.

DEPARTMENTAL manager wanted for company manufacturing steel products for fireproof buildings. Only engineer of excellent organizing and selling qualifications need apply, stating salary expected, experience, etc. P-474, Engineering News-Record, Leader-News Bldg., Cleveland, Ohio.

DRAFTSMAN—Structural steel for railroad office in New York City. Graduate engineer with two to five years' experience on details steel bridges preferred. Give full details with reply as to nationality, age, education, experience and salary wanted. P-332, Eng. News-Record, 10th Ave. at 36th St., New York.

DRAFTSMAN having not less than three years' experience in bridge work at modern fabricating plant. Must be technical college graduate. Applicants please give age, education, full synopsis of experience and salary desired. The Strauss Bascule Bridge Co., 225 N. Michigan Ave., Chicago, Ill.

DRAFTSMAN WANTED preferably mechanical engineer with extensive experience on paper machine design. Reply giving age, education, experience, salary. P-439, Eng. News-Record, 10th Ave. at 36th St., New York.

DRAFTSMAN (Electrical) and designer-draftsman wanted for the Panama Canal—Both should be graduates of technical engineering school with practical experience in drafting room. Electrical draftsman should be experienced in underground cable and duct layouts and records; in laying out electric lighting of buildings and in the application of electric power for general and miscellaneous industrial purposes. Designer-draftsman must be qualified for service in laying out reserve generating station, remodeling transformer substation and incidental drafting. Applicants must be American citizens (final papers) under 45 years, in good health. Free steamship transportation from New York or New Orleans, salary beginning date of sailing. No civil service examination required. For further particulars write "Chief of Office, The Panama Canal, Washington, D. C.," stating minimum salary would consider.

DRAFTSMAN wanted; experienced in structural and mechanical design in connection with industrial plants, experience in cement industry, desirable but not essential. In replying, give age, experience, salary expected. P-445, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

DRAFTSMEN—Structural steel draftsmen for factory and office buildings, coal bins, etc., must have at least three years detailing experience on this class of work, and good record and references. State education, salary expected and date able to report. Bridge Dept., Canadian Allis-Chalmers, Ltd., Toronto. Permanent positions to satisfactory men.

DRAFTSMEN experienced in detailing and checking structural steel work. State age, education, experience and salary expected. Lakeside Bridge & Steel Co., North Milwaukee, Wis.

POSITIONS VACANT

DRAFTSMAN wanted. Young man with experience on structural steel work detailing and estimating. Good opportunity for a varied experience on all classes and types of steel work. Apply by letter stating experience and salary desired. Bergen Point Iron Works, Bayonne, N. J.

ENGINEERING DRAFTSMAN wanted; 10 positions in middle west open to men experienced in power plant design. Experience in the following, necessary; piping, power equipment, electrical and structural layout—good wages and good working conditions. Write qualifications and for appointment to P-437, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

ENGINEER-FOREMAN: The construction department of a public utility in Eastern Pennsylvania has an opening for an engineer thoroughly experienced on underground distributing systems who is capable of handling field engineering and directing construction. Give age, education, details of experience, references, salary required and enclose small photograph with first letter. P-475, Eng. News-Record, Real Estate Trust Bldg., Philadelphia, Pa.

EXPERIENCED structural detailers wanted; single men preferred; application should give telegraphic address, state experience and accompany sample drawing of work, state salary desired, address Box 654, Havana, Cuba.

EXPERIENCED structural steel fabricating shop foreman wanted for layout, punching, fitting, and riveting departments. Good chance for advancement. Experienced men only need apply. State experience and references. P-463, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

GENERAL superintendent of construction industrial plant. Must be capable of handling all details of reinforced concrete and structural steel. Located in Louisiana. P-466, Eng. News-Record, Old Colony Bldg., Chicago, Ill

WANTED

Steel Mill Draftsmen

State experience and salary expected in first letter or apply personally at

JONES & LAUGHLIN STEEL CORP.
Aliquippa Works, Woodlawn, Pa.

Here is an opportunity for a man who wishes to come to, or return to, Minnesota.

We have an opening for one experienced structural steel shop detail checker who would also be a squad boss. He should be familiar with steel and iron stairways. The man who qualifies would be certain of a permanent position. Men without the required experience should not apply. Write, stating age, experience and salary expected, to Mr. Goetz, care of St. Paul Foundry Company, St. Paul, Minnesota.

POSITIONS VACANT

OPERATOR wanted for gravity swing clamshell dredge for work on the Hudson River. State salary and reference in first letter. Thomas Smee, Box 182, Tottenville, Staten Island, N. Y.

OPERATOR wanted for Keystone Excavator in North Bennington, Vermont, 3 months' work. Address at once to Long & Montagna, North Bennington, Vt.

OPERATOR wanted for small tunnel shovel; blacksmith for drill steel with Leyner Sharpener experience; also Tunnel Muck foreman, mechanics, pipefitters, riggers and handy men. Apply in person on job at Readsboro, Vermont or at New York Office, 52 Vanderbilt Ave., Mason & Hanger Co.

REINFORCED concrete designer and detailer on building work; unmarried technical graduate preferred; two to four years' experience; state age, experience, and salary expected; location, Middle West. P-426, Eng. News-Record, 10th Ave. at 36th St., New York.

STEAM shovel operator wanted for quarry work, location New Jersey; competent man used to handling rock; permanent position for the right party; in replying state age, married or single, salary expected and whether able to furnish references. P-479, Eng. News-Record, 10th Ave. at 36th St., New York.

STEEL freight car draftsmen wanted particularly detailers and a few checkers. Apply to Steel Car Engineer, Bethlehem Steel Co., Bethlehem, Pa.

STRUCTURAL draftsmen and detailers for work on subway construction in New York City; four to nine months' employment, with probable permanency; entrance salary $1,801 per annum, with opportunity for advancement; open to citizens with two years' experience or one year after technical graduation. Reply Chief Clerk, Transit Commission, 49 Lafayette St., New York City.

STRUCTURAL engineers wanted for designing structural steel factory and mill buildings; also for designing reinforced concrete buildings; state experience in full detail and salary expected. P-165, Eng. News-Record, Leader-News Bldg., Cleveland, Ohio.

STRUCTURAL steel detailers for building work. Apply, stating particulars The Berlin Construction Co., Inc., Berlin, Conn.

STRUCTURAL draftsman who can layout and direct detailing of structural steel for buildings. State age, education, experience, nationality, least salary to start, and how soon available. The James H. Tower Iron Works, Providence, R. I.

SUPERINTENDENT of quarrying, crushing and screening plant, thoroughly experienced handling large scale operation including steam shovels. P-462, Eng. News-Record, Leader-News Bldg., Cleveland, Ohio.

THREE chiefs of party for railway pre-[illegible] mountain [illegible] United States [illegible] experience to well qualify him to fill position and his [illegible] be supported by [illegible] None other need apply. P-468, Engineering News-Record, Real Estate Trust Bldg., Philadelphia, Pa.

[illegible] chief of party on river survey. Salary $185 per month and expenses in the field. Address [illegible]

POSITIONS VACANT

YOUNG man wanted who is looking for a future; chance for the right man to learn the quarry, and crushing business thoroughly; college man or machinist preferred; good salary to start; plant located in New Jersey. P-467, Eng. News-Record, 10th Ave. at 36th St., New York.

EMPLOYMENT AGENCIES

EXECUTIVES, engineers, sales engineers and draftsmen wanted. We have a constant flow of inquiries for experienced and qualified men from all sections of the country. Write fully; no advance charges. H. H. Harrison & Co., Confidential Employment Service, 19 S. La Salle St., Chicago.

APPLICATION FORMS

FIRST impressions are important. Snappy, business-like applications for positions help greatly. Dollar brings prize-winner model form. Specify sales, engineering, clerical. Application Service Co., 766 W. Market St., York, Pa.

POSITIONS WANTED

Civil Engineers

ASSISTANT Professor in large Western University desires position in Civil Engineering Department of Eastern School. Seven years' teaching experience. PW-366, Engineering News-Record, Old Colony Bldg., Chicago, Ill.

CIVIL engineer, competent and responsible, graduate of M.I.T., with four years' experience bridge, paving and building construction, desires connection with reliable architectural, engineering or contracting firm, with opportunity for a future; employed at present as inspecting and testing engineer on $5,000,000 building project; married; references. PW-416, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

CIVIL ENGINEER—College graduate, 35, desires responsible permanent position in office, field or preferably with industrial concern. Fifteen years' experience, heavy construction, reinforced concrete, dams, bridges, sewers, sewerage disposal, water works, water filtration, estimating, steel erection and design and highways. In charge large contracts as superintendent and engineer. Can furnish A-1 references. PW-444, Eng. News-Record, 10th Ave. at 36th St., New York.

CIVIL engineer [illegible] years of age with seven years' experience in highways and pavements design and construction, water works and sewerage design and construction and general municipal engineering, desires connection with Construction Company or Municipality in Central Western or Southern states. Thoroughly familiar with Commission-Manager form of government. Available on one month's notice. PW-[illegible], Eng. News-Record, 10th Ave. at 36th St., New York.

CIVIL engineer, 34, Cornell man, associate member American Society Civil Engineers, energetic, wants position of responsibility with future; especially experienced foundations and structural steel construction; some experience roads, [illegible] stands elements cost keeping and analysis [illegible] terial. PW-435, Eng. News-Record, 10th Ave. at 36th St., New York.

[illegible]

INTERSTATE SERVICE

[illegible] Draftsmen, Estimators, Engineers, Salesmen and Executives [illegible]

INTERSTATE BUSINESS EXCHANGE
[illegible]

HIGHER ENGINEERING (*By Mail*)

Thousands of technical graduates [illegible] EXPERIENCE [illegible] no time lost in elementary work [illegible] discriminating [illegible] FREE

Write TODAY [illegible]

Structural Steel Designing
Reinforced Concrete [illegible]
Concrete [illegible]
BRIDGES [illegible]

Required to enroll, technical [illegible]

WILSON ENGINEERING CORPORATION
10 Broadway, Haverhill, Mass.

POSITIONS WANTED

CIVIL ENGINEER, graduate, age 31, married; 9 years' experience same company as draftsman and field engineer in responsible charge of work on construction of by product coke oven plants, including tar and benzol plants and two years' coal and ore mining desires to make permanent change. Available on notice. PW-438, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

CIVIL engineer; graduate of leading midwest University, age 28, 5 years' experience with general contractor, field and office, last three years as estimator and purchaser, can take charge of construction cost keeping, desires position with growing construction company looking for results. Available on short notice PW-470, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

CIVIL engineer, graduate, age 34, 8 years' experience in construction of dams, canals, wharves, roads, retaining walls, bridges, railroads, buildings, sewer and water system; 1½ years on surveys of properties topographic and hydrographic; 1 year draughting, structural concrete topographic. Salary $250. Available now. PW-478, Eng. News-Record, 10th Ave. at 36th St., New York.

CIVIL engineer, degree, 34, married, desires permanent position. Nine years' railroad and municipal experience. Salary $24. Personal interview in New York state. Teaching considered. Available now. PW-481, Eng. News-Record, 10th Ave. at 36th St., New York.

CIVIL and hydraulic engineer, B.S., 1907, C.E., 1912, Assoc. M. Am. Soc. C. E., age 39, married. Experienced in irrigation reconnoisance to operation; especially in stream-flow measurements and runoff data. G. H. Ellis, U. S. G. S., Helena, Montana.

TRANSITMAN, age 23; 5 years' experience on sewer, water works and road construction wishes position on same. Location immaterial, available immediately. Minimum salary $160 per month. PW-483, Eng. News-Record, 10th Ave. at 36th St., New York.

Drafting and Designing

LADY, experienced in drafting room, desires position. Location anywhere; salary moderate. Address PW-459, Engineering News-Record, Old Colony Bldg., Chicago, Ill.

STRUCTURAL draftsman, American, 22, desires outside work with contractor or construction Co. Location immaterial. PW-471, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

STRUCTURAL draftsman designer. A-1 detailer and checker. Long experience on all kinds of steel structures. First class references. PW-455, Eng. News-Record, 10th Ave. at 36th St., New York.

Bridge & Structural

BRIDGE engineer of important railroad company wishes to change location. PW-417, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

BRIDGES and building, 10 years' experience direct supervision bridge and building construction, design, estimates and appraisal. Experience involved construction of deep foundations under heavy traffic, building of derricks, derrick cars, pile drivers, timber trestles, deep turbine foundations including installation of turbines, machine foundations, steel and concrete bridges, retaining walls and timber and brick power house and shop buildings. Age 35, married assoc. mem. Amer. Soc. Civil Engineers, American Railway Bridge and Building Association. Salary $4,000. PW-482, Eng. News-Record, Leader-News Bldg., Cleveland, Ohio.

STRUCTURAL and ornamental iron; 20 years' experience, engineer, designer, estimator, shop drawings. Capable to take charge and push jobs to completion. PW-452, Eng. News-Record, 10th Ave. at 36th St., New York.

STRUCTURAL steel engineer, technical graduate, 17 years' experience with steel fabricators, contractors, and architects; detailing, estimating, designing, contracting. Qualified for positions as chief engineer medium-sized fabricating plant, or assistant chief engineer, contracting engineer, or engineer with fabricators, contractors, or architects. Competent, hard working, A1 man. PW-469, Eng. News-Record, Leader-News Building, Cleveland, Ohio.

POSITIONS WANTED

STRUCTURAL engineer; American Protestant, 29, married, college. Seven years' experience structural estimating, design, details, measurement, surveys. Would like permanent position with consulting engineer or general contractor, with chance to generalize. Prefer New England district. PW-465, Eng. News-Record, 10th Ave. at 36th St., New York.

Estimators

ESTIMATOR, chief. Graduate C. E. Pricing all types of buildings and general construction, including sub trades. Also construction, costs and purchasing. PW-473, Eng. News-Record, 10th Ave. at 36th St., New York.

EXPERT estimator who can make neat, accurate and reliable estimates for all classes of building construction seeks connection with builder or construction firm. Age, 42. Active, good appearance and selling ability, backed up with 12 years experience as estimator and chief estimator for prominent New England builders and 8 years service as architectural draftsman for reputable architects. Available July 1st for New England territory only. PW-456, Eng. News-Record, 10th Ave. at 36th St., New York.

Surveying

HIGH school graduate with knowledge of trigonometry and surveying desires position with engineering or surveying firm. New York or vicinity. PW-495, Eng. News-Record, 10th Ave. at 36th St., New York.

INSTRUMENTMAN wants permanent position. Married, 30, three years' experience road work and general surveying. PW-905, 10th Ave. at 36th St., New York.

TRANSIT-MAN wants permanent position. Age, 27. Five years general surveying, drafting, and foreman on small construction jobs. Have a fair knowledge of hydraulic work and foundations. Have handled various kinds of labor. Can get results. PW-457, Eng. News-Record, Real Estate Trust Bldg.. Philadelphia, Pa.

Superintendents

BUILDING construction superintendent accustomed to handling large operations profitably open for a position with contractor or architectural firm. Experience covers all kinds of buildings in various parts of United States. Salary $90 per week. PW-458, Eng. News-Record, 10th Ave. at 36th St.. New York.

ENGINEER and superintendent, age 38, married, C. E. graduate, 15 years' responsible charge design and construction, reinforced concrete foundations, buildings, power plants, etc., desires permanent, responsible position with industrial concern or contractor. Location immaterial. PW-364, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

ENGINEER superintendent now employed would connect with good reliable company immediately; has handled big forces and built grain-elevators, paper mills, steel mills, bridges, and power houses; also office and industrial buildings. Age, 40, health excellent. Familiar with working conditions in East, South, West and Middle West, also Canada and Mexico. Can produce results and demands salary according. PW-464, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

Contract Manager, Executive, General Superintendent Estimator

I have filled all the above positions in two large construction companies. Graduate in Civil Engineering, 34 years of age, married I know the building construction business from 14 years work in it in all capacities Employed, and a director in the firm with which I am connected. Present salary $6000.00 Open for a proposition with construction company or supply house where results count in settling the remuneration.

PW 371, Engineering News-Record
10th Ave. at 36th St., New York City

POSITIONS WANTED

ENGINEER-SUPERINTENDENT — Extensive highway construction experience, also R.R. Municipal and concrete. Licensed. PW-485, Eng. News-Record, 10th Ave. at 36th St., New York.

SUPERINTENDENT of construction, 25 years' practical experience all kinds of buildings desires position in New Jersey or New York. Responsible and well recommended. PW-490, Eng. News-Record, 10th Ave. at 36th St., New York.

SUPERINTENDENT, 18 years' experience on building construction, foundations, pile driving, coffer dams, bridges, water lines, all classes reinforced concrete. PW-480, Eng. News-Record, 10th Ave. at 36th St., New York.

SUPERINTENDENT construction, thoroughly experienced; handle any size job in hydro-electric plants, dams, heavy foundations, pulp and paper mills, reinforced concrete, waterworks; understands camps; references. PW-415, Eng. News-Record, 10th Ave. at 36th St., New York.

SUPERINTENDENT of construction, broad experience on industrial and building construction, filtration plants, dock work, etc. First class organizer over fourteen years in charge of important work. Available immediately. PW-55, Eng. News-Record, 10th Ave. at 36th St., New York.

SUPERINTENDENT. Building construction, all types. 20 years' experience. A-1 man. Entire charge start to completion. Location immaterial. Open for assignment July 1st. R. S., P. O. Box 2002, Paterson, N. J.

SUPERINTENDENT, general foreman. State road builder, broad experience, A-1 man, all types of macadam, concrete, brick and paving, available short notice anywhere. PW-430, Eng. News-Record, 10th Ave. at 36th St., New York.

Miscellaneous

CONSTRUCTION and designing engineer, railroads, coal and ash handling, docks, general structures, power plants, fine experience. Would like field and design, or field only. PW-487, Eng. News-Record 10th Ave. at 36th St., New York.

ENGINEERING student wants position with Civil Engineer in middle west or western United States; 6 months college; married. Salary secondary. PW-451, Eng. News-Record, Old Colony Bldg., Chicago, Illinois.

ENGINEER, 23, with 5½ years' experience, which includes 2 years railroad maintenance of way, also city engineering, highway, sewers and farm surveys, building construction and real estate layout. Neat draftsman and excellent vertical letters. Employed at present. Location in New York City or Northern New Jersey. PW-472, Eng. News-Record, 10th Ave. at 36th St., New York.

GENERAL contractor's engineer; graduate, member A.S.C.E. with over fifteen years' broad experience in West. Quick and accurate in estimating quantities on all classes of work such as buildings, foundations, dams, pipe lines, bridges, docks, etc., experienced in designing same and cost keeping. Practically finished present work. PW-434, Eng. News-Record, Rialto Bldg., San Francisco, Cal.

HIGHWAY engineer, 32, available for employment. Seven years' experience including surveys, preparation of plans and estimates, and construction of macadam and concrete roads. PW-440, Eng. News-Record, 10th Ave. at 36th St., New York.

PAVING INSPECTOR would like to hear from contractor, state or municipal authority requiring experienced man, well-versed in street, road and plant inspection. All types of pavements. PW-489. Eng. News-Record, Old Colony Bldg., Chicago, Ill.

POSITION in legal department of large firm desired by lawyer, with executive experience. John W. Weis, 6218 Greenwood Ave., Chicago, Ill.

SECRETARY (young woman) capable handling office. Six years' experience, three commercial and three railroad, ditch and levee construction. Go anywhere but prefer North. PW-484, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

POSITIONS WANTED

RESEARCH engineer, graduate European university, tried mathematician, four years' varied industrial development experience, wants position assisting in difficult industrial research, requiring capacity for quickly absorbing and digesting widely varied scientific data, practical sense and ability for securing co-operation. Proofs of original solutions, four languages. Starting conditions not overimportant, if possibilities are promising. PW-486, Engineering News-Record, Leader-News, Building, Cleveland, Ohio.

YOUNG man desires work in field office of an engineering construction company during summer. Will return to school in fall. PW-454, Eng. News-Record, 10th Ave. at 36th St., New York.

WORK WANTED

Designing, Detailing Checking

For structural steel and reinforced concrete. Industrial, mechanical, structural engineering. Shop drawings. Central States Engineering Company, 28 East Jackson Boulevard, Chicago, Ill.

Structural Steel Designing

Detailing and checking, for owners, architects, engineers, and fabricators. Reasonable prices. Experienced Engineers. WW-393, Eng. News-Record, Leader-News Bldg. Cleveland, Ohio.

PART TIME WORK WANTED

CIVIL engineer, who also knows the ropes of the selling game fairly well, and is at least on speaking terms with general business ways can spare part of his time for congenial work that will pay a salary. If you, Mr. Employer, should happen upon this advertisement drop me a line or two. Possibly we could be of use to each other. PTWW-477, Eng. News-Record, 10th Ave. at 36th St., New York.

AGENTS WANTED

Agents for Exclusive Territory

On new patented Electric Trench and Caisson Hoist Unit. Being used by leading contractors. Louis Falzer Co., 2117 Tilden St., Chicago, Ill.

SALESMEN WANTED

Construction Equipment Salesman Wanted

Who has specialized in concrete mixers. State age, salary expected and past experience in detail. SW-397, Eng. News-Record, 10th Ave. at 36th St., New York.

BUSINESS OPPORTUNITIES

Partner Wanted

To purchase half interest in small dredging plant. Address BO-450, Eng. News-Record, New York, 10th Ave. at 36th St.

Will Sell All or Half Interest

Of refinery and steel construction company in Texas. Profits average about $10,000 per year. Present owner unable to give sufficient time to business. $5.000 cash will handle. BO-476, Eng. News-Record, Old Colony Bldg., Chicago, Ill

AGENTS WANTED

OSHKOSH

MIXERS-PAVERS SAW RIGS

See display ad in June 7th Issue

Oshkosh Mfg Co., Oshkosh, Wis

We Dig and Refill Trenches

for water, sewer, gas, conduits and drains.

Pipe laid by contract and installation of water systems.

Trench Machines and Backfillers For Rent

W. G. Fritz Co., Inc., ***Contractors***
258 Valley Road, West Orange, [illegible]

BUSINESS OPPORTUNITIES

Established Engineering Business

And concrete products plant in central Illinois for sale. Separate, or will make wonderful combination. BO-491, Engineering News-Record, Old Colony Bldg., Chicago, Ill.

Established Sales-Agency For Sale

Handling structural steel, reinforcing, and a number of specialties. Location Middle West. A real opportunity for a sales-engineer to start business for a small investment. BO-492, Eng. News-Record, Leader-News Bldg., Cleveland, Ohio.

PATENT ATTORNEY

PATENTS—Send for form "Evidence of Conception" to be signed and witnessed. Form fee schedule, information, free. Lancaster and Allwine, 450 Ouray Bldg., Washington, D. C.

FOR SALE

Dumpy Level

W. & L. E. Gurley makers. **J. L. Gray, Box 74, Louisa, Ky.**

WANTED

Used Engineer Transit

Having vertical arc. Describe fully including instrument number and lowest possible cash price. Buyer in New York. W-460, Eng. News-Record, 10th Ave. at 36th St., New York

CALIFORNIA!

INDUSTRIAL SITES around San Francisco Bay are handled by our industrial department, in charge of an experienced engineer. Information freely given. (Continuously in business 23 years).

F. F. PORTER, Porter Bldg., Oakland, Calif.

FERRY

FOR SALE

In absolutely good running order. 11 feet wide 40 feet long, including two aprons. Constructed by the Minneapolis Steel Machinery Co. Iron sides, two iron beams. 350 feet cable.

G. SCHWYZER
410 Donaldson Bldg. Minneapolis, Minn.

For Sale or Lease; A bargain

QUARRY AND CRUSHING PLANT

on railroad. Business thoroughly established. An exceptional proposition.

FS-431 Engineering News-Record
Real Estate Trust Bldg., Phila., Pa.

Second-Hand Transits and Levels

Guaranteed in Good Order and Adjustment
[illegible]

WILLIAMS, BROWN & EARLE INC
918 Chestnut St., Philadelphia, Pa
[illegible]

NEW AND USED SURVEYING INSTRUMENTS AT FACTORY PRICES

[illegible] Prompt service.

[illegible] INSTRUMENT CO
[illegible]

FOR SALE

Used Transits and Levels

BUFF, [illegible] Dey St., New York

FOR SALE

Oil Engine and Dynamo

Sealed bids will be received at the office of the County Clerk in the Court House in Galesburg, Illinois, up to 10 o'clock a.m., August 25th, 1923, for the following:

One Fairbanks-Morse Oil Engine. Type 25-H. P. 325 R. P. M. with 40 ft.-7 inch belt: 50 gal. Oil Tank, also two cooling tanks, capacity of each tank 400 gallons, with centrifugal pump size one inch. All in good shape. Factory No. 154985.

One Fairbanks-Morse Direct Current Dynamo, K. W. 15, Volts 125, Amp. 120, Type C. P. adjusted to 1,300 R. P. M. Volts 125 at full load also 125 at no load. Belt driven 7-inch pulley. No. 21368. In good shape.

Bids must be enclosed in a sealed envelope with the name of the bidder written or printed thereon and addressed to.

GEO. A. LARSON,
County Clerk.
Galesburg, Illinois.

EXCAVATION

Steam Shovels for rent with crews or work taken by contract.

Dinkeys and cars or teams furnished.

H. C. AMBLER
3717 Old York Road, Philadelphia, Pa.

TARPAULINS AND Waterproof Canvas Covers

All Sizes—All Weights at Hand

DASH MFG. CO., INC.
56 Suffolk St., New York City.

WANTED

LOCOMOTIVE CRANE

1—Standard Gauge, 25 tons capacity.

SADDLE TANK LOCOMOTIVES

2—Standard Gauge, 25-ton engine will do. Cannot use over 40.

W-433, Engineering News-Record
Leader-News Bldg., Cleveland, Ohio

WANTED

Stiff Leg Derrick

15 tons capacity 60 ft. boom.

Merritt Chapman & Scott Corporation
17 Battery Place, New York City

WANTED

Stone Crusher—Dump Bodies

250 yd. capacity Stone Crusher.
2 Dump Bodies for Ford Dump Truck.

F. H. WELLS, Savannah, N. Y.

WANTED DRAGLINE

[illegible]

THE H. C. DARNELL MACHINERY CO
[illegible]

AUCTION

AUCTION

Sale of

NAVY SURPLUS

by

PUBLIC AUCTION

At Navy Yard, New York, N. Y.

on JULY 10th and 11th, 1923

There is given below a general list showing the character of material in each sale referred to above. Catalogs of sale covering all details regarding the sales can be obtained from the Central Sales Office or the Auctioneers mentioned.

Catalog No. 504-A

Sale of July 10, 1923, Steel and Metals at Navy Yard, New York, N. Y. under the auspices of Alfred Freeman & Company, 149 Grand Street, New York City:—

Brass and Copper, Building Materials, Contractor's Supplies, Iron and Steel and other Metals. Scrap Accumulations,

Catalog No. 503-A

Sale of Surplus materials at Navy Yard, New York under the auspices of Smith & Jaffe, 68 W. 45th St., New York City, July 11, 1923:—

Fire Brick, Brass and Copper, Iron and Steel and other Metals, Gauges, Pipe Fitting, Plumbing Supplies, Marine Equip., Wire and Cables, Scrap Accumulation, Tools, Hardware and 12 Electric Railway Cars with 10 Trailers.

CENTRAL SALES OFFICE, NAVY YARD, WASHINGTON, D. C.

WANTED

Bucyrus Shovel

1—70-C, in first-class condition, A.S.M.E. boiler.

Dinkeys

3—36-in. gauge, either 18 or 20 tons, A.S.M.E. boiler.

Western Steel Beam Cars

40—4-yd., 36-in. gauge.

Cannot pay fancy prices. Dealers save postage

W-432, Engineering News-Record
Leader News Bldg. Cleveland, Ohio.

WANTED

STEEL SHEET PILING

100 Pcs. 40 to 50 ft. long.
200 Pcs 20 to 30 ft. long.

Suitable condition for redriving.

W-399, Engineering News-Record
1570 Old Colony Bldg., Chicago, Ill.

Ready for Delivery Now

4,000,000 FEET OF LUMBER

Fir and Yellow Pine.
Sizes as follows:

358 pcs., 12x12, 20 ft. long.
134 pcs., 12x12, 30 ft. long.
18 pcs., 12x12, 10 ft. long.
1,107 pcs., 6x6, 10 to 12 ft. long.
3,060 pcs., 3x12, 20 ft. long.
953 pcs., 4x10, 20 ft. long.
2,088 pcs., 2x8, 20 ft. long.
212 pcs., 6x10, 9 ft. long.
237,800 sq. ft. 2x8 floor beams, 9 to 18 ft. long.
200 windows, 2 ft. 10 in. wide by 5 ft. 2 in. high, complete.
132,600 sq. ft. 6-in. sheeting.
13,800 sq. ft. novelty siding.
20—8x8 ft. rolling steel doors.

Above lumber from Navy Warehouses, four years old free from nails and immediate delivery by rail or water. Two million feet same sizes, future delivery.

Kirsch Demolishing Co.

35th St. and 2nd Ave., So. Brooklyn, N. Y.

Steam Shovels For Rent

Type A1 Thew, located Jersey City, N. J.

Immediate Shipment

JAMES S. BRADEN
30 Church St., New York, N. Y.

FOR SALE

1—No. 3793, Size 61 (¾-yd.) Ransome **Concrete Mixer** with side loader and hoist for hoisting bucket, 25-hp., either 2 or 3-ph., 60-cy., 220-v. Motor, hoisting bucket with hopper for tower on truck with steel frame, lately overhauled	$1200
1—No. 520 (¾-yd.) Smith Chicago **Mixer** with 15-hp., 3-ph., A.C. Motor and side loader, rebuilt	600
1—No. 10 (1 bag) Chicago **Con. Mixer** on skids with pulley	60
1—20-cu ft Ransome **Concrete Hopper**	50
1—Fairbanks-Morse, 8-hp. **Gasoline Engine**, with pulley and clutch	60
1—No. 105 Standard **Concrete Mixer** on truck with Novo Engine	100
1—2¾x10 Deep Well **Pump Head**, with 2½-hp. Novo Engine	90

FRANK N. GOBLE, INC.
49 Brookfield St., White Plains, N. Y.

FOR SALE—FOR RENT

3—Austin Cube Pavers, Boilers, Engines, Boom, Bucket, Batch Meter, Caterpillars.
1—Potter Trenching Machine.
1—10-ton Kelly Roller.
1—5-ton Iroquois Roller.

Empire Engineering & Equipment Co.
Office and Yard Cor. W. Gen. Robinson and Dasher St., Pittsburgh, Pa.

FOR SALE

STEEL SHEET PILING

120 pcs., 14-in. Lack. Arch Web, 22 to 24 ft. long.
15 pcs., 14-in. Lack. Arch Web, 11 to 18 ft. long.
8 pcs., 14-in. Lack. Straight Web, 22 ft. 6 in. long.

Good Redriving Condition. Price $37.50 per ton 2000 lb. for entire lot F.O.B. cars, Salem, N. J.

J. M. HYNES
Lock Box 242, Salem, N. J.

TO RENT

Erie Steam Shovel

High Lift Type "B". Caterpillar Traction.

L. V. MORRIS,
Box 106, Locust Valley, N. Y.

TELEPHONES 2270
RECTOR 2271

Industrial Plants Corporation

APPRAISERS-LIQUIDATING ENGINEERS

25 CHURCH STREET

NEW YORK

We Liquidate Your Frozen Assets

We will sell at

PUBLIC AUCTION

Absolute By CHAS. KRISER, *Auctioneer* ***Unreserved***

By order of, and for the account of

NEWPORT SHIPBUILDING COMPANY

Wilmington, North Carolina **(Builders of Concrete Ships)**

All of the WOODWORKING MACHINERY, MACHINE TOOLS, CONTRACTORS and YARD EQUIPMENT, STEEL and SUPPLIES at the shipyard, Wilmington, N. C.

Thursday, July 12, 1923

Commencing 10:30 A. M. SHARP!! (Eastern Standard Time)

VALUATION $350,000.00

Everything will be sold without limit or reserve!!

SALE INCLUDES:

Chain Mortisers, Inside and Outside Moulders, Surfacers, Tenoners, Band Saws, Resaws, Bevel Band Saw, Boring Machines, Belt Sander, Saw Tables, Dado Saws, Scroll Saws, Joiners, Lathes, Shapers, Grinders, Pipe Machines up to 10 in., Pipe Expander, Bolt Cutter, Radial Drills, Drill Presses, Hack Saws, Vises, Forges, Benches, Concrete Mixers, Cement Guns, Engines, Air Compressors, Hoists, 50-ton capacity Steel Stiff Leg Derrick, Boilers, 40-ton Locomotive and Tender, Standard Gauge Flat Cars, 100 tons Steel Reinforcing Bars, tons of New Fittings, Brass, Malleable and Cast Iron, tons of Scrap, Rope, Chain Hoists, Bolts and Nuts, Ship Supplies, Air Tools, Acetylene Torches, 50 Electric Motors and Generators up to 75 H.P., Office Furniture and Hundreds of other items.

**This equipment is all of modern type and in excellent condition.
Plant open for inspection from June 28th to the day of the sale.**

ONLY ONE advertisement will appear in this paper—SO SEND IMMEDIATELY FOR *COMPLETE AUCTION CATALOGUE.*

Industrial Plants Corporation

'Phone Rector 2270

25 Church St., New York, N. Y.

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AND NEW, OFFERED FOR RE-SALE

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Construction WE BUY, SELL AND RENT *Equipment*

AIR COMPRESSORS

1—Ingersoll-Rand, 10x10, Belt drive.
1—Chicago, 70 ft., Gas. Power, mounted with Tank, mounted on Trucks.
1—Chicago, 150 ft., Gas. Power.
2—Westinghouse, Compound, 150 ft.

CRANES

1—P. & H. 205, semi-caterpillar.
1—Overland Traction Wheels, steam power.
1—20-ton Ohio, std. gauge.

HOISTS

1—American, 10 x 12, D.C., D.D., skel.
5—7 x 10, DC, DD, various makes.
1—6 x 8, DC, DD skel. Lambert.
1—Thomas DD with 50-hp., A.C. Motor.
1—Thomas DD with 75-hp., A.C. Motor.
1—Lambert, 8¼ x 10, DD, butt strapped boiler.
1—American, 8¼ x 10, DD, butt strapped boiler.
1—Thomas Double Drum with 100-hp., D.C. Motor.

LOCOMOTIVES

2—Std Gauge Baldwin and American, 50 ton.
1—Standard Gauge Baldwin, 30 ton, rebuilt.
7—24-in. Gauge Plymouth & Whitcomb, gas.
5—36-in. Gauge Davenport, Porter & Vulcan.
3—6-ton, 24-in. Gauge Geared Whitcomb.
1—Std. Ga. 10 x 16 Lima.

DERRICKS

3—Steel Stiff Leg, 60 to 100-ft. booms
1—Wood Stiff-Leg Derrick, bucket operating
6—Steel Guy, 100 ft. masts, 15 to 25 tons.
8—Steel Guy, 110 ft. masts, 25 to 40 tons.
2—Steel Stiff Legs, 110 ft. booms, 20 tons.
1—All-Steel Derrick Car, capacity 25 tons.

ROAD EQUIPMENT

2—Lakewood Finishing Machines, 16 & 18 ft.
60—Batch Boxes, 29 ft.
5—Rollers, 8 to 10 ton, tandem and 3 wheel, steam and gasoline power.
6—Pavers, 12E to 21E.

CONCRETE MIXERS

1—21-S Marsh Capron Batch Hopper.
2—7-S Rex Low Charging Mixers.
1—21-S Rex, Steam Power.
1—7-S Boss, Gas. Power, Side Loader.

STEAM SHOVELS

1—Type B, Erie.
4—Traction and Caterpillar, ¾ yd. shovels, Marion, Osgood, Bucyrus and Thew
2—Bucyrus 70C's; also 70-ton railroad type.
1—Bucyrus 35B on caterpillar.
1—Marion 35 traction wheels.
1—Standard Bucyrus 150-B.

CARS

75—36-in. gauge, 4-yd. Western Dump.
50—24-in. gauge, 1½ yd. steel "V"-shaped.
30—24-in. gauge, Western All-Steel Flat.
30—18-in. gauge, 1-yd. Western.
70—24-in. gauge, 1½-yd. Wood Bodies.

DRAG LINES

1—Monighan 1-T, Walker type.
1—Monighan 2½-T, Walker type.
1—Bucyrus 14-B, on caterpillar.

PILING HAMMERS

1—No. 3 McKiernan-Terry.
1—No. 9 McKiernan-Terry.
1—No. 3 Union. 1—No. 2 Vulcan.

BUCKETS

1—¾-yd. Kiesler Clam Shell Bucket.
1—1-yd. Hayward Clam Shell Bucket.
1—1-yd. Page Dragline Bucket.

MISCELLANEOUS

2—50-hp. Locomotive Type Boilers.
1—Erie 6-in. Centrifugal Pump with Engine
1—Lakewood Steel Tower, 150 ft., with Bucket
1—Insley Steel Tower, 200 ft. with Bucket
1—4-in., belt driven Centrifugal Pump.
2—Steel Stone Skips.
4—Vertical Boilers, ranging from 25 to 40-hp.

The above are only a few of the items we have for sale. Write or wire for our latest stock list.

RENNOLDS EQUIPMENT CO.

**711 STANDARD TRUST BLDG.
CHICAGO, ILL.**

PHONE: RANDOLPH 4184

ECA
REBUILT

"WE BUY—
REBUILD—
SELL OR RENT"

ELECTRIC HOISTS AND DERRICKS FORM HOG ISLAND

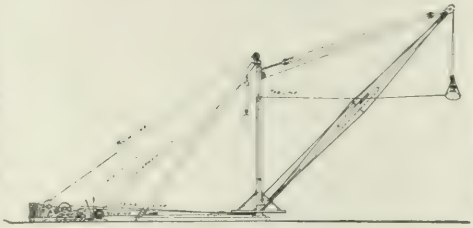
Available For Inspection and Shipment From Our Four Plants

Specifications of Electric Hoists

Large number of American late model hoists. These hoists have 2 drums with attached swinging gear, with 37-hp. Otis A.C., 440-v., 60-cy., 3-ph. electric motor—Complete with controllers and resistance grids—Can be changed to suit customer's current requirements if desired.

Can furnish counterweighted holding drums with these hoists when used for operating bucket.

Also several 55 and 75-hp., Single and Double Drum Hoists with A.C. Motors.



Specifications of Derricks

Large number of practically new American stiff leg derricks.
Boom, 14x14x80 ft., trussed.
Mast, 16x16x40 ft.
Legs, 14x14x62 ft.
Bull wheel, 16 ft.
For Single Line Work or Arranged for Bucket Operation.
Will sell fittings only if desired.
Also have large stock of lighter stiff-leg derricks, several steel stiff-legs, 20, 30 and 50 ton.

Guy Derricks

A number of both wood and steel guy derricks, 5, 10 and 25-ton capacity.

ALL THE EQUIPMENT LISTED BELOW HAS BEEN REBUILT AND MAY BE INSPECTED IN ONE OF OUR OWN WAREHOUSES

AIR COMPRESSORS

1—Sullivan Class W.G.3. belt driven cylinder, 10x12.

2—10½-in Type C Westinghouse Steam Compound Air Compressors. Capacity 150 cu ft. at 100 lbs. Requires 25 hp. Boiler.

1—Bury Class L 8x8 Compressor complete with air receiver with 15 hp. A C 220 volt, 60 cycle motor.

1—Schramm No 30 Gasoline, on trucks with air receiver, cap. 50 cu. ft. per minute.

CONCRETE MIXERS

30—Concrete Mixers, sizes 28S, cap. 1-yd., 21S, cap. ¾-yd.; 14S, cap. ½-yd., and 10S, cap. 1¾-yd. With steam or electric power; with side loaders or batch hoppers. Following makes: Marsh-Capron, Koehring, Milwaukee, Ransome, Smith, Smith-Chicago, Rex, Lakewood, Foote, Cube, or Oshkosh.

15—7S, cap 1 bag with low charging platforms with gasoline engines.

CRANES

1—Byers Auto Crane on traction wheels with 30-ft boom with ½ or ¾ [illegible] clam shell bucket.

1—15-ton, 8-wheel, O.&S., 40-ft boom.

1—15 ton Browning locomotive crane on 4-wheel, standard gauge trucks, with 40-ft. boom and bucket operated.

CLAM SHELL BUCKETS

20—Clam Shell Buckets. Sizes ½, ¾, 1, 1½ or 2 yd. All makes.

CRUSHER

1—No. 4 Austin Gyratory crusher.
1—10x20 Climax Jaw Crusher on [illegible]

DIAPHRAGM PUMPS

90—Diaphragm Pumps on trucks with 3-in. or 4-in suction, with 3-hp., 2-hp., or 1½-hp. Gasoline engines. Following makes: Atlantic, Bull Dog, C.H.&E., Domestic, Gould, Humphrey, Keystone, Novo, Schramm and Sultan.

30—Hand Diaphragm Pumps, 3-in and 4-in suction.

A large assortment of steam pumps, Simplex and Duplex; also several Nys and Pulsometer Pumps No. 5 and No. 6. Several hand driven force pumps 2 in. and 1½ in. suction.

CENTRIFUGAL PUMPS

All sizes from 12-in suction 10-in discharge down to 2½-in suction 2-in discharge. Belt driven and direct connected to steam engines, gas engines and electric motors.

STEAM HOISTS

20—Three-Drum Hoists, with or without boilers. Sizes, 10x12, 9x10, 8¼x10, and 7x10, with separate swingers for derrick work. All makes.

40—Two-Drum Hoists, with or without boilers. Sizes, 10x12, 9x10, 8¼x10, 7x10, 6¼x10, 6x8 and 5x8. Can be equipped with holding drum for bucket work. Several special Cableway Excavator or Drag Scraper Hoists. All sizes.

12—Single Drum Hoists 9x10, 6¼x10, 8x8 [illegible] American and Lambert.

6—Swinging Engines.

1—[illegible] Belt Hoist, cap. 6000 lb.

1—Belt Hoist, single drum, 2500 lb. line pull.

1—[illegible] single drum reversible with elevator sheave, complete with boiler.

[illegible] D. Reversible, with boiler and elevator sheave.

ELECTRIC HOISTS

[illegible] with [illegible] drum controller, resistance grids complete.

RAIL AND TRACK

[illegible] Miles [illegible] Gauge Portable Track [illegible]

GUY DERRICKS

1—Wooden Guy Derrick, mast 60-ft., boom 56-ft. 16x16 timbers—single line.

1—All steel with 90 ft mast, 80 ft boom, with all guys, with bull wheel, 10 ton capacity, bucket operating.

ROAD ROLLERS

2—Erie Tandem 1—8-ton, 1—3-ton

2—Kelly-Springfield, 10-ton, 3-wheel 1—gas, 1—steam

1—Iroquis, 5-ton, steam Tandem.

3—10 ton, 3 wheel, 2—Buffalo-Pitts, steam 1—Austin, gas

STEAM SHOVELS

1—Bucyrus 70 ton on MCB std gauge trucks, with 2½-yd. dipper.

4—Keystone Excavators 3—No 3 1—No 4

1—Marion No 28 Traction Wheel ¾ yd bucket.

1—Type A1 Thew on traction wheels with [illegible] dipper

2—Type O Thew on traction wheels with [illegible] dipper

STEAM HAMMERS

[illegible]—McKiernan & Terry 6—No. 9B 1—No [illegible]

[illegible]—Vulcan 1—No [illegible] and 1—No 1 Several drop hammers

LOCOMOTIVES

[illegible]

Write for latest Stock List just off the press.

Equipment Corporation of America

Manufacturers and Rebuilders of Contractors' Equipment

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855 Land Title Bldg.
Phone Spruce 549[illegible]

CHICAGO, ILL.
1455 Lumber Exchange Bldg.
[illegible]

PITTSBURGH, PA.
655 Empire Bldg.
[illegible]

FOR SALE OR RENT

STEAM SHOVELS

1—14B Bucyrus Traction Shovel, Shop No. 3338 new in 1920 2 3-yd dipper.
1—Model 36 Marion, full revolving traction, Shop No. 3304, new 1½-yd. dipper.
4—70C Bucyrus Shop No 1167, 1426, 1499 and 1608, 2½-yd. dippers.
3—70-ton Bucyrus Shop Nos. 860, 977, and 1233. 2½-yd. dippers.
1—70-ton Bucyrus. Shop No. 920, equipped with new 70C boom. 2½-yd. dipper.
3—Model 60 Marion, Shop Nos. 1463, 1711 and 2367, 2½-yd. dippers.

STEAM SHOVEL PARTS

3—Booms for 70-ton Bucyrus, length 29 ft.
1—Boom for 70C Bucyrus shovel, composite, length 40 ft.
3—Dippers, Bucyrus 2½-yd capacity
1—Bucyrus Dipper, 3 cu. yd capacity.
Jack Arms, Dipper Arms and Boom Engines for 70-ton Bucyrus Shovels.
1—Boom for Model 60 Marion Shovel.
2—Dipper Arms for Model 60 Marion.
1—Dipper, 2½ yd., for Model 60 Marion.

DRAGLINE EXCAVATORS

1—Class 14 Bucyrus Dragline; 60-ft boom, 2-yd. Page Bucket, skids and rollers, or truck wheels.
1—Class 24 Bucyrus Dragline, Shop No. 772; skids and rollers, 100-ft boom, 3½-yd. Page bucket.
1—Class 24 Bucyrus Dragline, built 1919, 115-ft boom, 3½-yd. Page bucket, steam operated.

LOCOMOTIVES

1—17 x 24 Davenport, 6-wheeled switcher, new in 1912, weight 47 tons, steam pressure 180 lb
1—18 x 24 American 6-wheeled switcher, Brooks No. 2318. Wt. 55 tons on drivers.
1—16 x 22 C. M. & St. P. Ry., Class J-2, 4-wheeled switcher. Weight 32 tons.

LOCOMOTIVES (Continued)

1—standard gauge, 11 x 16 American 4-wheeled saddle tank Locomotive, shop No. 47421, built 1912. Weight 21 tons, steam brakes, automatic couplers.
3—36-in. gauge, 11 x 16 Vulcan dinkies, shop Nos. 1700 to 2200 series. Steel cabs and butt joint boilers. Weight 20 tons.
1—36-in. gauge, 11 x 16 Davenport dinkey. Shop No. 710. Wt. 20 tons.
1—36-in. gauge, 10 x 16 Porter Dinkey. Shop No. 3912. Wt. 18 tons.
1—36-in. gauge, 10 x 16 Vulcan Dinkey. Shop No. 868. Wt. 18 tons.
1—36 in gauge Baldwin Dinkey. Shop No. 34550; wt. 18 tons.
1—36-in. gauge American Dinkey, Shop No. 46733; wt. 18 tons.

CRANES

1—Type B Erie Traction Crane; 33-ft. boom and ¾-yd. clam shell bucket. Shop No. 838. New in 1920.
1—10-ton Industrial Crane (Shop No. 1989), 4 wheeled, 40-ft. boom.
1—20-ton McMyler, Serial No. 388, built 1912, 8 wheeled; 45-ft. boom, bucket operating drums.
1—25-ton Industrial Crane, 8 wheeled, full M.C.B., bucket handling drums; (Shop No. 3261), 55-ft. boom and 20-ft. ext.
1—30-ton Ohio Crane, new in 1918, 8-wheeled, full M.C.B.; bucket handling; 50-ft. boom; Ohio, Penn., N. Y., Mich. and Mass. Std. boiler.
1—30-ton Ohio Locomotive Crane, 8-wheeled, full M.C.B., bucket handling, 50-ft. boom, with 20-ft. extension. Shop No. 3416. Built 1920. A.S.M.E. boiler.
1—Pintle Type Crane, built by Variety Iron & Steel Works. New in 1919; 48-ft. boom, 15-ton cap. at 18-ft. radius; 7-ft. 10½-in. gauge, 12-ft. wheelbase, self-propelling. Base of boom 17 ft. above track. Bucket-operating drums. Wt. 50 tons. Price, 25% of new.

DUMP CARS

3—16-yd. Western Air Dump Cars.
20—12-yd. Western Air Dump Cars, 19-ft. beds, full M.C.B. steel underframes, box girder doors
4—12-yd. Western Dump Cars, air brakes and hand dump, 19-ft beds, steel underframes, box girder doors, full M.C.B., 60,000 lb. capacity trucks.
5—12-yd. Oliver Dump Cars, steel underframes; full M.C.B.
13—8-yd. Western, 36-in gauge, double truck side Dump Cars; steel draw sills, wood beds.
9—4-yd. Continental, 36-in. Gauge Side Dump Cars, wood beds, steel draw sills.
70—4-yd. Western, 36-in. Gauge, Wood Sill Dump Cars, truss rod doors.
34—4-yd. Continental, 36-in. gauge, wood draw sills, 4 pedestals, truss rod doors.
8—3½-yd. Peteler 36-in. gauge side dump cars, wood sills and wood beds.

SPREADER AND DERRICK CARS

1—Standard Gauge Western Spreader Car.
1—36-in. gauge Western Spreader Car.
1—36-in. gauge Oliver Spreader Car.
1—Std. Gauge Derrick Car.

HOISTING ENGINES

1—7 x 10, D.C., D.D. Lambert Hoisting Engine, with boiler.
1—7 x 10, D.C., D.D. Clyde Hoist with A.S.M.E. boiler.

MISCELLANEOUS

2—80-hp. horiz. Boilers, complete with fittings.
2—1½ yd. Page Dragline Buckets.
6—1½-yd. Western Dump Wagons
11—Mead-Morrison 1⅝-yd. Clam Shell
1—Industrial Steam Pile Driver Hammer, Serial No. 324.
1—Pair Steel Pile Driver Guides, 42 ft. long, for above hammer.
1—Stable Tent, 30 ft. x 50 ft.

CLAPP, RILEY & HALL EQUIPMENT CO., 14 So. Canal St., Chicago
(Successors to Clapp, Norstrom & Riley Equipment Co.)

FOR SALE

7—Dump Scows, 280 to 700 cu. yd. capacity.

1—5 to 7 cu. yd. Clam Shell Dredge.

1—5-yd. Clam Shell Dredge.

1—2½-yd. Dipper Dredge.

3—Flat Deck Scows, 87 to 110 ft. x 30 to 32 ft.

1—Coal Scow with Derrick and Hoisting Engine, 300 tons.

Prices on application to

WILLIAM S. NOLAN, *Shipbroker,*
31 State St., Boston, Mass.

LOCOMOTIVE CRANE

1—10-ton Industrial, 4-wheel standard gage, 40-ft. boom, ¾-yd. clam shell bucket.
1—12-ton, 8-wheel O. & S., M.C.B., 40-ft. boom, equipped with ¾-yd. clam shell bucket.
1—O. & S. Gasoline traction, 35-ft. boom, ¾-yd. bucket.
1—Erie "B" traction, 36-ft. boom.

SHOVELS

1—Model 61 Marion, 2½-yd. dipper, railroad trucks.
1—70-ton Bucyrus, 2½-yd. dipper, railroad trucks.
1—Type "A" Erie traction, ½-yd. dipper.
1—Model 36 Marion, 32-ft. boom, 22-ft dipper stick, 1-yd. dipper, caterpillar traction.
1—Model 28 Marion combination crane and steam shovel, traction wheels.
1—Late Type "O" Thew, 1921, boom, ¾-yd dipper. Traction wheels, high lift shipper shaft.
1—Model 18 Osgood, caterpillar traction, high lift, 20-ft. boom, ¾-yd. dipper.
1—Erie "B", caterpillar, high lift, with boom hoist, 20-ft. boom, 18-ft. dipper handle, ¾-yd. dipper. Used 6 months on light work.
1—Browning, Type No. 8, 38-ft. boom, 22-ft. dipper handle, 1-yd. dipper, mounted on 4 wheels, standard gage, with stability wheels on same shaft Used 2 months.

DRAGLINE

1—Erie caterpillar traction, 40-ft. boom. 1-yd. Page bucket.
1—Austin combination steam shovel and dragline, Model 5, caterpillar traction.
1—Marion Model 251, 115-ft. boom, 3½-yd. bucket.
1—Monighan, 120-ft. boom, 3½-yd. bucket.
1—Monighan T1 (Walker) Gasoline, 50-ft. boom, 1-yd. Page bucket.

HOISTING ENGINES

1—Byers Traveling Derrick, all-steel construction, 14-ft. gage, 3-drum engine independent swinger, 50-ft. boom.
1—10x13, D.C., 3-drum Mundy Hoisting Engine with Boiler.

LOCOMOTIVES

1—Vulcan, 38 ton, saddle tank, std. gage.
1—Vulcan, 21 ton, saddle tank, std. gage.
1—Vulcan, 11 ton, saddle tank, 36-in. gage.

JOHN F. CONNELL CO.
549 West Washington Blvd., Chicago

LOCOMOTIVE CRANES

1—McMyler, 20 ton, 8 wheel, M.C.B., 40-ft. boom, bucket drums.
1—Byers Semi-Caterpillar, 35-ft. boom, ½-yd. Owen bucket.
1—15 to 20-ton Brown Hoist, 50-ft. boom, 1½-yd. bucket.
1—New 12-ton, Type E Orton & Steinbrenner, gasoline on caterpillars, bucket drums, 40-ft boom.
1—O.&S., 20 ton, 8 wheel, M.C.B., 50 ft. boom, bucket drums, with dragline equip. & bucket.
1—O.&S., full revolving, 32-ft. boom on traction wheels, ¾-yd. bucket.

LOCOMOTIVES

1—6-wheel switcher, 18x24.
1—12x18, Porter saddle tank, 36-in. gauge.

SHOVELS AND DRAGLINES

1—Model 18 Osgood on caterpillars, ¾-yd. dipper, high lift.
1—Model 92 Marion on standard gauge railroad trucks.
1—Model 18B Bucyrus on caterpillars, 1¼-yd. dipper
1—No. 3 Keystone with ditcher and skimmer scoops.
1—No. 6 Keystone, ditcher and skimmer with clam shell attachment.
1—Erie B on traction wheels, ¾-yd. dipper.

HOISTING ENGINES

1—Flory, 8¼x10, D.D., Incline or Shaft Hoist.
1—Stroudsburg 10 x 12, D.C.,D.D., with boiler, like new.

PAVERS

1—21E Austin, steam, semi-caterpillar.
1—21E Foote, Steam, full caterpillar, new.

ASPHALT PLANTS

1—2000-yd. Merriman, 1 car plant.
1—800-yd. Iroquois, Portable.

STEAM ROAD ROLLERS

1—8 ton Iroquois tandem.
1—10-ton, 3-wheel Case roller with scarifier, new last year.
1—10-ton, 3-wheel Kelly-Springfield.

CARS, AIR COMPRESSORS, BOILERS AND OTHER EQUIPMENT.

F. MAYER, 737 Monadnock Building, Chicago

HOISTS DERRICKS

WE EXPECT TO BE SOLD OUT AND DO NOT GUARANTEE DELIVERY AFTER JULY 1, 1923

ELECTRIC HOIST AND DERRICK $1800

PRICES F. O. B. CARS, PRIMOS, PA.

PARTS

We have a quantity of parts and fittings that came into our possession with the Hoists and Derricks that we purchased at Hog Island that we are offering for sale as Hoist extras or a set of Derrick fittings.

TIMBERS

Several 14 x 14 and 16 x 16, 40 ft., 50 ft. and 55 ft. new fur pine at 10c. per BM foot.

You Save at Least $2000

These Hoists and Derricks are standard late models, manufactured by The American Hoist & Derrick Co., St. Paul, Minn. They are almost new, and every one is GUARANTEED to be in first-class running order.

The Hoists have two drums and swingers, and are complete with starting and control equipment. Having banked lever control, and rated 6,000 pounds single line on each hoisting drum. Slewing rope 36 ft. per minute, and hoisting rope speed 160 ft. per minute. The MOTORS are OTIS 37 hp. A.C., 60-cycle, 3-phase, 440-volt, intermittent duty, slip-ring induction type and, if desired, may be changed to suit the individual current requirements of purchasers at cost.

These Hoists and Derricks may be inspected at any time. This Equipment is being sold in sets and in units of a Hoist or Derrick if desired. Immediate shipment can be made anywhere, but QUICK ACTION IS IMPERATIVE.

Wire, Phone or Write for Detailed Information, Folder, etc.

THE ELECTRIC HOIST & DERRICK CO.
PRIMOS, PENNSYLVANIA
Primos, Pa., is 8 miles west of Philadelphia on P., B. & W. R. R.

DIMENSIONS OF DERRICKS

Mast—16 in. square, 40 ft. high.

Boom—Made of (2) 14 in. sq. timber 48 ft. long spliced to lengths of 80 ft. with (2) ⅞ in. and (2) 1⅛ in. truss rods.

Stiff Legs—14 in. sq., 60 ft. long or 16 in. sq., 46, 50 or 55 ft. long, will furnish either length desired, capacity 5 to 10 tons. Bull wheel 16 ft. dia. Principal sheaves 16 in. dia. and 14 in. single blocks.

The Cable which was formerly used will be given with each purchase of a Hoist with Derrick.

FOR SALE OR FOR RENT

Concrete Mixers, Lakewood Concrete Towers, Hoisting Engines, Derricks, Pumps, Gasoline Tractors, Steam Hammers, Buckets and Compressor outfits.

Edward Ehrbar, Inc., 29-33 Meserole Ave., Brooklyn, N. Y.

STIRLING BOILERS

823 Horse Power

Operated Less Than 90 Days

30—Class M-30, 823 hp. Babcock and Wilcox Stirling Water Tube Boilers, 200 lb. pressure. Drums, double riveted, double strap butt joint. Complete with Westinghouse Stokers, Forced Draft Fans, Vulcan Soot Blowers and all accessories. Inspection invited.

Send for our special specification folder.

Nashville Industrial Corporation
Jacksonville, Tennessee

REAL BARGAINS

in new Gas, Gasoline, Kerosene and Oil Engines, about half price, retested and inspected carefully and painted before shipment.

A large number of used and rebuilt Engines of all kinds, Steam Engines, Hoists, Boilers, Compressors, Stone Crushers and complete equipment for contractors and other plants.

Electric Motors, Generators and Direct Electric Units for all purposes.

INTERNATIONAL ENGINE & COMPRESSOR CO.
109 Mohican Bldg., Mansfield, Ohio.
Phone Canal 1116

Single Track Through Truss R. R. Draw Span Bridge

436 ft. 0 in. C. to C. End Pins. E 50, 659 tons. New, never been erected.

40 other bridges

J. NORMAN JENSEN
343 S. Dearborn St., Chicago, Ill.

PAVERS—ROLLERS

1—16 E Smith steam paver, [illegible]
1—[illegible]
2—[illegible]

H. Y. SMITH CO., Milwaukee, Wis.

SCALES

Guaranteed in Good Condition

[illegible]

NASHVILLE INDUSTRIAL CORPORATION
Jacksonville, Tennessee

Erie Pump Bargain

New, Never Used

[illegible]

STROUD & COMPANY
Omaha, Neb.

FOR SALE

CABLEWAY OUTFITS

3—Complete Cableway Outfits for light work of about 1,000-ft. span; including hoisting engines, boilers, carriages, buckets, fall blocks, sheaves, rope, etc., complete. Each	$2,500

HOISTING ENGINES

1—D.C., D.D. Link Motion, Byers 5½x7, no boiler	$ 500
1—D.C., D.D. Link Motion, Lidgerwood, 6x8, no boiler	600
1—D.C., D.D. Link Motion, Byers, 5½x7, with boiler	1,000
1—D.C., D.D. Single Motion, Byers, 6x7, with boiler	1,000

BOILERS

2—35-hp. Vert. Boilers, all fittings, each	$ 400

AUTO CRANES

1—Type C Byers, Trac. Wheels, ¾-yd. Clam Shell	$2,200

PUMPS

2—3-in. Emerson Steam Pumps, each	$ 200
2—3-in. Pulsometer Steam Pumps, each	200
1—2-in. Goulds Steam Force Pump	75

HAULING EQUIPMENT

2—3½-ton Paige Dump Trucks, good as new, each	$2,500
1—Cletrac Caterpillar Tractor, used 2 mos.	1,000
2—Studebaker Dump Wagons, each	150

MISCELLANEOUS

1—No. [illegible] McKiernan-Terry Steam Pile Hammer	$ 300
2—McKiernan-Terry Steam Drills, each	200
3—Electric Blasting Machines, each	25
26 Insley, Ransome and Archer Chutes, per Lin. Ft.	1
1—Insley Mast Hoist, complete	150
60—Pcs. Lackawanna Steel Sheet Piling, 9-ft., 0-in. Lengths	250
1 Littleford Portable Tar Heater, with 2 pouring pots	60
1—O.&S. ¼-yd. Orange Peel Bucket, new.	250

The Concrete Steel Bridge Co.
Clarksburg, West Virginia.

FOR SALE

Tractor

New 5-ton, Caterpillar Type, standard make, never used, suitable for road work and excavation. F.O.B. Buffalo, New York. Write for specifications.

FS-400, Engineering News-Record
10th Ave. at 36th St., New York City.

1—10-ton, 3-wheel **Kelley-Springfield**, 4 years old, 8 months' use.
1—10-ton, 3-wheel **Buffalo Pitts.**
2—5-ton **Tandem Kelley.**
1—8-ton **Buffalo Pitts.**
2—**No. 3 Keystone Excavators.**
2—**No. 4 Keystone Excavators.**

Acme Equipment Company
207 Fulton Building, Pittsburgh, Pa.

I BEAMS

200 tons of 6-in., 12¼-lb Steel Beams, 15 ft., 9 in. long.

HOISTING ENGINE

1—Twin Drum Coal Hoist, made by Geo. Haiss Mfg. Co., N. Y.; cylinders, 8x12; drums 24 in. dia.; 16-in face; 37 in. dia. flanges; 40 hp.; Grab ½ ton.

BOILERS

3—Manning Vertical Boilers, 500 hp.; will insure for 175 lb.; immediate delivery.
1—H.R.T. Mass. Std. Boiler 72 in. dia.x19 ft., 6 in. long; 125-lb pressure
3—Vertical Boilers; 55 hp.; 48 in. dia.x 9 ft., 1 in. high; insured for 125 lb.

TANKS

All sizes of Tanks, open and closed, suitable for storage of gasoline or oil, in stock at our Boston Yard.

SECOND-HAND PIPE

Of all sizes, with new threads and couplings.

THE PERRY, BUXTON, DOANE CO.
214 West First St., South Boston 27, Mass.

Dependable Used Equipment

maintained, inspected and overhauled at our own shops, by men familiar with every piece, which assures you equipment that is dependable and superior to just ordinary used machines.

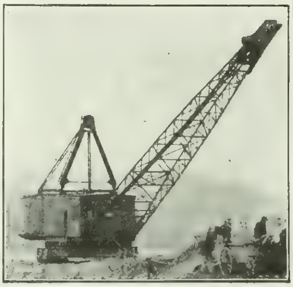
Miami Conservancy District

DRAGLINE EXCAVATORS

1—"Lidgerwood" Class "B" Steam Dragline Excavator, truck mounted, 60 ft. or 75-ft. boom, 2-yd., or 1½-yd. bucket.

1—"Lidgerwood" Class "B" Dragline Excavator, truck mounted, 60-ft. or 75-ft. boom, 2 yd. or 1½-yd. bucket.

1—"Lidgerwood" Class "B" Steam Dragline Excavator, mounted on four double flanged wheels. Boom is 60-ft. with 15-ft. extension and handles 1½-yd. or 2-yd. bucket.



1—"Bucyrus" Class 24 Electric Dragline Excavator, mounted on skids and rollers, 100-ft. boom and 3½-yd. bucket.

1—"Bucyrus" Class 14 Steam Dragline Excavators, mounted on caterpillars, with 60-ft. boom and 2-yd. bucket.

3—"Bucyrus" Class 24 Electric Dragline Excavators, skid mounted, with 85-, 100-, or 115 ft. boom, and 4½-, 3½-, or 2½-yd. bucket.

1—"Marion" Model 21 Dragline Excavator and Crane, mounted on caterpillars; 32-ft. boom, ¾-yd. bucket, either drag or clam shell.

August 1st Delivery

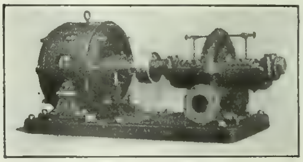
PUMPS

1—Worthington 4-in. centrifugal.
1—Worthington 6-in. centrifugal.
2—Weinman steam-driven automatic.
1—Piston Pump, 1½-in. suction, 1½-in. discharge, with gas engine.
1—Morris 8-in. centrifugal.
1—Worthington 8-in. centrifugal pump.
1 Weinman 3-in. suction, with 3-hp. motor.
1—Dean 7½x5x6
1—Cameron steam piston, 7x6x7.
1—6-in. American centrifugal, dir. conn. to vertical steam engine.
1—12-in. Kingsford horiz. cent. pump.
1—"Swaby" 8-in cent., with steam eng.
1—Morris 8-stage centrifugal.
1—14-in. Plat., double suction centrifugal stage horiz. dir. conn. 50-hp. motor; pump and motor.
1—12-in. R.H. "Morris" horiz. cent. unwatering pump, dir. conn. to steam engine.
2—Cameron 10-in. cent., dir. conn. to 100-hp. Westghse. motors, pump and motor.
1—8-in. Class B. S. Worthington cent. double suction, dir. conn. to 200-hp. Gen. Elec induction motor. Pump and motor.

NOTE:—Will sell any of the above pumps without motors.

3—6-in. Allis-Chal., double suction, dir. conn. Bronze Impeller. Pump and motor.
6—8-in. Allis Chal., double suction, dir. conn., Bronze Impeller. Pump and motor.
2—12-in. Allis-Chal., double suction, dir. conn., Bronze Impeller. Pump and motor.
1—14-in. Allis-Chal., double suction, dir. conn., Bucyrus Impeller. Pump and motor.

The Allis-Chalmers Pumps are direct connected to motors and can be bought without motors.



DUMP CARS

(Ready for delivery)
10—12-yd. Western, late model air dump.
8—12-yd. Western hand dump.

125—ELECTRIC MOTORS—125

7½ to 500 hp.—220-440—A.C.

PLYMOUTH GASOLINE LOCOMOTIVES

3-ton, 24 and 36-in. gauge.

SUB-STATION TOWERS

high voltage, with lightning arresters, and disconnecting switches.

9 CONCRETE BUCKETS

1½-yd. capacity.

SMITH CONCRETE MIXERS

½-yd. steam—¼-yd., gasoline.

LOCOMOTIVE CRANE

Orton & Steinbrenner, 20 ton.

SPIRAL RIVETED PIPE

5000 ft., 12 and 15 in.

100—TRANSFORMERS—100

6/10 kva. to 500 kva.

TRANSMISSION AND HIGH TENSION LINE MATERIAL

DREDGE PIPE

15-in. slip joint and elbows.

STEAM PILE HAMMERS

1—No. 4 Vulcan.
1—Ingersoll-Rand, 3 in.

LOCOMOTIVES

1—40-ton Baldwin, std gauge.
1—15-ton Vulcan, 36-in. gauge.

Miami Conservancy District, Dayton, O.
(Sales Division)

FOR SALE

Industrial Road Equipment

Located in Central Illinois

1—Complete Industrial Road Outfit consisting of 20-lb., 24-in. gauge track, 24-in. gauge Koppel batch-box Cars, also V-dump.

Plymouth Locomotives, 2-in. pipe, CH & E pumps, Lakewood Finishing Machines. Lakewood sub-grader, 5-ton Roller, etc. All in perfect condition.

Frazier-Davis Const. Co.
Arcade Bldg., St. Louis

NEW BOILER TUBES

Immediate Stock Shipment—All Sizes
Desired Lengths at Mill Prices

NEW AND RELAYING RAILS

ALL WEIGHTS
Small Vertical Boilers
Automatic Gas Fired Boilers

HYDE & CO., INC.
331 4th Ave., Pittsburgh, Pa.

BOILER

1—250 Hp. Return Tubular 84 in. x 18 ft.

BENTLEY-MORRISON CORP.
Elizabeth, N. J.

Robert H. Laverie & Harris Brothers Co., Liquidators

Announce the Sale of

Machinery-Equipment-Supplies

Located at

SHOOTERS ISLAND, New York

Machinery, equipment and supplies now located on Shooters Island. Finest machine tools, structural tools, power equipment and general industrial plant supplies.

26-ft. Wickes Bros. Horizontal Bending Rolls, equipped with motors to suit requirements.

14-ft. Vertical, Southwark Foundry and Machine Works Bending Rolls, equipped with motors to suit requirements.

Hugh-Smith Company Hydraulic Flanging Bending Machine or Brake, Horizontal Type, 24-ft. bed.

Smith Brothers & Company Four-Sided Punching and Shearing Machine, capacity to punch 1 in. thru 1 in. and shear 6 x ¾ in.

Collier-Smith Quickwork No. 6 Rotary Shear, 48 in. throat, 1 in. plate.

Crane Company 8 in. Pipe Threading Machine, capacity 2½ in. to 8 in.

Chambersburg & Erie Foundry Steam Hammers, 5, 3 and 1½ tons capacity.

Dietrick & Harvey Open Side Planer, 74 in. x 60 in. x 20 ft.

10, 25 and 50 ton Overhead Electric Travelling Cranes.

Ingersoll-Rand 5,000-ft. direct connected Air Compressors.

Sullivan 2,500-ft. Corliss Steam Driven Air Compressors.

Address all communications concerning Shooters Island equipment to Harris Brothers Co., Room 712, 17 State St., New York, N. Y.

STEAM SHOVELS

1—95-ton Bucyrus Railroad Type Steam Shovel, 4½-yd. dipper.
4—70-ton Bucyrus Railroad Type Steam Shovels, 2½ to 3-yd. dippers.
Shovels are rebuilt and in first class working order.

DUMP CARS

80—12-yd. Western & Oliver All Steel Dump Cars. Standard gauge.
10—1¼-yd. Austin Two Side Dump Cars. Wood body. 20-in. gauge.

POWER PUMPS

1—24-in. Kingsford Horizontal Centrifugal Pump. Belt driven.
1—12-in. Platt Iron Works Horizontal Centrifugal Pump. Arranged for [illegible] connection.
1—12-in. Fulton Machine Co. Horizontal Centrifugal Pump. Belt driven.
1—8-in. American Horizontal Centrifugal Pump. Direct connected to [illegible] Westinghouse 220 v. direct current [illegible]
1—No. 924—9-in.x10-in. Goulds Triplex Pump. Belt driven.
1—8-in.x8-in. Deane Triplex Pump, belt driven.
1—7-in.x8-in. Deane Triplex Pump, belt driven.

HOISTING ENGINES

1—7¼-in.x10-in. Duke Dbl. Cyl. [illegible] Drum Steam Hoists, with [illegible] throttle valve.
1—6¼-in.x8-in. Clyde Dbl. Cyl. Dbl. Drum Steam Hoist.
1—[illegible] Stroudsburg [illegible] Drum Steam Hoist [illegible]
1—5-in.x8-in. Lidgerwood Dbl. [illegible] Drum Steam Hoist, revers[illegible]tion.

STEEL STORAGE TANKS

12—20,000 gal. capacity, vertical.
8—10,000 gal. capacity, horizontal.
1—5,000 gal. capacity, horizontal.
10—2,000 gal. capacity, horizontal.

AIR COMPRESSORS

1—1850-ft. W.B. 2 Sullivan Steam Driven Air Compressor. 100 lbs. pressure.
1—1700-ft. G.C. S.D. Chicago Pneumatic Tool Co. Steam Driven Air Compressor. 100 lbs. pressure.
1—1000-ft. Class H Ingersoll Steam Driven Air Compressor.
[illegible]—[illegible]-ft. New York Air Brake Co. Locomotive Type Air Compressors.
1—[illegible]-ft. Laidlaw Dunn Gordon Belt Driven Air Compressor. 100 lbs. pressure.
1—[illegible]-ft. Class [illegible] Chicago Pneumatic Tool Co. Oil Engine Driven Air Compressor. 100 lbs. pressure.

STEAM PUMPS

1—[illegible] Fairbanks Morse [illegible] Steam Pump. [illegible]
1—[illegible] Worthington Duplex Steam Pump.
1—[illegible] Worthington Duplex Steam Pump.
1—[illegible] Worthington [illegible]
[illegible] Deane Duplex [illegible]
1—[illegible] H. Wheeler [illegible] Steam Fire Pump [illegible] Section 10 in. [illegible]

Ask for Free Copy Bulletin No. 205

HARRIS BROTHERS CO.

35th and Iron Streets **CHICAGO**

FOR SALE

1—1-yd. HAYWARD ORANGE PEEL.
2—24-in. gauge LAKEWOOD CARS with Lakewood Controllable Farm Buckets.
1—STIFF LEG DERRICK with 12-in.x12-in.x60-ft. boom, with bull wheel, equipped for clam shell work. Good condition.
1—STIFF LEG DERRICK with 14-in.x14-in.x63-ft. boom, with bull wheel, equipped for clam shell work. Good condition.
3—No. 19 D.B. SULLIVAN AIR JACK HAM'RS.
1—No. 9 D.C. SULLIVAN AIR JACK HAM'RS.
400 ft. of 6-in. W. I. PIPE, with flanges.
1500 ft. of ¾-in. BLACK PIPE.
5—½-yd. TWIN HOPPER, Lee Bodies, designed for Ford Truck.
1—4-yd. LEE SIDE DUMPING BODY with drop end gate.
1—No. 5 Type C LEE LOADER.
1—DITCHER SCOOP and Attachment for No. 3 Keystone.
1—A-FRAME TRAVELING DERRICK with 80-ft. Steel Boom.
1—Type O THEW FULL REVOLVING SHOVEL for sale or rent.
1—8-in. GOULD CENTRIFUGAL PUMP, D.C. Steam Engine, complete with fitting.
1—20-in. MORRIS CENTRIFUGAL PUMP, D.C. Steam Engine.
3700-ft. INDUSTRIAL TRACK, 24-in. gauge, 20-lb. rail, 15-ft. sections, 6 ties to the section, and three switches.
1—No. 21-S STANDARD BUILDING MIXER with Steam Engine and Batch Hopper, on skids.

THE MILLER EQUIPMENT CO., INC.
583 Dillaye Building, Syracuse, N. Y.

FOR SALE

No. 4 Keystone Excavator

Shop No. 4262 in first class condition with six roll Skimmer Scoop. **Price $3500.00**

M. IRVING DEMAREST
Smith and Front Sts., Perth Amboy, N. J.

FOR SALE

IMMEDIATE DELIVERY

50—Yale & Towne, 5 to 8-ton Triplex Chain Hoists. Guaranteed to be in first class operating condition. 12 to 18 ft. lift. Each $90.00 to $125.00.
12—Richardson-Phoenix Co. Peterson Type Marine Oil Filters. Capacity 1200 to 2400 gal. per hour. These are New and in original shipping crates. Each $50.00.

Special prices on lots of five or more.

The Day & Maddock Company
Contractors' New and Used Machinery and Equipment
West 82nd St. and Denison Ave.,
Cleveland, Ohio.

Transmission

New and Used Dodge Equipment for Immediate Delivery

Shafting—Cold Rolled Steel—All sizes and lengths
Shaft Hangers—All types and sizes
[illegible]
Pillow Blocks
Friction Clutches—Dodge Split, solid and [illegible]
Couplings—Split and Flanged
Pulleys—Split and Solid, Cast Iron, Steel [illegible]
[illegible]
[illegible]

Our Bulletin No. 15 will give you complete information

Nashville Industrial Corporation
[illegible]

FOR SALE

I-BEAMS

[illegible]

LOUIS J. SIELING, Red Bank, N. J.

Immediate Shipment

ASPHALT PLANTS

1—Iroquois 800-yd., 2 unit Portable Plant.
2—Merriman 2000-yd Railway Car Plants.

ASPHALT ROLLERS

1—5-ton Iroquois Tandem Roller.

CARS

10—80,000-lb. capacity Gondola Cars.
5—60,000-lb capacity Rebuilt Box Cars

PRESSURE DISTRIBUTOR WAGONS

FOR RENT

Box Cars—40 ft.—Steel Underframes.
Gondola Cars—80,000 lb. Capacity.

Let Us Quote You On Your Requirements

P. E. FRANCIS & COMPANY, Marquette Building, Chicago, Ill.
Railroad and Industrial Equipment

Steam Hoists

FOR SALE OR RENT

7½-in.x12-in. **Mundy** Double Cylinder, Double Drum Hoisting Engine with A.S.M.E. Code Boiler.
6¼-in.x8-in. **Lidgerwood** Double Cylinder, Single Drum Skeleton Frame Hoisting Engine.
5½-in.x10-in. **Mundy** Double Cylinder, Double Drum Hoisting Engine with A.S.M.E. Code Boiler.
5-in.x10-in. **Mundy** Double Cylinder, Double Drum Hoisting Engine with Boiler.

Send for our July list of the largest stock in the United States of slightly used and thoroughly overhauled **Machine Tools, Power, Electrical and Contractors' Equipment.**

Wickes Machinery Company
Jersey City, N. J.
Established 1900.

WATER TUBE BOILERS

Immediate Delivery

48—250 Horse Power, New, Standard Cross Drum Water Tube Boilers. Built for 200 lbs. working pressure. Complete with steel casing, steam fittings and grates. Ready for immediate delivery from Chicago, Dumont, New Jersey and Orange, Texas.

HARRIS BROS. CO., 35th and Iron Sts., Chicago, Ill.

FOR SALE

LOCOMOTIVES and DUMP CARS

7—36 in. gauge; 18 ton, 4-driver saddle tank Locomotives.

50—36 in. gauge; 4 yard, 2-Way Dump Cars.

All in first class condition, ready for immediate shipment.

Southern Iron & Equipment Co.
Atlanta Ga.

FOR SALE

1 Smith Tilting Mixer

1 cu. yd. capacity, with batch hopper. With or without motor. Used on two jobs.

1 Wood Frame Whirley

40-ft. boom, full circle swing, American hoist engine and independent swinging engine. Just the thing for the job that cannot stand much investment.
The mixer and Whirley must sell regardless of price. Also have 2 Whirleys, all steel construction, with 50 and 60-ft. booms and three drum hoists on them.
1—Williams, Hercules, clam shell bucket. Used very little.

GLEN M. WILEY
Room 63, Davis Bldg., Dayton, Ohio.

Paver—Roller—Shovel

READY TO GO

Model 29 Osgood Shovel on road wheels completely overhauled, two years old	$6,500
Ten-ton Kelly Tandem Steam Roller in excellent condition, shop number 747	$1,350
14E Lakewood - Milwaukee Paver on road wheels, steam boom and bucket	$1,700

Minneapolis Equipment Co.
309-11 Fifth St., South, Minneapolis, Minn.

10x12 Lidgerwood Cableway Steam **Hoisting Engine;** bank of 5 levers; double cylinder, double drum; A-1 condition.
20-ton McMyler, 8-wheel **Locomotive Crane;** double drum for bucket operation; 50-ft. steel boom, with clamshell bucket; in first class condition. Immediate shipment.

ARTHUR S. PARTRIDGE
415 Pine St., St. Louis, Mo.

Foote 10-E Paver

steam power, on wheels, with distributing spout. Practically new. First-class condition.

Address P. O. Box 1378
Richmond, Va.

FOR SALE

BYERS AUTO CRANE

Type "C." ½-yd. bucket. First class condition.

COLD SPRING CONSTRUCTION CO.
East Aurora, N. Y.

BUY OR RENT A

PULSOMETER STEAM PUMP

See our large advertisements in the display advertising section.

NEW and GOOD AS NEW!

New Pulsometers can be rented or leased from the factory at big savings.

Reconditioned Pulsometers—good as new—on sale at the factory. Buy direct and be protected. All sizes, 2 in. to 8 in.

Pulsometer Steam Pump Company
225 West 42nd Street, New York City

Practically New Caterpillar Dragline

FOR SALE OR RENT

Class 9½ Bucyrus, full revolving Dragline, mounted on Caterpillar Traction, A S M E. boiler, 60-ft. boom, 1½-yd. Page Dragline Bucket, completely re-built in May, 1923, with new boiler, new treads, new gears, pinions, brasses, etc., guaranteed like new. Located near Detroit, Mich. Ready for immediate shipment and service.

Exceptional Bargain

GREY STEEL PRODUCTS COMPANY
111 Broadway, New York, N. Y.

HOISTING MACHINERY

T. H. LETSON CO.

Good Used Equipment — 50 Church St — NEW YORK — Clean Business Methods

CONTRACTORS EQUIPMENT

CRUSHERS

1—24x18 Buchanan Jaw manganese fitted, excellent condition immediate shipment.
3—No. 5 Gates gyratory manganese fitted.

HOISTS

2—4x6, National swingers.
1—7¼x10, DD, Mundy and boiler.
1—8¼x10, three drum and A.S.M.E. boiler.

DERRICKS
For Bucket Work

1—75-ft. boom, Terry, wooden stiff-leg.
1—92-ft. boom, Terry, wooden stiff-leg.

LOCOMOTIVES

Standard Gage **Saddle Tank**

5—14x22, 4-wheel Americans.
2—13x18, 4 wheel Americans.
2—14x22, 4-wheel Baldwins.
3—15x20, 4-wheel Baldwins.

STEAM SHOVELS

1—95C Bucyrus, 3½-yd. dipper Serial No 1415.
1—73 Osgood, 3 yd. dipper, Serial No. 496.
2—70C Bucyrus, 2½-yd dipper, Serial No 1782.
1—69 Osgood, 2½-yd. dipper, Serial No. 546.

CARS

11—16-yd. K & J all steel air dump, standard gage, rebuilt like new.

QUALITY H-F Co SERVICE

SELECTED ITEMS

From Our Large Stock of New and Overhauled Equipment

- 7-S Knickerbocker Concrete Mixer, gasoline driven.
- 10-ton Buffalo Pitts 3-wheel Roller with pressure scarifier.
- 7 x 10 Stroudsburg D.D.D.C. Hoist with Mass. Boiler.
- 10-E Austin Paver, steam driven.
- 4½ ton Milwaukee Gasoline Locomotive, 24 in. gauge, rebuilt.
- 4 mi. 24-in. gauge Portable Track, 20-lb. rail.
- 4 in. Lawrence Centrifugal Dredging Pump, direct connected to 40 hp. A.C. Motor.
- 10 in. Lawrence Centrifugal Pump, direct connected to 30 hp. A.C. Motor, never used.

Also Forms, Graders, Concrete Mixers, Road Pumps, Shovels, Buckets, etc.
Write for Complete List.

THE HUBBARD-FLOYD CO. INC.
MAIN OFFICE: 452 Lexington Ave., New York, N Y Vanderbilt 1465
BOSTON OFFICE: Old South Building, Main 4233

STEAM SHOVELS

1—Type B Erie Caterpillar ¾ yd dipper, 22-ft. boom, 19-ft. sticks.
1—Type B, Erie Revolving Traction Type, ¾-yd. dipper.
1—No 1 Thew 1 yd dipper, Traction Type.
1—14 B Bucyrus Traction Type ¾ yd. dipper.

Many other shovels—send for list.

LOCOMOTIVES

1—24 in gauge 7 in x 12 in 8 ton Locomotive
80 Locomotives in stock—send for list

TRACK

4 miles, 24 in gauge Kopple Portable Track, 20 lb Rail

We have 50,000 ft 1½-in Galvanized Steel Cable New never used recently purchased from government.

Phone Wire Write

Contractors Mchy. & Supply Co.
318-320 Penn Ave., Pittsburgh, Pa.

Locomotive For Sale

1—Vulcan 6x10 Four Driver Saddle Tank 36-in gauge in first class condition. Price $1500.00

KEISER-GEISMER ENGINEERING CO
1308-9 American Trust Bldg.
Birmingham, Ala.

40-TON LOCOMOTIVE

1—14x22 stand gauge 40-ton American 4 wheel Saddle Tank New [illegible] A S M E boiler 190 lb. pressure, automatic couplers, slightly used [illegible] hauled guaranteed like new

Immediate Shipment—[illegible]

GREY STEEL PRODUCTS CO
111 Broadway New York, N. Y.

---

2 LOCOMOTIVES

New 30-in gauge 15 tons. Very [illegible] price. For particulars address

FS-114, Engineering News-Record
10th Ave. at 36th St., New York City.

FOR SALE

1—Whitcomb 6 ton 24 in gauge Locomotive, used 90 days, [illegible]
[illegible] Locomotives [illegible] 30 days respectively, at $2,500
[illegible] Batch Boxes, bottom [illegible] capacity with separate compartments for cement, [illegible] practically new, [illegible]

[illegible] guaranteed the [illegible] to be inspected at our warehouse

SHEA & COMPANY
[illegible]
[illegible]

FOR SALE

100,000 lbs. Capacity Flat Car

[illegible]

Walter A. Zelnicker Supply Co.
[illegible]

FOR SALE OR RENT

Late Type Thew Steam Shovel, ¾-yd. dipper. Shipper shaft boom.
Rex 14-E Paver on wheels.
Bucyrus 70 C Steam Shovel, completely overhauled. Also all other types of contractors' machinery.
What have you to offer?

HOLLANDER EQUIPMENT COMPANY
"The Key to Good Machinery"
[illegible] New York, N. Y.

I Specialize In

All Types—COMPRESSORS—*All Drives*

I am the only machinery dealer specializing in compressors, and have the largest stock—located in all sections of North America. Each inquiry will receive the benefit of ten years experience.

5320-5011 ft. PRE Ingersoll, Electric.
2678-2033 ft. PRE Ingersoll, Electric.
1730 ft. O-CE Chicago, Electric.
1190-599 ft. XB-2 Ingersoll, two-stage belt.
706-445 ft. WJ-3 Sullivan, two-stage belt.
688 ft. ER-1 Ingersoll, single-stage belt, 45 lb.
324 ft. ER-1 Ingersoll, single-stage belt.
New—209 ft. Climax, single-stage belt.
121 ft. ER-1 Ingersoll, single-stage belt, 25 lb.

2588 ft. OC-3 Ingersoll, steam.
2570 ft. Laidlaw Feather Valve, steam, 80 lb. air.
1592 ft. X-1 Ingersoll, steam, 55 lb. air.
1955-1531-648 ft. XPV-3 Ingersoll, steam.
1190-599-446 ft. X-3 Ingersoll, steam.
888-599-446 ft. X-2 Ingersoll, steam.
396 ft. WB-2 Sullivan, steam.
386 ft. FR-1 Ingersoll, steam.
176 ft. N-SS Chicago, steam.

MISCELLANEOUS

2500 kw., Westinghouse Turbo, 3-60-2300.
1875 kva., Westinghouse Turbo, 3-60-2400.
625 kva., Westinghouse Turbo, 3-60-2400.
375 kva., Westinghouse Turbo, 3-60-2400.
New 400 kw., Westinghouse Turbo, 3-60-240.
250 kw., Nat. Brake-Russell set. 3-60-2300.
202 hp. HRT Mass. Std. 165 lbs.
No. 5 Leyner Drill Sharpener.
20-ton Browning Loco. Crane, 50-ft. boom.
2—1000 ft. Cableways, Engines, no towers

BOILERS--GENERATORS—LOCOMOTIVE CRANES—DERRICKS, ETC.

10 High St.——***A. Lee Ellis***——Boston, Mass.

"The Buyer Must Be Satisfied—Always"

FOR SALE

PAVER

Ransome 21-E Paver, steam driven boom and bucket discharge. Has laid 2 miles 20 ft. road. $4,000.

FINISHING MACHINE

1—Lakewood Machine in perfect condition. $1,000.

LOCOMOTIVES

1—6-ton Plymouth. $2,200.
3—3-ton Plymouths. $1,200. Perfect condition.
6,000 ft. 24 gauge track; 15 batch-box cars with Hyatt roller Bearings; 30 batch-boxes 34 cubic ft.

Tri-State Construction Company
Bridgeton, N. J.

General Equipment

Located in various parts of the United States

BOILERS
BATCH BOXES
CABLEWAYS
CARS
COMPRESSORS
CONVEYORS
CRANES
CRUSHERS
DERRICKS
DITCHERS
DRILLS
ENGINES
FORMS
FINISHERS
GRADERS
HOISTS
LOADERS
LOCOMOTIVES
MIXERS
MOTORS
PAVERS
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ROLLERS
SCRAPERS
SHOVELS
TRACTORS
TRUCKS
TRACK
TANKS
WAGONS
ETC.

Write, wire or phone for descriptions and prices of machines you need.

ALEXANDER T. McLEOD
First Nat'l Bank Bldg., Chicago

PAVERS

FOR SALE

14-E Rex, good as new, used but 4 weeks.
14-E Koehring.
No. 9 Koehring.

SUTTON & CORSON CO.
Ocean City, N J

FOR SALE

Complete New Concrete Plant

(used six months), including 180-ft. Insley steel tower, two 40-ft. bucket elevators, Blaw-Knox measuring batchers, 21-S Smith Tilting Steam Mixer, Lambert double drum concrete tower hoist—speed 350 ft. per minute, 80 hp. locomotive boiler, now located at Washington, D. C., on job. Save $4,000.

Consolidated Engineering Company
Calvert Building, Baltimore, Md.

FOR SALE

2—10-ton **Buffalo Pitts Rollers.**
1—21-E **Rex Paver.**
1—100-ton **Blaw-Knox Bin.**
1—36x48 **Jaw Crusher.**
1—6-ton **Kelly-Springfield Roller.**
1—**Traveling Derrick**, with 9x10 3-drum engine and boiler.
1—Marion 60 **Steam Shovel.**
1—Type O **Thew Shovel.**
1—**Byers Auto Crane.**
1—**Mundy Swinging Engine.**
1—10-ton **Monarch Roller.**
1—24-in.x30-ft. **Belt Conveyor.**

J. T. WALSH
500 Brisbane Bldg., Buffalo, N. Y.

TRAILERS—TRACTORS—TRUCKS

12—Troy Trailers. Drop Frame. Side Dump. High Speed.
1—10-ton Holt Caterpillar Tractor, 40-60 type.
2—5-ton Mack Chassis, Flusher Equipment.

All in First-Class Condition—completely overhauled

HARRY BROCKLEHURST
512 W. Norris St., Philadelphia, Pa.

ROAD BUILDERS' PLANT

FOR SALE.

Road-Rollers; Pavers; Shovels; Keystone Excavators; Locomotives; Track; Dump and Flat Cars; Hoists; Cranes; Graders; Finishers.

All necessary Equipment for complete plant.

JOHN M. GREENE
430 Chestnut Street, Philadelphia, Pa.

FOR SALE

Rex (Chain Belt) Concrete Mixer, ½ yard capacity

Mixer is equipped with steam engine and boiler, power loader and automatic water tank, mounted on steel skids and trucks. Holds 24 feet of loose material. Thoroughly overhauled and equipped with new fittings throughout. For practical purposes. Like new.

We offer this mixer at a SAVING OF OVER $1,000.00. F.O.B. cars or truck, Metropolitan District.

Brown & Sites Co.
30 Church St., New York.
Cortlandt 1190

FOR SALE

Stiff Leg Derrick

70-ft. boom; all steel. First class condition.

Walter A. Zelnicker Supply Co.
St. Louis, Mo.
Rails, Cars, Locomotives, Steel Piling, Etc.

FOR SALE

PAVERS

1—Foote Paver, size 27-E, with steam engine and boiler and distributing chute—$1800.
1—Ransome Paver, high drum, size 7-E, with 6 hp. Novo gasoline engine and 10-ft. distributing chute—$1100.

For immediate shipment. Located close to New York; in good working order.

W. H. HUDSON
Room 1230
150 Nassau Street, New York City

FOR SALE

Steam Hoist with Boiler

1—Donegan & Swift, with 125-ft. ⅝-in. cable, 4½-in.x8-in. double cylinder, single drum.

Good as new, will sell cheap.

CONRAD SEBOLT
16 Richmond St., New Brunswick, N. J.

STONE CRUSHER

1—Gyratory No. 6-F with fittings

Holbrook, Cabot & Rollins Corp.
52 Vanderbilt Ave., New York, N. Y.

FOR SALE OR RENT

EARTH MOVING, HIGHWAY, RAILROAD AND BUILDING CONTRACTORS EQUIPMENT

STEAM SHOVELS

Railroad Type

1—Model 92 Marion, 5 yd.
1—Model 80 Marion, 4 yd.
1—Model 60 Marion, 2½ yd.
1—70-C Bucyrus, 2½ yd.
1—Model 41 Marion, 1½ yd.
2—Model 40 Marion, 1½ yd.
1—Model 20 Marion, 1¼ yd.
1—Model 36 Marion, 1½ yd. (Revolving).

Crawler Type

2—Model 37 Marion, High Lift, 1¼ yd.
4—Model 36 Marion, High Lift, 1 yd.
1—225-B Bucyrus, 6 yd.
1—50 B Bucyrus, 1¼ yd.
1—35-B Bucyrus, 1½ yd.
5—Model 21 Marions, ¾ yd.
2—Model 28 Marions, ¾ yd.
2—18 Osgoods, ¾ yd.

Traction Type

1—Model 36 Marion, 1½ yd.
1—Model 30 Marion, ¾ yd.
2—18 Osgoods, ¾ yd.
2—Model 28 Marions, ¾ yd.
2—Type B. Erie, ¾ yd.
2—Type A. Erie, ½ yd.

LOCOMOTIVES

1—40-ton Davenport, 4-D, S.G. Switcher.
1—40-ton American, 4-D, S.T., S.G.
1—20-ton Lima, 4-D, S.T., S.G.
2—10x16-18-ton, 36-in. gauge Porters.
2—10x16 18-ton, 36-in. gauge Vulcans.
3—9x14 14 ton, 36 in. gauge Vulcans.
1—50 ton, 36-in. gauge Climax Geared.
1—40 ton, 36 in. gauge Climax Geared.
1—10x16-18 ton, 42 in. gauge Porter.
1—6x10-7½-ton, 42-in. gauge Vulcan.
1—7x12 24 in. gauge Vulcan.
1—7x12 24 in. gauge Davenport.
1—8x12-24-in. gauge Vulcan.
2—3½-ton, 24-in. gauge Burton, Gasoline
1—3-ton, 24-in. gauge Plymouth, Gasoline
2—3-ton, 36-in. gauge Plymouth, Gasoline.
2—5-ton, 36 in. gauge W. Elec., Trolley Type.
1—8-ton, 36 in. gauge W. Elec., Trolley Type.

TRACK

2 miles track, 80-lb. rail, complete with splices.

CLAM SHELL BUCKETS

1—¾-yd. Williams "Favorite."
1—¾ yd. Blaw-Knox
—¾-yd. Owen
4—1-yd. Owen.
2—1¼-yd. Owen
1—1½-yd. Owen
2—2 yd. Owen

LOCOMOTIVE CRANES

1—25-ton, 8 wheel Ohio, 60-ft. boom.
1—20-ton, 8-wheel Ohio, 60-ft. boom.
1—20-ton, 8-wheel Industrial, 42 ft. boom.
1—14-ft., 6-in. ga. McMyler Whirley, 60-ft. bm.
1—10 ton Byers Crawler, Revolving, 35 ft. boom.
1—Byers Auto-crane, Semi Caterpillar.

ROAD ROLLERS

1—10-ton, 3 wheel Kelly-Springfield.
1—10-ton, 3 wheel Buffalo-Pitts
1—Steam Pressure Cylinder Scarifier.
1—"Porcupine" Scarifier.

PAVERS

1—14-E. Rex Traction, Steam.
1—21-E. Rex Crawler, Steam.

CARS

12—12-yd., S.G. Oliver Hand Dump (All Steel).
10—12-yd., S.G. Western Hand Dump.
14—12-yd., S.G. Western Air Dump.
12—4-yd., 36-in. gauge Western Steel Beams.
20—4-yd., 36-in. gauge Western Wood Beams.
12—4-yd., 36-in. gauge K.&J. Steel Beams.
16—3-yd., 36-in. gauge K.&J. Wood Beams.
9—3-yd., 36-in. gauge Continental Wood Bms.
1—36-in. gauge Flat.
11—1½-yd., 24-in. gauge Western Wood Beams.
8—36 cu. ft., 24-in. gauge Koppel (Steel).

Also Air Compressors, Engines, Boilers, Derricks, Steam, Gasoline and Electric Hoists, Road Builders' Equipment, Concrete Mixers, Pumps, Crushers, Rails, Portable Track, Steam Hammers, Scrapers, and Wagons.

UTILITY EQUIPMENT COMPANY, Union Bank Bldg., Pittsburgh, Pa.

DERRICK BOAT FOR SALE

Two hulls 90 ft. x 16 ft. each, clearance over all 35 ft., fully equipped locomotive type return tube boiler, triple drum 9 x 12 National hoist, swing engine, necessary spud hoists and spuds, etc., boom 55 ft. long	$7500
1—10 16 Vulcan Locomotive, 36 in. gauge	1200
7—12-yd. Oliver Dump Cars (entirely rebuilt and not since used,) each	1000
1—65-ton Bucyrus Shovel	7500
1—70-ton Bucyrus Shovel	5000
1—1-yd. Haywood Orange Peel Bucket	550
1—3-yd. Haywood Orange Peel Bucket	1500

Also other construction equipment at low prices.

James H. Dawes, General Contractor, Tonawanda, N. Y.

DITCHER

No. 3 Austin Ditcher For Sale

Used less than six months. Four cylinder Buffalo Engine, burns kerosene. Excavates ditch 12 ft. across top, 3 ft. across bottom, sloping sides. First-class condition.

MacAndrews and Forbes Company
3rd St. and Jefferson Ave., Camden, N. J.

STEAM HOISTS

7x10 Lidgerwood, D.C., Dble. Drum, with Boiler.
8¼x10 Flory, D.C., Double Drum, with Boiler.
8¼x10 American, D.C., Double Drum, with Boiler.
8¼x10 American, D.C., 3 Drum, with Boiler.
8x12 Flory, D.C., Double Drum, without Boiler.
8¼x10 Amer., D.C., Double Drum, without Boiler.

GASOLINE LOCOMOTIVES

3-Ton Plymouth, 24-In. Gauge.
6-Ton Whitcomb, 24-In. Gauge.
7-Ton Whitcomb, 24-In. Gauge.
3-Ton Plymouth, 36-In. Gauge.
10-Ton Port Huron Steam Roller, 3 Wheeler, D.C.
25-hp. Rumley Traction Eng., D.C., Steel Gearing.
3 Port Huron, Reversible, 6-yd., Steel Dump Cars

ARTHUR S. PARTRIDGE
115 Pine Street, St. Louis, Mo.

FOR SALE

ROAD EQUIPMENT

1—10 ton Austin Road Roller, gasoline.
1—15 ton Holt Caterpillar Tractor, 75 hp
2—Maney Scrapers.
1—Little Giant Austin Western Road Grader.
2500 lin. ft., 20 lb. 24-in. gauge industrial track in 15 ft. sections.

MIXERS

1—¾ yd. Ransome Mixer, mounted on skids equipped with steam engine side loader and batch hopper.

DRAGLINE

1—Class 14 Bucyrus Dragline mounted on caterpillar traction. Shop No. 3562 with 70 ft. boom 2 yd. Page bucket.

Above Equipment Located at Chicago

MELLON-STUART CO.
Fisher Bldg., Chicago

MISCELLANEOUS

New and second-hand structural steel; all sizes.
100 tons 4 1 military barb wire, galvanized.
C 1 Bessemer screw cutting stock 9/32 in., 11/32 in., 5/16 in. and ⅜ in.
[illegible] in. x 18 ft. H R T Pennsylvania standard, 125 lbs., complete with fronts and fittings.
300,000 ft. Merchant Long Leaf Yellow Pine sizes 12 x 14 and under.
700 [illegible] 34 in. section A. 85 A S [illegible] bars.
Tanks, [illegible] Stacks, Contractors' Equipment, Hoisting Engines, Boilers, Pumps, etc.

Henry A. Hitner's Sons Co.
[illegible] St., Philadelphia, Pa.

FOR SALE

AUSTIN TRENCHER

1—OO, used very little, like new. Also [illegible] Austin Backfiller.

R. F. KELLY CONTRACTING CO.
Easton, Penna.

TRENCH MACHINES

1—Austin 00 digs 10 ft. deep up to [illegible]
3—Parsons Backfiller, caterpillar traction
2—[illegible] No. 1, [illegible]
1—[illegible] Austin digs 18 ft. deep up to [illegible] gasoline driven.

J. McELROY, 11 S. La Salle St., Chicago

FOR SALE

PARSONS' TRENCHING MACHINE

For Immediate Delivery

JOHN B. McLANE & COMPANY
Newport, Kentucky

MERRIMAN ASPHALT PLANT

We have for sale one rebuilt No. 1 Merriman 2000 yard, One-Car Steam Melting Asphalt Plant. It is in fine condition and we can make good delivery.

Here's your chance to get a real asphalt plant at a price that is right. Better get in touch with us quickly.

The East Iron & Machine Co.
[illegible]

For Sale Cheap

[illegible] Paving Brick
Also
[illegible] Locomotives, [illegible]
[illegible] Koppel Cars and Western Batch Boxes
SAMPSON & REUTER
[illegible] St., Elizabeth, N. J.

FOR RENT OR SALE

Hoisting Engines
Air Compressors
Concrete Mixers
Boilers, Pumps
Derricks
Steam Shovels
Buckets and Smoke Stacks

Pierce Foundation Corp.
128 E. 141 St., New York City
[illegible]

FOR SALE OR RENT

STEAM SHOVELS

1—Model 18, Osgood, revolving, mounted on caterpillar, high-lift equipment, ¾-yd. dipper (New July, 1922).

1—Model 18, Osgood, revolving, mounted on caterpillar, high lift equipment, ¾-yd. dipper (New 1920).

1—Model 28, Marion, revolving, Shop No 3375, traction wheels, standard boom, ⅝-yd. dipper.

1—18B Bucyrus, revolving, Shop No 1764, traction wheels, standard boom, ⅞-cu. yd. dipper.

2—70C Bucyrus, Railway type, Shop Nos 1499 and 1582, standard gauge, 2½-yd. dippers.

1—Little Giant, Railway type, standard gauge, equipped with standard boom, 1¼-yd. dipper.

GONDOLA CARS

50—80,000-lb. capacity, standard gauge, all cars in service. Specifications on request.

LOCOMOTIVE

1—24-ton, 6-wheeled, connected Whitcomb gasoline switcher, standard gauge, 6-cyl. Minneapolis engine.

TRACTORS AND TRAILER

1—10-ton Holt Caterpillar Tractor.
1—120 hp. Holt Caterpillar Tractor, completely rebuilt at factory.
1—5-ton Troy Trailer.

DRAGLINES

1—Class 14 Bucyrus caterpillars 60-ft boom, 2-yd. bucket.
1—Class 24 Bucyrus, steam-operated, Shop No. 772, skids and rollers, 100-ft. boom, 3½-yd. bucket.
1—Class 24 Bucyrus Electric skids and rollers, 100-ft. boom, 3½-yd. bucket.
1—Monighan, A 1, steam, traction wheels 40-ft. boom, 1-yd. bucket.

The above list is constantly changing. No matter what your machinery requirements are, write us—we may have it.

BECK & BABB, 29 La Salle Street, CHICAGO, ILL.

CRANE

Austin No. 4 full revolving gasoline driven Crane on caterpillar tread 35 ft. boom. Used two months.

LOCOMOTIVE

Baldwin 35-ton, standard gauge saddle tank 0-4-0 air brake and air dump.

A. J. O'Neill Company
1524 Chestnut St., Philadelphia, Pa.

EXCEPTIONALLY GOOD ITEMS

LOCOMOTIVE CRANES

1—25-ton Broad Gauge Locomotive Type Crane, 50-ft. boom, D.D., Bucket Handling, A.S.M.E. Boiler, new 1918. Perfect condition.
1—20-ton Browning D.D., 50-ft. boom, 8 wheel Mass. Boiler, Shop No. 1149. Located Phila.

ROAD CRANE

1—"Little Giant", Full Revolving Road Crane, mounted on traction wheels, 30-ft. boom, new July, 1920.

AIR COMPRESSOR

1—2000-cu. ft. Laidlaw, 2-Stage Tandem, Compound Steam Operated Air Compressor, new 1918. Perfect condition. Must be moved quickly. Will price right for quick sale.

SADDLE BOILER CARS

3—All-Steel Saddle Boiler Cars, 140,000-lb. underframe Can be used also as Flat Cars. Standard gauge, 8 wheel. Perfect condition.

WE ALSO OFFER

Dredges, Shovels, Cars, Locomotives, Draglines, Road Equipment, Hoisting Engines, Etc.

WHAT ARE YOUR REQUIREMENTS?

B. M. WEISS
1324 Widener Bldg. Phone Locust 4816 Philadelphia, Pa.

LOCOMOTIVE CRANES

1—McMyler, 20 ton, 8 wheel, 40-ft. boom, bucket operating, located in Cleveland.

1—Orten & Steinbrenner, 15 ton, 8 wheel, 40-ft. boom, 1-yd. bucket, located in Elizabeth, N. J.

1—Interstate, 20 ton, 8 wheel, 50-ft. boom bucket operating, located in Elizabeth, N. J.

1—Browning, 15 ton, 4 wheel, 50-ft. boom bucket operating, located in Elizabeth, N. J.

1—Browning, 15 ton 8 wheel, 38-ft boom, bucket operating, located in Ohio.

1—Brown Hoist, 15 20 ton, 8 wheel, 42-ft. boom, hook block

1—Industrial, 7½ ton, 4 wheel.

1—Browning, 7½ ton, 4 wheel, electric.

Hoisting Machinery Co.
50 Church Street, New York.

LOCOMOTIVE CRANE

20-ton American, 8-wheel, M.C.B. Trucks, double drum arranged, for clam shell operation. A. S. M. E. boiler, 125 lb. working pressure. Crane in excellent condition. Ready to put on job.

Big List Contractors Equipment

L. A. GREEN
1120 1st National Bk. Bldg Pittsburgh, Pa.
Phone Court 0690.

FOR SALE

BYERS AUTO CRANE MODEL "C"

Modern Type on Traction Wheels, in Excellent Operating Condition.

30 hp., 4 cylinder, Gasoline Engine Car body, deep steel channels, 18 ft. long. Width outside wheels, 10 ft. Derrick capacity 4,500 lb. at 20-ft. radius.
¾-yd. bucket capacity.
Length of boom, 30 ft.

Immediate Delivery.

THE NEW LONDON SHIP & ENGINE CO.
Groton, Connecticut

Railroad Cars

100—80,000-lb. capacity flat cars; new bodies.

100—80,000-lb. capacity box cars; thoroughly rebuilt.

35—100,000-lb. capacity tank cars; good as new—7,200-gal. capacity.

Houston Railway Car Co.
Houston, Texas.

FOR SALE

Cranes—Shovels

1—Osgood "18" Steam Shovel. On traction wheels. In excellent condition. Price $3000.

1—P & H "205" Crane ½-yd clamshell. Only used four months.

1—Keystone No. 6 with ditching and skimmer attachments. New in 1921, just overhauled. Price $3200.

(Other Equipment not listed)

G. C. WILLIAMS
28 East Jackson Blvd., Chicago, Ill.
Phone Wabash 9327.

LOCOMOTIVE CRANES

No. 205 P & H 30 ft boom, ¾-yd. bucket
No. 3 Byers, 32 ft boom, ¾-yd. bucket, steam.
BYERS AUTOCRANE, 30-ft. boom, 1-yd. bucket.

STEAM SHOVELS

Model 28 Marion, ⅞-yd. dipper, traction.
No. 0 Thew ⅝ yd. dipper, railway type.
3 Model 60 Marion, 2½-yd. dipper, railway type.
225 B Bucyrus Electric Shovel. 5, 6, 8-yd. Bkts.
110-C Bucyrus Standard Gauge Shovel.

BOILERS

2—100 hp. Locomotive type, 100 lb.
60 hp. Locomotive type, 90 lb.

HOISTS

25 and 50 hp Electric Hoists, D.D., Dragline, 440 v., 60 cy., 3 ph. motors.
100 hp. Thomas 2-speed, 220 v., 3 ph., 60 cy.
Contractors and Rock Crushing Equipment.

ROSS POWER EQUIPMENT CO.
Indianapolis, Ind.

FLAT CARS
40 STD. GAGE 20,000 LBS. CAPACITY
4 WHEEL—ROLLER BEARING

All-Steel Construction. GOOD AS NEW.

Suitable for general industrial purposes as push cars or with gasoline or steam locomotives. Auto couplers; weight 2700 lbs. each.

WALTER A. ZELNICKER SUPPLY COMPANY, St. Louis, Mo.
Rail, Locomotives, Steel Piling, Cranes, Tanks, Etc.

We Buy, Sell, Rent and Rebuild

CONTRACTORS EQUIPMENT

For Immediate Delivery

Browning ⅞-yd. Caterpillar Shovels

CATERPILLAR CRANES

Browning 7½-ton Caterpillar Cranes, 38-ft. boom.

TRACTION WHEEL SHOVELS

Marion Model 31, on traction wheels.
Type 3-A Thew 22-ft. dipper sticks, 1¼-yd. dipper, shipper shaft type.
Type A-1 Thew, on traction wheels, ⅞-yd. dipper.
1—Electric Self-Generating Locomotive Crane, mounted on traction wheels.

LOCOMOTIVE CRANES

1—20-ton, 4-wheel Browning Crane, 40 ft boom.
1—15-ton, O. & S., 8-wheel Crane, 40 ft boom.
1—30-ton Browning Crane, 8 wheel, 40-ft. boom.
1—20-ton Browning Locomotive Crane 8 wheel, 50-ft. boom.
1—Brown Hoist, No 4-J Locomotive Crane, 50-ft. boom.

STRIPPING SHOVELS

New and used, ranging in capacity from 2 to 6 yds., either steam or electric driven.

VICTOR R. BROWNING & CO.
Lock Box 27, Collinwood Station,
Cleveland, Ohio.

LOCOMOTIVE CRANE

1—25-ton, 8-wheel, stand. gauge Browning No 5-C, built late 1921 A S M E boiler, 50-ft. boom, double drums out riggers, slightly used just overhauled like new.

Immediate Shipment—Attractive Price

GREY STEEL PRODUCTS CO.
111 Broadway, New York, N. Y

CRANE

100-ft. Radius, American Hoist and Derrick Cos., 60-ft. lift. Six ton capacity. Complete with Hoisting Engine and fittings. (Excepting guy lines and cables). This machine is new—never erected, perfect condition. Bargain, at less than 1/3 of its value.

SPECIALTY ENGINEERING CO.
Allegheny Ave. & Trenton Ave., Phila

FOR SALE

LOCOMOTIVE CRANE

Osgood "29" Mounted on standard railroad trucks for clamshell or crane service. 40-ft boom.

THE LAKEWOOD ENGINEERING CO.
Cleveland, U. S. A.

WE OWN AND OFFER

CRANES

Cranes are standard, 25 to 30 ton, Link Belt, locomotive crane tops, mounted on all steel heavy Gantry sub-structure. Full revolving, steam operated, Mass. std. boilers, self-propelling, 20-ft. gauge, 90-ft. booms (52-ft. with 38-ft. center section), 22-ft. clearance in heighth.

Cranes all perfect condition, like new.
Immediate Delivery

B. M. WEISS
1324 Widener Bldg., Philadelphia, Pa.

LOCOMOTIVE CRANES

1—Brownhoist 15-ton Locomotive Crane, 8 wheel, Built 1919.
1—O&S 18-ton Locomotive Crane 8 wheel, bucket-handling
1—O&S 15-ton Locomotive Crane, 8-wheel, bucket-handling

LOCOMOTIVES

1—[illegible] Baldwin [illegible] shifter, built 1907, 180 [illegible] working pressure.
1—[illegible] shifter, 160 [illegible] working pressure.
1—[illegible] Standard Gauge Shay Geared Locomotive.
10—[illegible] Gauge [illegible] Storage Battery Locomotives. [illegible] Locomotives, Steam Shovels, Steel, Rails, etc. [illegible]

Birmingham Rail & Locomotive Co.
Birmingham, Ala.

Clyde Crane

New, Never Used

Will handle material, can be used as drag line or hoist. Write for bargain price.

STROUD & COMPANY
Omaha, Nebr.

Step Out With Me—

and look at my BIG BROWNHOIST Locomotive Crane Dragline at Chicago. A real money maker for someone—you perhaps. I have priced it at less than half the manufacturer's price. Used only 4 months. 100 ft. boom, full revolving; mounted on two 8-wheel R.R. trucks, spaced 24 ft. between centers. Self-propelling.

Other Money Makers

A rebuilt INDUSTRIAL, 8-wheel, M.C.B., capacity at 12-ft. radius 25-TONS with outriggers, 20-TONS without outriggers; new 50-ft boom; new A. S. M. E. boiler; 1 YEAR'S GUARANTEE. Location Bay City, Mich.

A 20-TON INDUSTRIAL 8-wheel M.C.B., double drums, 50-ft. boom, 1½-yd. clamshell bucket. Fine condition. Location; La Salle, Ill.

A 25-TON BROWNING No. 8, 8-wheel, M.C.B., equipped with double drums, 52-ft. boom and turbo-generator. Location; Bay City, Mich.

A Model E, 25-TON OHIO, 50-ft. boom, 8-wheel M.C.B., double drums with 7½-kw. generator. New A. S. M. E. boiler. Location; Franklin, Pa.

A large 14-ft. gage McMYLER, 64-ft. boom, 2½-yd. clamshell bucket, Ohio-Massachusetts boiler, double drums. Excellent working condition. Location; Port Huron, Mich.

A 10-TON capacity McMYLER, 50-ft. boom, 1½-yd. bucket, double drums, A.S.M.E. boiler, 4-wheel, std. gage. Can be made 8-ft. gage. Location; Port Huron, Mich.

A 20-TON BROWNHOIST, 8-wheel, M.C.B. 40-ft. boom. Location; Chester, Pa.

A 12-TON O. & S., 8-wheel, M.C.B., single drum, 54-ft. boom. Location; St. Louis, Mo.

2 OSGOODS, single drum, 4-wheel R.R. trucks, 35-ft. booms. Location; Lincoln, N.J.

An OSGOOD, single drum, 4-wheel R.R. trucks, 40-ft. boom. Location; Kingston, N.Y.

A 10-TON INDUSTRIAL, 4-wheel, single drum, 35-ft. boom. Old machine, but in good operating condition. Priced especially low. Location: Pottstown, Pa.

A 15-TON BROWNING, 8-wheel, M.C.B., 40-ft. boom, single drum. Priced low for quick sale. Location: Pottstown, Pa.

Brand New—To Rent

1—17½ Ton INDUSTRIAL
1—20 Ton OHIO

Philip T.
KING
"The Crane Man"
30 Church St., New York

HOLT TRACTORS

(caterpillar)

12 TON and 10 TON

[illegible]

VERY CHEAP for QUICK SALE

CROCKWELL MINE & MILL SUPPLY CO.
[illegible]

Some Real Purchases

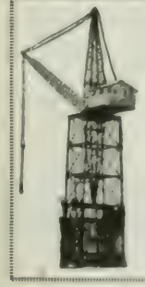
Immediate Shipment

1—20-ton McMyler Interstate Locomotive Crane
1—10-ton McMyler Interstate Locomotive Crane
[illegible] Thew Traction Steam Shovels
1—[illegible] Saddle Tank [illegible] Gauge Davenport Locomotive
1—[illegible] Saddle Tank [illegible] Gauge Porter Locomotive
1—[illegible] Steam Shovel [illegible] dipper

Exceptionally Low Prices

Please Telephone, Telegraph or Write [illegible]

A. C. TORBERT
Continental and Commercial Bank Bldg.
Chicago, Illinois



FOR SALE

Gantry Tower Cranes

New

Electrically Operated

78-ft. high—[illegible] boom—[illegible]-ft. between rail centers.

Capacity 40,000 lbs.

POTTSTOWN STEEL COMPANY
Douglassville, Pa.

STEAM SHOVELS

1—Model 37, on crawlers.
2—Type "B" Erie, on crawlers.
1—No. 18 Osgood, on crawlers, with crane attachment
2—Type "B" Erie, on traction wheels.
1—Model 20 Marion.

LOCOMOTIVE CRANES

1—20-ton Industrial, on MCB trucks, with 42-ft. boom
1—Byers Auto Crane, on crawlers.

HOISTING ENGINES WITH BOILERS

1—7¼x10 D.C. three drum Mundy.
1—6½x12 D.C. three drum Mundy.
1—6½x12 D.C. two drum Mundy.
1—8½x10 D.C. two drum Lambert.
1—7½x10 D.C. two drum Lambert.
2—7 x10 D.C. two drum Lidgerwood.

HOISTING ENGINES WITHOUT BOILERS

1—9 x13 D.C. three drum National.
1—8½x12 D.C. single drum Lidgerwood.
1—9 x10 D.C. single drum Lidgerwood.
2—8¼x10 D.C. two drum Lidgerwood.
1—9 x12 D.C. single drum Pen Argyle.
1—10 x15 D.C. single drum Bacon.
1—12 x15 D.C. single drum Bacon.
1—8½x12 D.C. single drum Lambert.
3—7 x10 D.C. single drum Carlins.
1—6¼x 8 D.C. single drum Lidgerwood.

ELECTRIC HOISTS

1—3-drum Clyde 75-hp.,550-v. D.C. motor.
1—2-drum Thomas 50-hp.,220-v. D.C. motor.
3—2-drum Thomas 30-hp.,220-v. D.C. motor.
3—2-drum Thomas 30-hp.,220-v. A.C. motor.

SWINGING ENGINES

1—7 x8 American.
1—5½x8 Lambert.
1—4 x6 National.
1—4 x6 Mead-Morrison.

Derricks, Boilers, Pumps, Concrete Mixers, Road Rollers, Air Compressors.

Everything for the Contractor

Pittsburgh Machinery & Equipment Company
Fulton Bldg., Pittsburgh, Pa.

FOR SALE

Two—4 cylinder Reo Motor 15 Passenger Busses

Mounted on Standard Steel RR Wheels and Axels

Also a 13-foot Long Box Car Trailer

All in Good Condition

A very handy, convenient and economical outfit for a small railroad

Also the original tires and axels to readjust for general road work

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Bargain for Quick Transaction

Hyman-Michaels Company
531 Peoples Gas Bldg., Chicago

Repaired Equipment

Steam Shovels

2—Type "B" Erie, ¾-yd., traction wheel, standard booms, shop numbers 206 and 312.

1—Type "B" Erie, ¾-yd., traction wheel, high lift, shop number 914.

3—Model 28 Marions, ⅝-yd. dipper, traction wheels, shop numbers 3134, 3137 and 3229.

4—Model 60 Marion RR type, 2½-yd. dipper, shop numbers 1995, 1999, 2059 and 2372.

1—Model 70 Marion RR type, 2½-yd. dipper, shop number 2693.

Locomotives, Standard Gauge

1—18x24-in., 60-ton, 6-wheel Switcher with side tanks

12-yard Standard Gauge Cars

20—26-ft. bed Western, air-dump.

36 in. Gauge Saddle Tank Locomotives

5—10x16-in. H. K. Porter, 18-ton.

Also a large stock of miscellaneous construction machinery including railroad ditchers and locomotive cranes. All the above equipment is located at our Pittsburgh shops where inspection can be made.

H. KLEINHANS COMPANY

Union Trust Building, Pittsburgh, Pa.

STEAM SHOVELS

Thew No. 0 Traction, Electric.
Erie B Caterpillar, ¾ yd., high lift.
Erie B Traction, ¾-yd., standard.
Erie B Traction, ¾ yd., high lift.
Marion 21 Caterpillar, ¾ yd.
Marion 31 Caterpillar, 1 yd.
Marion 28 Traction, ¾ yd., **attractive price.**
Marion 36 Caterpillar, 1½ yd.
Marion Railroad 41, 60, 61 and **70.**
Bucyrus Railroad 70-C and 100-C.
Osgood Railroad 43, 69 and 73.
Osgood 18 Traction, ¾ yd., **standard.**
Large Revolving Stripping Shovels.

Cars—Locomotives—Cranes

W. R. WADDELL
50 Church St., New York
Tel.: Cortland 4873

A REAL BARGAIN

Model 92 Marion Steam Shovel

with 5-yd. Dipper. Machine is as good as new. Three years old, but handled only about 200,000 yards soft material.

F. MAYER
Monadnock Bldg., Chicago, Ill.

STEAM SHOVEL

18-B Bucyrus, shop No. 2031.

DUMP CARS

24—3-yd. Double Truck, 24-in. gauge.
8—Camp Cars, standard gauge.

LOCOMOTIVES

2—8½x12 Davenport Geared, A.S.M.E. Boilers, 24-in. gauge, shop Nos. 1823 and 1824.

All of above equipment in first class condition.

Porter Bros., Norfolk, Va.

FOR SALE

USED CONTRACTORS' EQUIPMENT

SHOVELS

1—Erie Type B, ¾ yd., caterpillar tread, only handled [illegible] cu. yd. excavation, attachment, 1-[illegible]-ft. boom and 1-yd. clam shell bucket.
1—No. [illegible] Keystone Excavator, with skimmer and [illegible] attachments. Rebuilt.

CRUSHER

1—[illegible] Farrell Jaw Crusher, extra set jaws and [illegible], drive belt, line shaft, etc.

PAVERS

1—1[illegible]-E Koehring boom and bucket, laid three miles road.
1—14-E Lakewood, boom and bucket, laid five miles road.

Low Prices Write for Information

Hagerstown Equipment Company
Hagerstown, Maryland

FOR SALE

NEW HAYWARD

CLAM SHELL BUCKETS

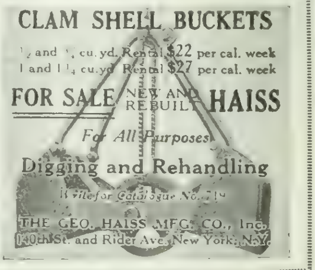
Class E

Sizes:

1 cu. yd. 1½ cu. yd. 1⅝-cu. yd.

At two-thirds of present prices Immediate Delivery from Brooklyn Stock

MARVIN BRIGGS, INC.
167 Sixth St., Brooklyn, N. Y.



CLAM SHELL BUCKETS

½ and ¾ cu. yd. Rental $22 per cal. week
1 and 1¼ cu. yd. Rental $27 per cal. week

FOR SALE NEW AND REBUILT HAISS

For All Purposes

Digging and Rehandling

Write for Catalogue No. 71

THE GEO. HAISS MFG. CO., Inc.
140th St. and Rider Ave., New York, N.Y.

ALBERT

PIPE

SUPPLY CO.

Berry and North 13th St., Brooklyn, N. Y.

Special Offerings

Second Hand Standard Line Pipe

25,000 ft. 2 in. Pipe 9 cents ft.
25,000 ft. 3 in. Pipe 19 cents ft.
25,000 ft. 4 in. Pipe 26 cents ft.
50,000 ft. 6 in. Pipe 50 cents ft.
5,000 ft. 12 in. Pipe 50 lb. Pipe $1.25 ft.

F.O.B. cars Ohio, shipping point, good threads and couplings.

1000 tons ½ in. to 20 in. S. H. Black and Galv. Pipe
New threads and couplings.

NEW PIPE

1000 ft. 8 in. New Galv. 29 lb. Pipe $1.45 ft.
1500 ft. 16 in. New Bl. Steel Pipe ⅞ in. wall P. E. $3.00 ft.

400 tons New Black & Galv. Pipe ½ in. to 3 in. inclusive

Second-Hand and New

PIPE

¾ to 18 inch with threads and couplings.
Guaranteed for service.
Pipe up to 18-in cut to sketch.

Pipe & Contractors Supply Co.
3 Dover Street, New York City

SECOND-HAND PIPE

All Sizes.
Immediate Shipment
from Stock.
Right Prices.

J. SAVESKY'S SONS
Marion, Ind.

Second Hand **PIPE** **Guaranteed Retested**

Wrought Iron or Steel. Straight lengths 16 ft and over, with new threads and couplings. Also pipe cut to sketch. Large stocks always on hand for prompt shipment. [illegible]

LINK PIPE & SUPPLY CO.,
Ferry and Foundry Sts., Newark, N. J.

Established 1904

ALBERT & DAVIDSON Corporation

FOR SALE
Second-Hand
and NEW

PIPE

Large Stock
All Sizes
Threaded and
with Couplings
Also Cut to Sketch

256-264 Oakland Street, Brooklyn, N. Y.

WROUGHT IRON AND STEEL PIPE

New and second hand. With new threads and couplings. All sizes from ½ to 12 in. Also cut to sketch.

DAVIDSON PIPE & IRON CORP
436-40 Kent Ave., Brooklyn, N. Y.

PIPE **SECOND HAND**

With new threads and couplings; also cut to sketch.

PFAFF & KENDALL
Ferry & Foundry Sts., Newark, N. J

FOR SALE

HEAVY PIPE

[illegible]

FLOWER CITY PIPE & IRON CORP
[illegible]

FOR SALE

Cast Iron Water Pipe

1200 ft., 8 in., Class B bell and spigot.
Good as new. Immediate shipment.

WALTER A. ZELNICKER SUPPLY CO
St. Louis, Mo.

Second Hand
Wrought Iron
and Steel

PIPE

Overhauled
Rethreaded
Coupled

All Sizes in Stock

Greenpoint Iron & Pipe Co., Inc.
[illegible] Brooklyn, N. Y.

0-4-0 Switcher

40 ton, 8 wheel. 160 lb. steam working pressure. Air brakes. Reported by inspector in good operating condition. Price $1000 f.o.b. Newton Falls, N. Y.

W. D. Arnot Purch. Agent
Newton Falls Paper Co.
Newton Falls, N. Y.

For Sale at a Sacrifice Price

NEW PIPE

25 pieces 12 in. Submarine Flexible [illegible] Joints, 12 ft. length, [illegible] each

LUNA AMUSEMENT COMPANY
Coney Island, New York

PIPE

Large Stocks, New and Second Hand.
Immediate Delivery

L. & D. Pipe Supply Co., Inc.
1096 Flushing Avenue, Brooklyn, N. Y.

1500 Tons

85 lb. A. S. C. E. Section

Relaying Rails

with Angle Bars

Immediate Shipment

Central South and Southwestern delivery

S. W. LINDHEIMER

1st National Bank Bldg.
Chicago, Ill.

Rails and Track Material

RAILS

New and Relaying

All sections in stock Bridge girders, locomotives, cars.

M. K. FRANK
Union Trust Bldg., Pittsburgh, Pa.

PILING

Steel Sheet Piling

Lackawanna and United States in various lengths for immediate shipment.

BROWN & SITES CO.

Main Office:
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Steel Sheet Piling

FOR RENT

Bought and Sold

J. R. WEMLINGER & CO., Inc.
149 Broadway, New York

FOR SALE

STEEL SHEET PILING

350 pieces 12 ft and 15 ft lengths.
275 pieces 20 ft and 30 ft lengths
60 pieces 50-ft Lackawanna Wedge Piles.

CAN LOAD IMMEDIATELY

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We specialize in

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New and Used
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Advise your requirements or offerings.

Walter A. Zelnicker Supply Co., St. Louis

Rails Cars Locomotives Pipe

RELAYING RAILS

600 tons 60's—200 tons 70's
1500 tons 75's—2000 tons 90's

EQUIPMENT BARGAINS

- Austin O Trencher, gasoline, 22 to 42 in. by 18 ft.
- Austin A.M.T. Trencher, gasoline, 20 to 30 in. by 9 ft.
- Bucyrus 14B Steam Shovel, traction, ¾ yd., revolving.
- Vulcan, 36-in. ga., 14-ton, 4-wheel S. T. Locomotive.
- American, 36-in. ga., 18-ton, 4-wheel S. T. Locomotive.
- Plymouth, 24-in. ga., 3½-ton Gasoline Locomotive.
- Koppel Cars. (3) 24-in. ga., 36 cu. ft. V shape.
- Northern 20-ton Pillar Crane.
- Lidgerwood, 7x10-in. Hoister S.C., S.D. and boiler.

E. C. SHERWOOD

50 Church Street, New York.

100-LB. STEEL RAILS

With Angle Bars

First Class Relayers

Subject to Inspection at Destination for Prompt Shipment

Write or Wire

HYMAN MICHAELS COMPANY
531 Peoples Gas Bldg., Chicago
or 1312 1st Natl. Bank Bldg., Pittsburgh, Pa.
Other Offices at: New York, St. Louis, Detroit, San Francisco

We carry in stock rails from 50 to 90 per yard.

Rails

Relaying rails and switches of various weights in stock at our Chester, Pa., yard and other points.

Also let us quote on your requirements for locomotives, locomotive cranes, cars and other items of railway equipment.

E. H. WILSON & COMPANY
COMMERCIAL TRUST BUILDING
PHILADELPHIA

RAILS and CARS

- 150 tons 70-lb. section.
- 185 flat cars, 36 ft. to 40 ft., capacity 60,000 and 80,000 lb.
- 25 gondola cars, 60,000 and 80,000 lb. capacity, 25 ft. 6 in. to 36 ft. long, one and four-board high, flat and hopper bottom.
- 12 box cars, 36 ft.—50,000 lb. capacity.

All standard gauge, air and hand brakes, overhauled, acceptable to railroads, also interchange service.

Henry A. Hitner's Sons Co.
4501 Richmond St., Philadelphia, Pa.

HARRY BENJAMIN EQUIPMENT CO.
785 Central National Bank Bldg
St. Louis, Mo.

75 lb. Relaying Rails

Priced to move promptly.

Delivery—Any point on the line of the St. Louis Southwestern Railroad in Texas, Louisiana, Arkansas, Illinois or Missouri.

We Purchase Abandoned Plants and Railroads

4650 TONS NEW RAILS

[illegible] 12 to 40 lbs. F.O.B. Buffalo, N.Y.

3500 TONS NEW RAILS

[illegible] F.O.B. Lebanon Pa.

The Morrison & Risman Co., Inc.
[illegible] Buffalo, N.Y. [illegible] Philadelphia, Pa.

We Have Rail Located Near You

---

400 TONS

New 25-lb. RAILS

also

NEW SPLICES, FROGS and SWITCHES at less than mill price

STACKED READY FOR IMMEDIATE LOADING

Delivered Prices Quoted
State Quantity and Where Wanted

WRITE or WIRE

WALTER A. ZELNICKER SUPPLY CO.,
St. Louis.

Locomotives, Cars, Steam Shovels, Tanks

Second Hand Portable Track

5000 ft. 24 in. 20 lb.

HENRY LEVIS & CO.
Commercial Trust Bldg., Philadelphia, Pa.

Additional Searchlight Ads on bottom of opposite page

INTERRUPTION REPAIRS FIRE

This is the Triumvirate that you always find seated around the Electric Elevator.

1. INTERRUPTION

The Superintendent of the Bureau of Engraving and Printing at Washington sent for us and said:

"WE WANT YOU TO PUT YOUR STEAM-HYDRAULIC IN PLACE OF THE ELECTRIC.

THE BUSINESS OF THE GOVERNMENT IS TOO IMPORTANT FOR THIS CONTINUAL INTERRUPTION"

How about your business? Well we guess so!

2. REPAIRS

There are no repairs to speak of with a Ridgway Elevator. Nothing to it to break and wear out and get out of order.

In 1914 the Remington Arms & Ammunition Co. put in 12 Ridgway Elevators. They were driven as hard as they could go day and night all through the Great War.

IN 9 YEARS THE REMINGTON ARMS CO. HAVE NOT HAD TO ORDER A SINGLE REPAIR FOR ANY RIDGWAY ELEVATOR

It is the same story with all Ridgway Elevators.

How about those elevators you have? Well we guess so.

3. FIRE

The electric elevator machinery is almost always in a dark place.

Electricity is the greatest Fire Fiend now devastating. Your paper daily has accounts of FIRES FROM THE ELEVATOR.

The Ridgway Elevator is operated by a small steam pipe, always harmless.

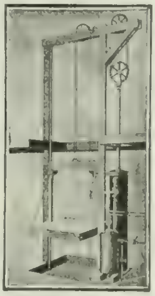
These are three of the many reasons why the Biggest and Best Concerns

"HOOK 'ER TO THE BILER"

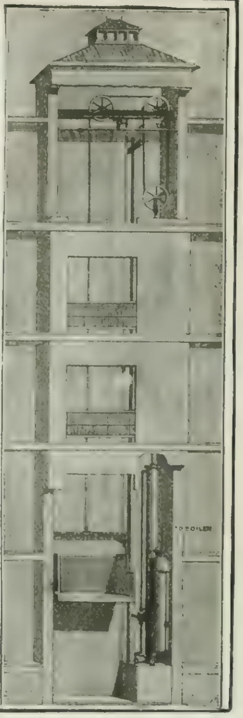
CRAIGE RIDGWAY & SON CO., Coatesville, Pa.
ELEVATOR MAKERS TO FOLKS WHO KNOW

Direct Acting

Over 3000 in Daily Use



Doubled Geared



Standard Gauge Locomotive

We have just purchased a standard gauge 10x16 4-wheel saddle tank Locomotive, built by the American Locomotive Co. Hunt reports that with some minor repairs machine will be in good second hand condition. The price is about one-third the cost of a new engine.

HENRY LEVIS & CO.
Commercial Trust Bldg., Philadelphia, Pa.

FOR SALE

VULCAN DINKEY

21 ton, 36-in. gauge in first class condition.

THE BELCAN COAL COMPANY
314-322 Wheeling Steel Building,
Wheeling, W. Va.

FOR SALE

STONE CRUSHER BINS

2—Stone Crusher Bins, 25 and 50 ton, mounted on wheels.

[illegible]

The Public Works Construction Co.
[illegible]

Koehring Paver

[illegible]

Address P. O. Box 1378
Richmond, Va.

FOR SALE

LITTLE GIANT ROAD CRANE

Shop number 121. This machine has a 30-ft. boom, full revolving operated with steam, boiler new last year. Mounted on traction wheels and self-propelling. Equipment in good working condition and in operation every day in Louisville, Ky., 34th Street and Woodland Avenue. Can be seen anytime and shipped at once. Just the rig for unloading materials for road work. Price $2,000.

The Cannell-Conrad Construction Company
Louisville, Ky.

FOR SALE

STEAM SHOVELS

1—Bucyrus No. [illegible] with skimmer and [illegible] attachment.

1—Model [illegible] Marion Traction Wheel Shovel.

Both in excellent condition. Can be [illegible] and demonstrated at any time.

R. K. HALL, Room 1200
[illegible]

NEW AND REBUILT MACHINERY

Immediate Delivery

- 1—17-ton Industrial 8-wheel Locomotive Crane.
- 1—¾-yd. Blaw Clamshell Bucket.
- 1—Large Concrete Bucket.
- 1—5½ x 10 Horiz. D.C., D.D. Hoisting Engine.
- 1—12 x 14 Deming Triplex Pump.
- 1—10 x 10 Deane Triplex Pump.
- 1—5 x 8 Goulds Triplex Pump.
- 1—40 hp Fairbanks-Morse Gasoline Hoisting Engine.
- 1—7¼ x 8 Vertical D.C., S.D. Hoisting Engine.
- 5—New bronze Centrifugal Pumps, each direct connected to 5 hp. turbine.
- 1—No. 28 Pomona Deep Well Pump.
- 2—New 9 x 8 Horiz. D.C., D.D. heavy duty Hoisting Engines.
- 2—4½-ton, 24-in. gauge Gasoline Locomotives.
- 1—5-ton 36-in. gauge Gasoline Locomotive.

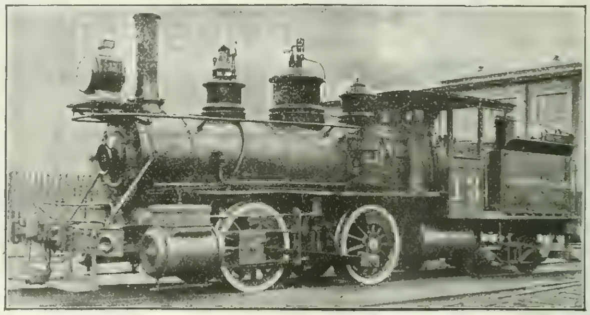
Write for Stock List

Machinery & Supply Corporation
Dept. 25
JOPLIN, MISSOURI

For Sale or Rent

1—30 hp Locomotive Boiler with stack.

W. H. CAMPBELL, INC.
30 Church St., New York City
[illegible]



BALDWIN LOCOMOTIVES For Durability

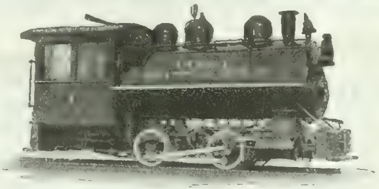
They give many years of service

BY keeping locomotives in repair, it is possible to secure many years of continuous service. Our share in this work is to promptly furnish duplicate and repair parts to maintain locomotives in first class working order. This is a branch of our business to which we give great care and attention.

The locomotive illustrated—a Forney type—was built by these Works in 1879, and is today in excellent condition at Algiers, Louisiana, after forty-four years of continuous operation. It is at the present time employed for miscellaneous work.

THE BALDWIN LOCOMOTIVE WORKS
PHILADELPHIA

1039



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ROD AND GEAR-DRIVE
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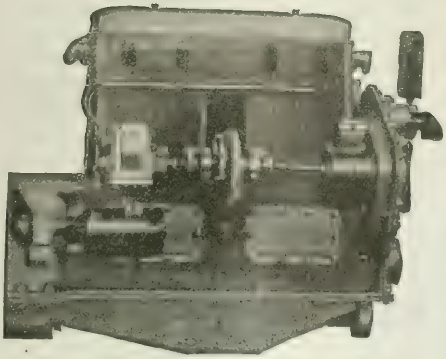
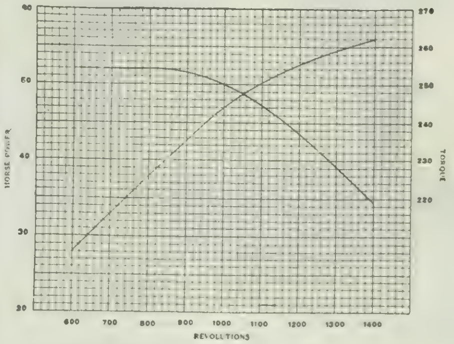


4-CYL—4¾ in. x 6 in. MODEL C-4



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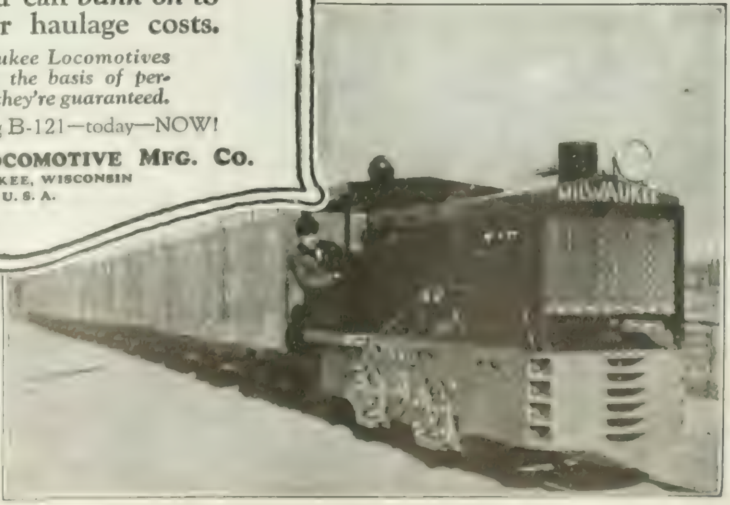
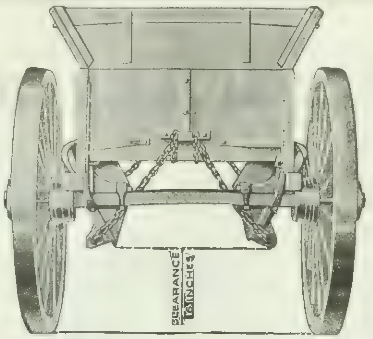
You'll never know how much real value can be built into a locomotive until you learn more about the "Milwaukee."





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of *Engineering News-Record*

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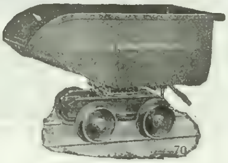

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For issue of the following Thursday

73

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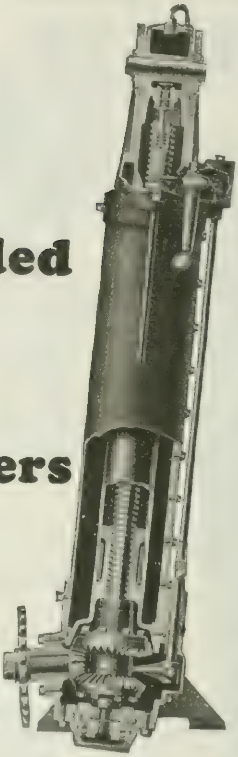

Cutaway View of Vertical Hoist showing screw and principle of operation and automatic lubricating device.

OUR Mechanical Dump Truck Hoists, in vertical and horizontal types, have been quickly accepted as a means toward faster, better truck dumping. All leading truck manufacturers use and recommend Van Dorn Hoists and Bodies.

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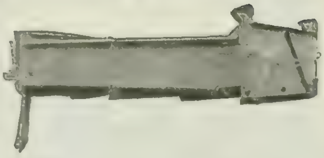
MECHANICAL DUMP TRUCK HOISTS
BODIES—FRAMES—PRESSED PARTS



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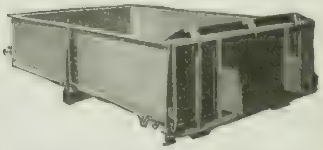
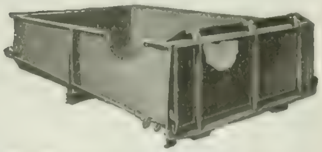


Van Dorn Coal Body. Coal chute can be placed in side for side dump jobs.



Van Dorn Asphalt Body; a double shell body with insulation of asbestos between walls to hold the heat.

Van Dorn Garbage Body; wood lined, tail and water tight comp. New York City is using 332 bodies of this type.

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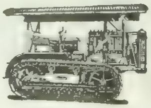

"I make more money by using the BEST for road machine instead of horses"

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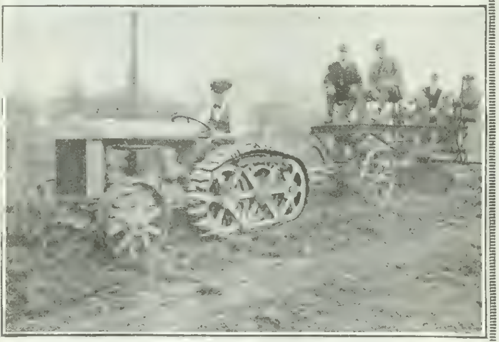
Double Your Fordson's
Draw Bar Pull with

RIGID RAIL TRACKS



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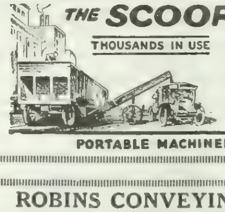

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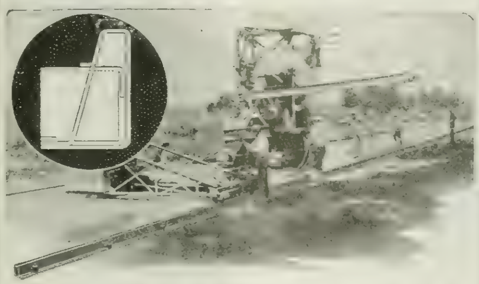

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COMPARE the cross-section! Note that the Metaform road rail has more metal—greater weight per foot. But still more important, note how its design, with continuous web, lapped, welded and riveted, multiplies ordinary road rail strength. Note the extra sturdiness of stake boxes and joints.

Metaforms will far outlast any other road rail.

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QUALITY ROLLERS
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In all types and sizes, steam and motor.

Buffalo - Springfield Pressure Cylinder Scarifiers can be built on new rollers or attached in the field to rollers already in service.

Inquiries Invited.

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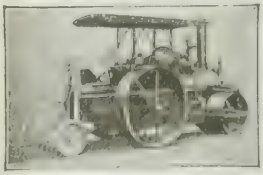

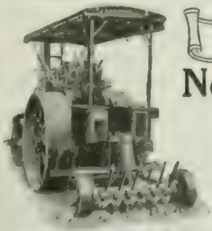

Monarch Steam Road Roller with Scarifier Attachment. Roller is made in 10 and 12 ton sizes.

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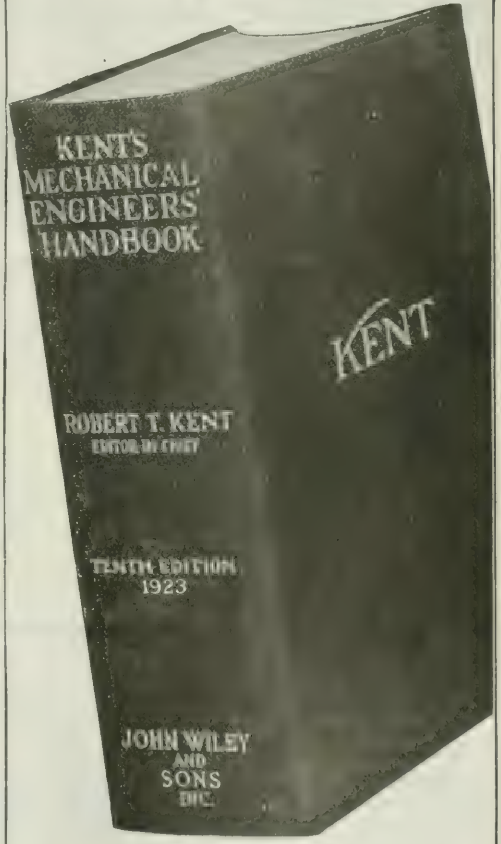

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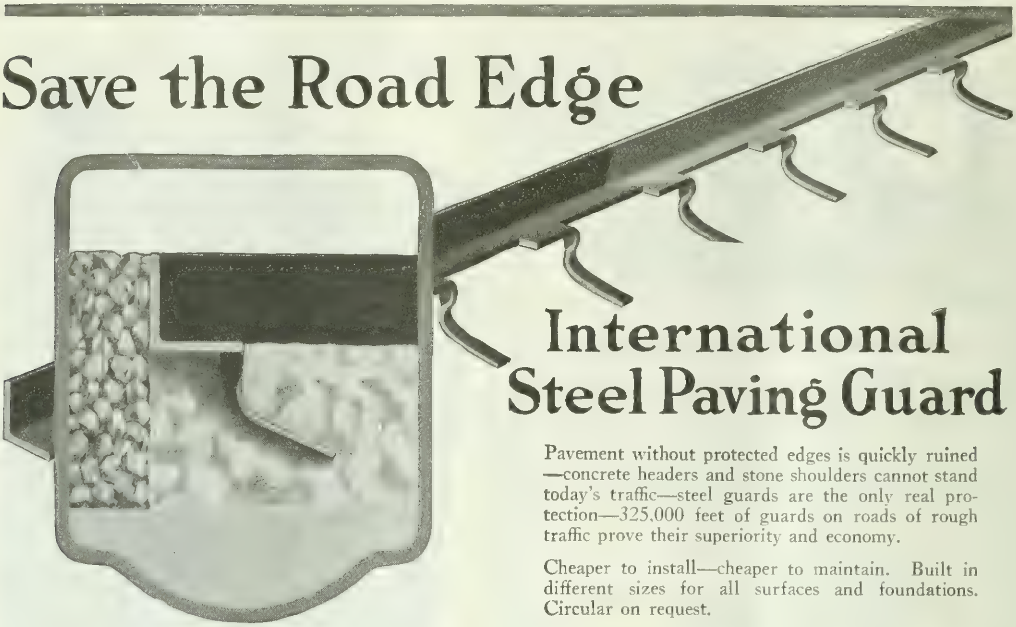

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Pavement without protected edges is quickly ruined—concrete headers and stone shoulders cannot stand today's traffic—steel guards are the only real protection—325,000 feet of guards on roads of rough traffic prove their superiority and economy.

Cheaper to install—cheaper to maintain. Built in different sizes for all surfaces and foundations. Circular on request.

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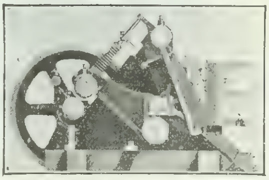

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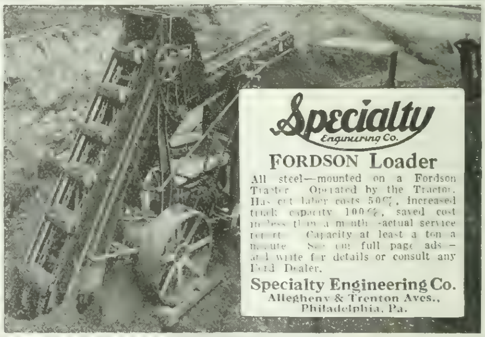

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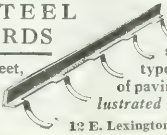

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NON-OOZING EXPANSION JOINTS

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1893

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1923

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WHEN Tulsa, Oklahoma, consisted of a handful of buildings and a couple of handfuls of venturesome pioneers, in 1893, its water supply problems were not at all complicated. Tulsa did not change appreciably up to 1900. It looked very much as in the picture above. But then, with the finding of oil, Tulsa began to grow like a magic city until today its skyline looks as it does in the picture below. With that growth have come great and imperative water-supply needs and naturally, just as with dozens of other big cities, it has required the best in pressure-pipe lines. We are now installing at Tulsa

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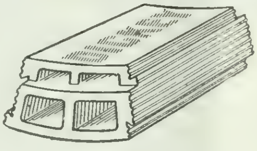

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Rapid and Economical Construction in all seasons.

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Made of anti-Corrosive Toncan Metal. Write for prices.

THE CANTON CULVERT & SILO CO.
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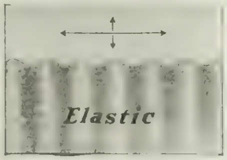
The A-B-C of Culvert Engineering



Corrugated Culverts give to stress in any direction.

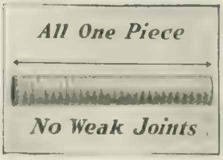
Corrugated Culverts endure pounding and reversals of stress better than any other type.

ARMCO Culverts have been proved uncrushable under a fill equal to diameter.

A Few culverts can have an adequate foundation. They are usually located in depressions filled high with silt. In most instances, it is totally impractical to dig deep enough to give any structure a bed-rock base in such a location.

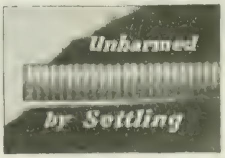
B When foundations are at all adequate, they are usually the most expensive part of the installations—an expense far in excess of that required.

C There is but one type of Culvert that will endure without resting upon a solid base. The well made Corrugated Culvert resists the forces of shifting, heaving earth, settling, freezing and the weight and pound of traffic.



Stress may disarticulate a weak or jointed culvert.

ARMCO Culverts do not absorb water. They do not "weather" like porous materials.



Settling and earth creepage leave the Corrugated Structure efficient and unharmed.

and—

The A-B-C of Corrugated Culverts

A The material of Corrugated Culverts must resist rust.

B Rust resistance requires high purity of the iron used, for two reasons—iron of high purity *resists rust of itself,* and it takes and holds more firmly a protecting coat of galvanizing.

C ARMCO Culverts are made of ARMCO Ingot Iron, the purest commercial iron produced, and of the highest UNIFORM purity. The ARMCO Culvert you buy tomorrow is made of exactly the same material that is found in ARMCO Veterans under the highways and railways of the world — the culverts that have made ARMCO the world's standard for durability and economy.

■

This Little Dot

If this rectangle were a sheet of ARMCO INGOT Iron, the little dot would represent all the impurities. If the dot were the least bit larger, due to the addition of any other material, the result would not be ARMCO Ingot Iron. ARMCO has less than 1 part impurities to every 625 parts of pure ferrite—less than 1 *ounce* of impurities to every 39 *pounds* of pure iron.

ARMCO
Ingot Iron

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The vibration of heavy machinery, the pounding of endless lines of trucks cannot harm Creo-Pine Wood Block Floors. They are built for heavy duty. They stand up under any and all conditions.

Creo-Pine Wood Block Floors are *permanent* floors. Installation can be made without interfering with production.

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Whether your Railroad be Steam or Electric, large or small—*you can only afford the best.* Our *Creosoted* Southern Yellow Pine *Hewn Cross Ties* are the *longest lived* and ultimately far the *cheapest.*

We also Manufacture and Creosote—Lumber, Switch Ties, Piles, Poles and other products.

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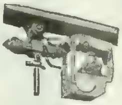

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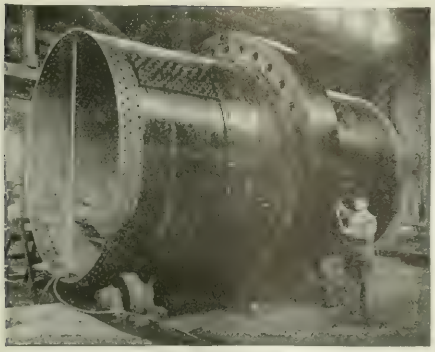

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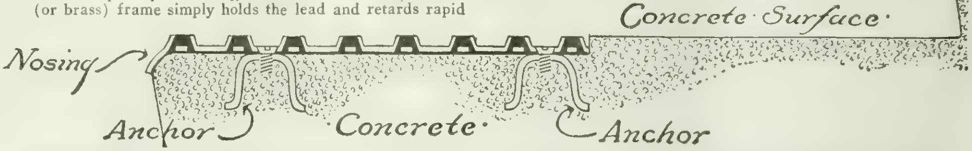

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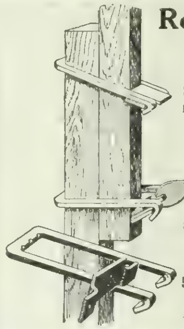

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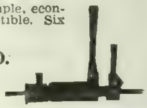

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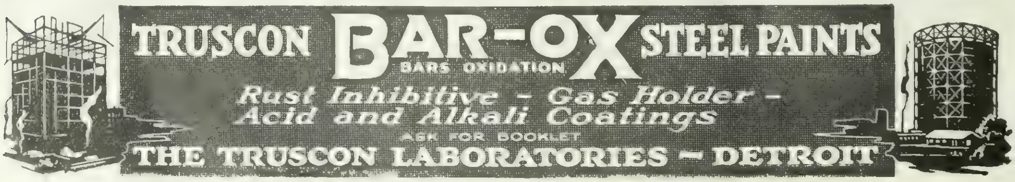
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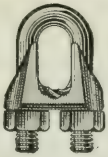

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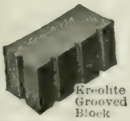

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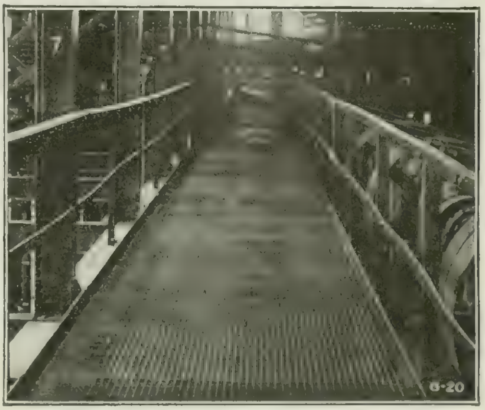

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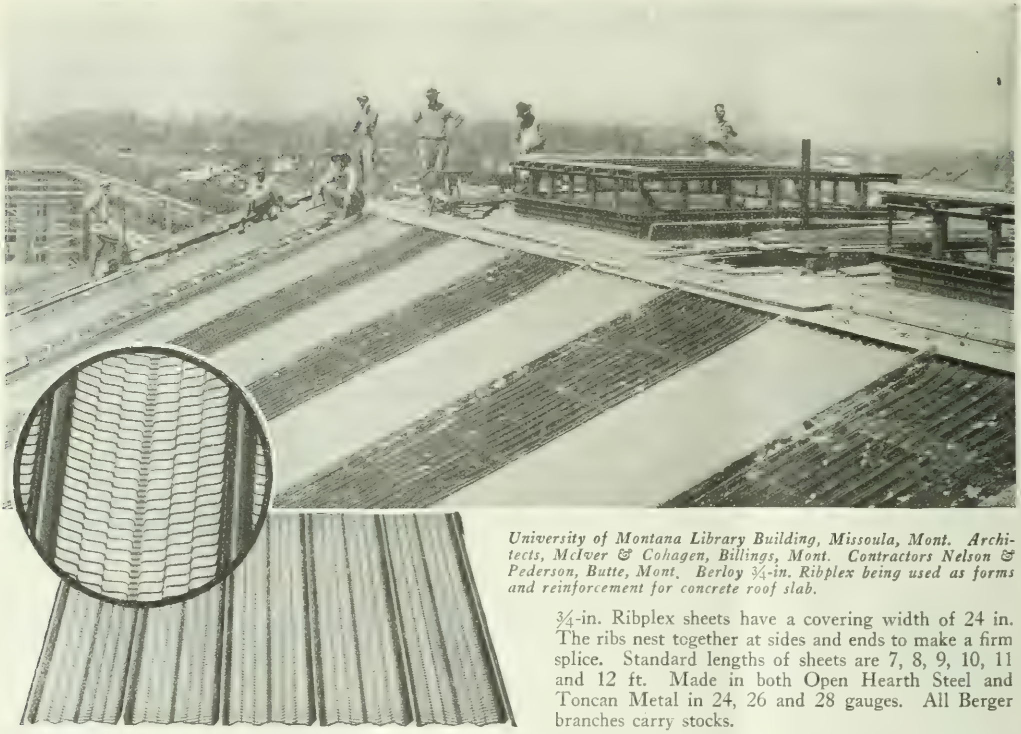

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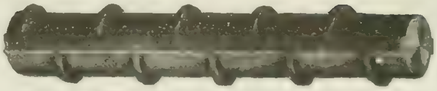

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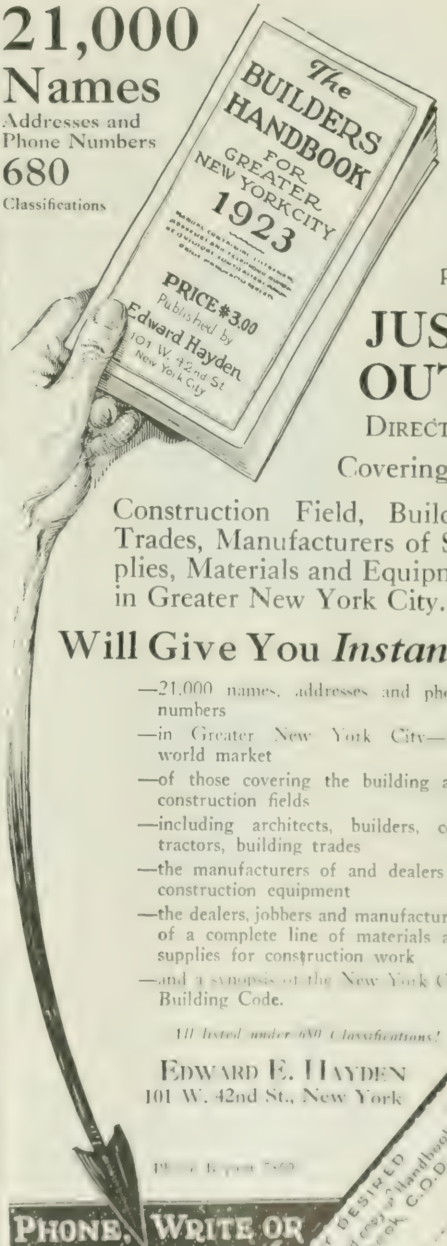

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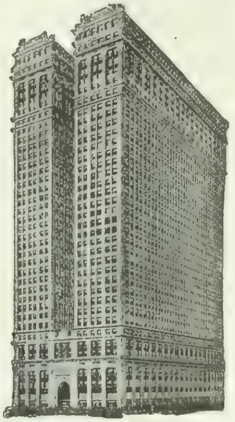

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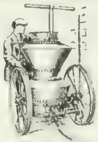

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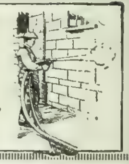

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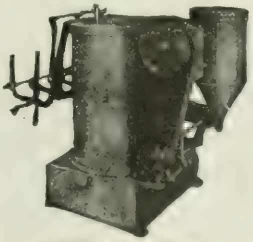

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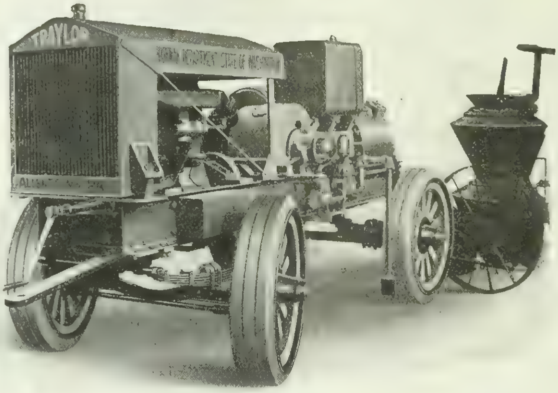


Here's the way you've always felt a Compressor should be mounted!

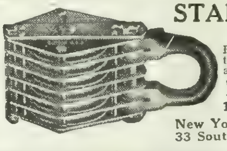
The TRAYLOR PORTABLE GASOLINE COMPRESSOR

If you've ever had a compressor wracked to pieces by the bumps—thumps—jumps of transportation, you'll welcome this "rubber heel" mounting with the sturdy wheels, axles and springs to back it up! This is the last word in compressor efficiency now—this is the perfected Traylor, with the slow speed, horizontal straight-line drive, worm gears and pump for delivering water under pressure. Runs equally well on gas or current. *Write for Bulletins.*

Cement-Gun Company, Inc.
Allentown, Pa.
New York Chicago Pittsburgh
Los Angeles Laredo, Texas Seattle
Agents in Eastern Canada:
General Supply Company of Canada
356 Sparks St., Ottawa
Foreign Agency:
International Cement-Gun Company
Zeist, Holland

Made in two sizes. Also mounted on standard iron wheels, if desired.

The Underpinning & Foundation Co. 342 Madison Ave. New York City
Difficult Foundations
Pneumatic, Steel, Concrete and Wooden Pile Foundations. Bridge Piers; Underpinning Heavy Building
"HERCULES" STEEL PILES



STAR BRAND BLOCKS
Are Standard
For any lift or difficult working condition they are safest, strongest and most durable.
Boston & Lockport Block Co.
108 Condor St., East Boston, Mass.
New York City 33 South St.
Chicago 413 Fort Dearborn Bldg.

VULCAN IRON WORKS
THE WARRINGTON (VULCAN)
STEAM PILE HAMMERS
PILE DRIVERS AND PILE DRIVING MACHINERY
327 NO. IRVING AVE. —— CHICAGO

AMBURSEN DAMS
Best for Any Foundation
High Safety Factor Low First Cost
Rapid Construction No Maintenance
Send for Cost Data, Literature, Photos.
Ambursen Construction Co., Inc.
New York Atlanta Kansas City

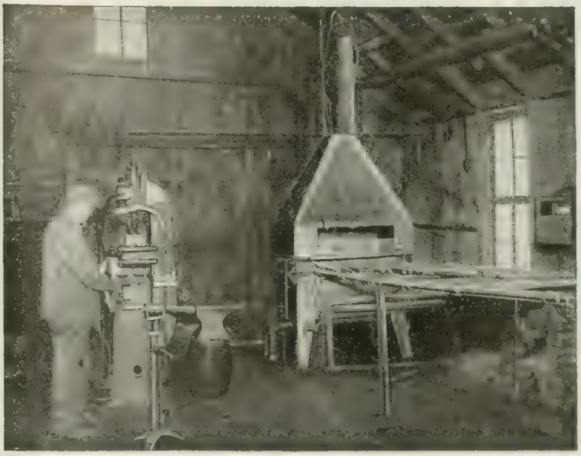
New England Foundation Co., Inc.
120 Tremont Street, Boston, Mass.
SIMPLEX CONCRETE PILING
Open Caissons—Difficult Foundations
Engineering and Construction

"The Pile With a BIG Foot"
MAC ARTHUR PEDESTAL PILE-
The MACARTHUR METHOD insures maximum foundation safety under every working condition in all kinds of soil.
Complete information on request
MacArthur Concrete Pile & Foundation Co.
Telephone Beekman 6196 55 John Street, New York City

SPENCER, WHITE & PRENTIS
FOUNDATION SPECIALISTS
Steel Tubes to Rock "PRETEST" SYSTEM
Spencer, White & Prentis, Inc. 100 W 41st St., New York
The Spencer, White & Prentis Co. 1501 Euclid Ave., Cleveland, Ohio

Parsons, Klapp, Brinckerhoff & Douglas
84 Pine St., New York Hanna Bldg., Cleveland
WM BARCLAY PARSONS HENRY M. BRINCKERHOFF
EUGENE KLAPP WALTER J. DOUGLAS
Engineers—Constructors—Managers
Design, Estimates, Supervision, Operation and Management, Examination and Reports

"Sullivanize" Your Drill Steel



Sullivan Drill Steel Furnace and Drill Sharpener, showing compact installation.

DON'T handicap your rock drills or delay your runners by using steel that is improperly heat-treated, badly formed or poorly sharpened.

Train your blacksmith to put as much footage as possible into each steel he sends on the job.

Sullivan Furnaces and Sharpeners Provide Drill Steel Quality Insurance

The Sullivan oil or gas Furnace heats the steel gradually, evenly, while electrical devices prevent overheating or burning, and indicate, also if the steel is **not** hot enough for working or tempering.

The hammer-forging action of the Sullivan Sharpener refines the grain of the metal, and with each repeated sharpening renders it tougher, less liable to wear or breakage.

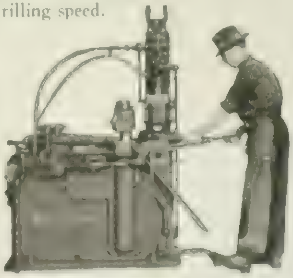
Sullivan-sharpened bits are made to exact shape and gauge by tool steel dies and dollies. They "follow" accurately in the drill hole.

With the Sullivan gauging device, genuine double taper bits are quickly and correctly formed, providing increased drilling speed.

Sullivan Furnaces and Sharpeners insure that each steel is of uniform hardness, of exact shape, that the steel quality you paid for is preserved and that you will obtain the maximum feet of hole from each steel.

Sharpeners, Bulletin 472-E

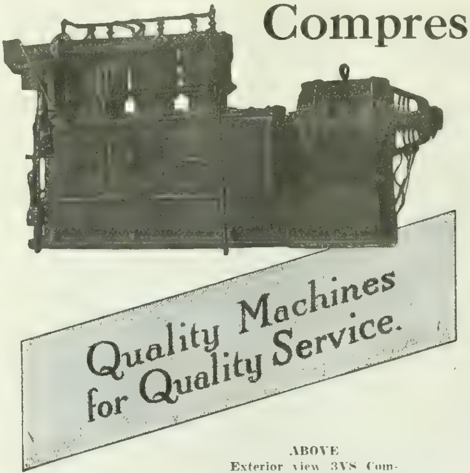
Furnaces, Bulletin 474-A



Send for New Steel Handbook and Instructions, 80 pages, free, No. 472-G

SULLIVAN MACHINERY COMPANY

124 SOUTH MICHIGAN AVE., CHICAGO, ILLINOIS U.S.A.



Compressed Air at Minimum Cost!

THE price you pay for compressed air depends on the cost of air compressor maintenance and operation.

It is traditional of Westinghouse-National Compressors that they remain in perfect running condition for years without requiring expensive repairs or replacements.

As to cost of operation—figuring power as the chief item—our distinctive Automatic Control effects a saving that is quickly reflected in production costs.

ABOVE
Exterior view 3VS Compressor, furnished in low pressure sizes of 250 to 520 cu. ft. displacement; high pressure sizes, 150 to 335 cu. ft.

Westinghouse Traction Brake Company
General Offices and Works: Wilmerding, Pa.

Offices:

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Chicago, Ill.
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Denver, Colo.
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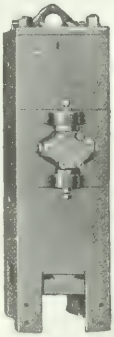
Los Angeles
Mexico City
St. Paul, Minn.
St. Louis, Mo.

New York
Pittsburgh
Washington
Seattle
San Francisco

WESTINGHOUSE-NATIONAL
AIR COMPRESSORS

If it can't be done with McKiernan-Terry Pile Hammers—it can't be done at all!



WRITE FOR
BULLETIN 31

**McKIERNAN-TERRY
DRILL COMPANY**

Rock Drills Pile Hammers Lifting Jacks
Mining and Quarrying Machinery
13 Park Row, New York

Works at Dover, N. J.

Agencies in the following Cities: Boston, Chicago, Pittsburgh, Cleveland, Detroit, St. Paul, San Francisco, Columbus, O., New Orleans, Philadelphia Portland Oregon. *Foreign Representatives:* British Steel Piling Co., London, England.

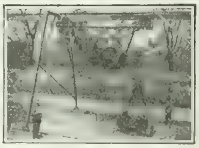
American Wire Rope
AND
AERIAL WIRE ROPE TRAMWAYS
Send for Illustrated Catalogue
American Steel & Wire
Chicago-New York Company

Rental or Sale

POTTER

Trench Machines, Buckets

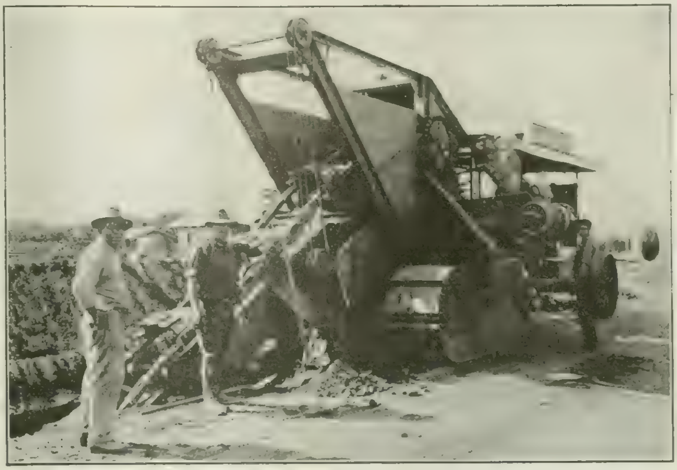
POTTER MFG. CO.
3505 E. Washington St.,
INDIANAPOLIS, IND.



"MORETRENCH" Conveying Excavator

Digs and backfills trenches in one operation Any size—any depth. See our big advertisement next week. Write or phone.

Moore Trench Machine Co.
Rockaway, New Jersey

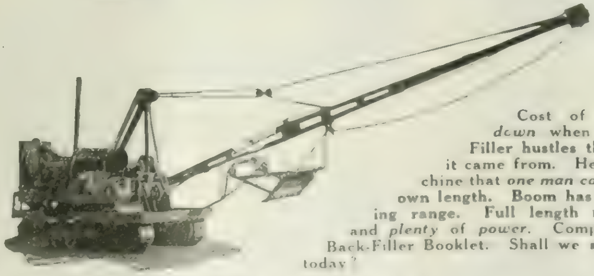


It's a Comfortable Sort of Feeling

Makes you feel kinda good to know that the company you've bought a machine from is going to take care of you. Here's a contractor way out in Los Angeles—Harper D. Churchill. He wrote us:

"I chose a Buckeye after carefully checking their performance and specifications. At this instance, I wish to go on record that the Buckeye organization is the squarest and easiest to do business with that I know of. Your wants are taken care of promptly and efficiently. They make you feel as though they are interested in your welfare. This alone would make us give them all our business."

That's putting it pretty "strong." But you'll find most Buckeye owners *strong for Buckeyes* and the *service* that goes with 'em. Put a Buckeye on your next job—you'll find we're right when we say "you'll always be glad you bought a Buckeye."



Going Down!

Cost of back-filling *going down* when a Buckeye Back-Filler hustles the dirt back where it came from. Here's a one-man machine that *one man can run*. Turns in its own length. Boom has 160 degree swinging range. Full length multiplane traction and *plenty* of *power*. Complete details in the Back-Filler Booklet. Shall we shoot you a copy—today?

The Buckeye Traction Ditcher Company, Findlay, Ohio

Manufacturers of Trench Excavators (both Wheel and Chain-and-Bucket Types), Pipe-Line Trench Excavators, Tile and Open Ditchers, Back-Fillers, Pipe Screwing Machines, Curb Diggers and Clay Diggers.

Branch Sales Offices

[illegible]

Buckeye ✓

UNION
Cableway Skips

This company is probably the largest producer of heavy cableway skips in this country. We fill orders for hundreds every year and have executed single orders for two hundred and more.

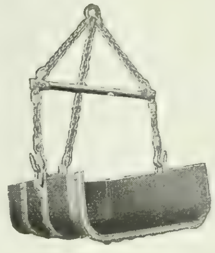
STYLE K
UNION STANDARD TYPE SKIP with spreader bar and chains built in capacities up to 10 cubic yards. (Illustrated.)

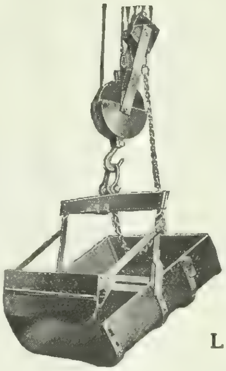
STYLE L
UNION GATE SKIP (Patented). A skip permitting full loading of material such as coal, sand, earth, etc. Built in capacities up to 10 cubic yards. (Illustrated).

STYLE M
UNION STEEL SCALE BOX, with chains and dumping trigger. Built in capacities up to 2½ cubic yards. (Illustrated).

STYLE N
UNION WOOD SCALE BOX. Built of oak with iron mountings.

STYLE O
UNION EXPORT SKIP. A skip developed by us for export. Sloping sides permit nesting, thereby saving a large percentage of the ocean transportation charges.


K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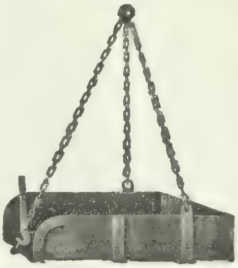
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Write for new Catalog published April, 1923.

UNION IRON WORKS
Lackawanna Siding
Hoboken, N. J.

UNION HAMMERS DOUBLE ACTING
DRIVE AND PULL

Dredging

Filling, Land Reclamation, Canals and Port Works

River and Harbor Improvements
Deep Waterways and Ship Channels

We are equipped to execute all kinds of dredging, reclamation and port works anywhere in the United States.

CONTRACTORS to THE FEDERAL GOVERNMENT

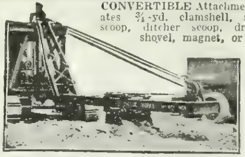
Correspondence Invited from Southern Officials and Corporate and Private Interests Everywhere.

Largest Plant **Longest Experience**

Atlantic, Gulf and Pacific Co.

New York
21 Park Row

Houston, Texas
Scanlon Bldg.


CONVERTIBLE Attachment Operates ¾-yd. clamshell, skimmer, scoop, ditcher scoop, drag line, shovel, magnet, or hook.

With Skimmer Scoop

BAY CITY CRANE EXCAVATOR

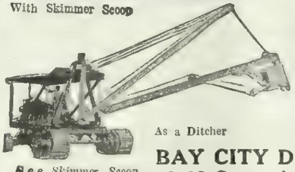
Model 16

One machine—Many uses
The Versatile Bay City never need be idle.
A profitable investment for every contractor.

Write for Circular 12

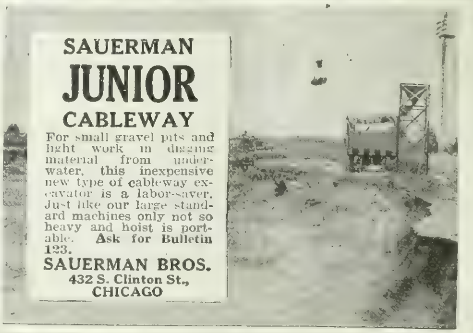
Builders of
CRANES
EXCAVATORS
LAND DREDGES

Walking, Track Crawler and Floating Type


As a Ditcher

See Skimmer Scoop our ad in last issue.

BAY CITY DREDGE WORKS
2603 Center Ave., Bay City, Mich.



SAUERMAN
JUNIOR
CABLEWAY

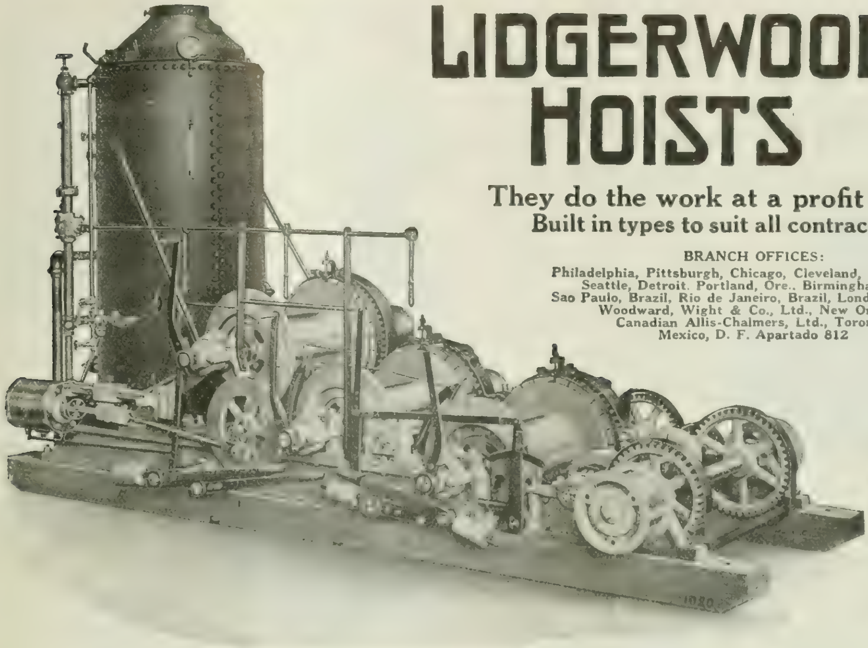
For small gravel pits and light work in digging material from underwater, this inexpensive new type of cableway excavator is a labor-saver. Just like our large standard machines only not so heavy and hoist is portable. **Ask for Bulletin 123.**

SAUERMAN BROS.
432 S. Clinton St.,
CHICAGO

LIDGERWOOD HOISTS

They do the work at a profit to the user
Built in types to suit all contractors' uses

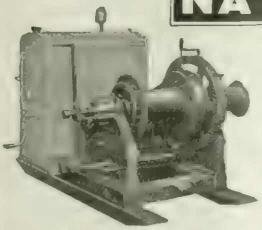
BRANCH OFFICES:
Philadelphia, Pittsburgh, Chicago, Cleveland, Los Angeles,
Seattle, Detroit. Portland, Ore., Birmingham, Ala.,
Sao Paulo, Brazil, Rio de Janeiro, Brazil, London, England,
Woodward, Wight & Co., Ltd., New Orleans,
Canadian Allis-Chalmers, Ltd., Toronto,
Mexico, D. F. Apartado 812



HOISTS
Steam
Electric
Gasoline
DERRICKS
CABLEWAYS

LIDGERWOOD MFG. COMPANY, 96 Liberty Street, New York, N. Y.

NATIONAL

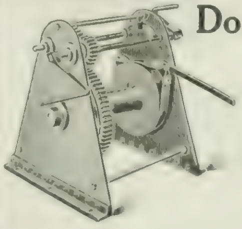


15 HP with Le Roi Engine

Gasoline Hoists

Send for Catalog

National Hoisting Engine Co.
Office and Works
300 Bergen St.,
Harrison, N. J.



Dobbie Derricks and Hoists

Stocks of Fittings, Blocks, Sheaves, Winches, etc., carried by our agents—

G. S. Green Co., New York.
[illegible] Co., Pittsburgh, Cleveland, Charleston, W. Va.
P. I. Perkins Co., Boston

DOBBIE Foundry & Machine Co.
Manufacturers
Niagara Falls, N. Y.

PATTERSON
Extra Heavy Snatch Blocks

Double [illegible]

Write for Catalog No. 22

W. W. Patterson Co.,
50 Water Street, Pittsburgh, Pa.

Dependable Wire Rope

[illegible] resisting [illegible] strength [illegible] economical as well as dependable.

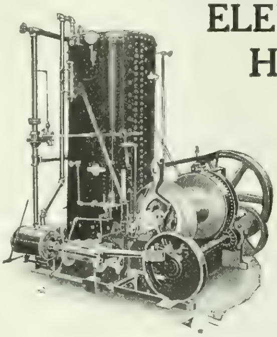
Established 1857

A. Leschen & Sons Rope Co.
St. Louis, Mo.
New York Chicago Denver San Francisco

STROUDSBURG
HOISTING MACHINERY
STEAM—ELECTRIC—GASOLINE
FOR ALL PURPOSES
[illegible]
STROUDSBURG ENGINE WORKS
[illegible], Pa.

MUNDY
TRADE MARK
ESTABLISHED 1869

BRICK MASON'S
ELEVATOR
HOIST



IDEAL for use in building construction for light hoisting. It is especially adapted for double elevators carrying building materials, being provided with large elevator sheave wheel clutch to the drum shaft.

J. S. MUNDY HOISTING ENGINE CO.
Manufacturers of High Grade Hoisting Equipment
New York Sales and Export Office: 30 Church Street
NEWARK, NEW JERSEY, U. S. A.

Clyde's Greatest Asset—

Hundreds of satisfied customers who always specify Clyde Equipment on repeat orders.

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Clyde Iron Works Sales Company
DULUTH, MINN., U. S. A.
Sole Distributors for Clyde Iron Works
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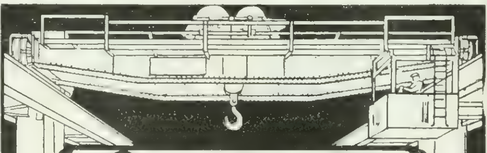


CLEVELAND CRANES
250 LBS. TO 500 TONS
Designed for the Power Plant
The Cleveland Crane and Engineering Co.
Wickliffe, Ohio
Sales Offices 50 Church St., New York City, 511 Farmers Bank Bldg., Pittsburgh, Pa.; 557 Railway Exchange Bldg., Chicago, Ill.; 2401 Chestnut St., Philadelphia, Pa.; 149 E. Larned St., Detroit, Mich.; 500 Arch St., Pittsburgh, Pa.

"TOLEDO CRANES"
Fulfill Every Requirement
Save Time, Labor and Space
THE TOLEDO CRANE CO.
BUCYRUS, OHIO

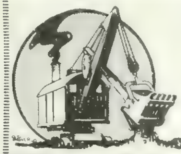
MOORE SPEEDCRANE

A lightweight, flexible speed crane that represents the greatest advance made in crane construction in the past 20 years.

Has a single universal clutch that swings the crane, propels the machine, raises and lowers the boom.

Send for literature.

MOORE BROS.
New York Life Bldg., Chicago, Ill.



——"Marions" Pioneered
In Big Operations—
They Still Lead

The Marion Steam Shovel Co.
Marion, Ohio, U. S. A.

A Giant's Strength
With a Wizard's Deftness
THE BROWNING COMPANY
East 162nd St. & Waterloo Rd
Cleveland, Ohio

Roebling Welding Wire
For Electric Welding
For Oxy Acetylene Welding
John A. Roebling's Sons Company
Trenton, N. J.

CRANES
All
Types

WHITING CORPORATION
HARVEY-ILL. U. S. A.
(CHICAGO SUBURB)

Foundry
Equipment

When the digging looks *"Too tough for a clamshell"*— use the WILLIAMS *Hercules*

Take the advice of concerns like the Kirkpatrick Sand & Cement Company, who have tried out different makes of buckets in the hardest digging. They will tell you that the WILLIAMS "Hercules" has dug successfully in material that was too hard for an orangepeel.

The "Hercules" digs hardpan, tough clay, cemented gravel and imbedded boulders.

If you have hard excavating to do, you don't have to experiment. The experience of many contractors has demonstrated the ability of the "Hercules" to dig hard materials—and the *reliability* of this powerful bucket is covered by the regular WILLIAMS guarantee: *All parts guaranteed against breakage.* What other bucket but a WILLIAMS can you get for the hardest kinds of excavation, with a guarantee like this behind it?

If you are going to have some hard clamshell excavation, just describe the work and we will tell you what you can expect to do with a WILLIAMS "Hercules". Write us.

"In the past 15 years, we have tried many different makes of clam-shell and orangepeel buckets, but we have found that the WILLIAMS clam-shell is the best digging bucket we have ever used." *A. Mohan, Kirkpatrick Sand & Cement Co., Birmingham, Ala.*

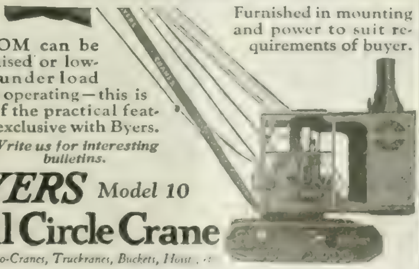
The WILLIAMS Closing Arm, with sheaves in tandem, gives the "Hercules" unrivalled power for biting into hard materials.

Our 60-page catalog describes the WILLIAMS "Hercules," and other WILLIAMS 1-line, 2-line, 3-line and 4-line clamshells. It contains interesting photos, blueprints and descriptions of the 12 standard types of clamshells in the complete WILLIAMS line—for any class of work, any kind of crane or derrick. Write for Catalog N.

G. H. WILLIAMS CO., Erie, Pa., U. S. A.

WILLIAMS
QUICK-ACTING CLAMSHELLS
All Parts Guaranteed Against Breakage

Get a Practical Crane



Furnished in mounting and power to suit requirements of buyer.

BOOM can be raised or lowered under load while operating—this is one of the practical features, exclusive with Byers.

Write us for interesting bulletins.

BYERS Model 10
Full Circle Crane

Also Auto-Cranes, Truckranes, Buckets, Hoist...

THE BYERS MACHINE COMPANY, 250 Sycamore St., Ravenna, O.

Speed in Construction

INDUSTRIAL CRANES

are readily adapted for Excavation Work, Pile Driving, Concrete Work, Handling Coal, Iron, Timber and Steel Cars

Our Golden Anniversary Catalog now ready for mailing

INDUSTRIAL WORKS
BAY CITY MICHIGAN
NEW YORK CHICAGO PHILADELPHIA DETROIT
Sales Engineers in all principal cities
1873 BUILDERS OF CRANES FOR 50 YEARS 1923

Chicago, Railway Exchange Bldg. New York, 50 Church St.

O. S. Dependable

Buckets
Buckets
Buckets
Buckets
Buckets
Buckets
Buckets

All Types
All Sizes
For All
Purposes

ORTON & STEINBRENNER CO.
Offices: Chicago Ill.
Factory: Huntington, Ind.

OSGOOD
Heavy Duty Steam Shovels

Have you seen one of them at work? A regular giant for digging. Easy to operate—low operating and maintenance cost—and fast. Will go most anywhere. Has interchangeable trucks and can be converted, easily and quickly, to Clamshell or dragline.

¾ and 1 yd. capacities
Ask for Bulletin

The OSGOOD Company
Marion, Ohio, U. S. A.

ESTB. 1848

VULCAN
Clamshell and Orange-peel Buckets

Dredging Buckets. Hydraulic Dredging Equipment. Complete Dredges. All work designed and finished in our own plant. Backed by 50 years' experience. Repairs to all types of Buckets and Dredges.

Write for new catalog—just published

VULCAN
Iron Works, Inc.
Jersey City, N. J.

McMYLER-
buckets
clam-shell and orange peel
Locomotive Cranes · Bridge Cranes
Equipment for Moving Materials
THE McMYLER-INTERSTATE Co.
CLEVELAND
INTERSTATE

LAKEWOOD
CLAM SHELLS

for digging, dredging
and handling - send
for descriptive bulletin

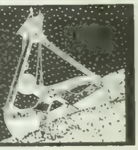
The Lakewood Engineering Company
· Cleveland. U. S. A.

Complete Paving Plant
Paving Mixers, Batch Boxes, Car [illegible] Finishing Machines, Subgrader, [illegible]

Construction Plant
Steel Towers, Chuting Plant, Heavy Duty and Small Mixers, Cars, Track, Hoppers Carts

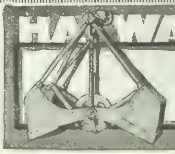
CLAMSHELL BUCKETS

Built by master builders for every kind of digging or rehandling. One, two, three or four line buckets built to fit your crane and fit your work.



BLAW-KNOX COMPANY
601 Farmers Bank Building, PITTSBURGH, PA.

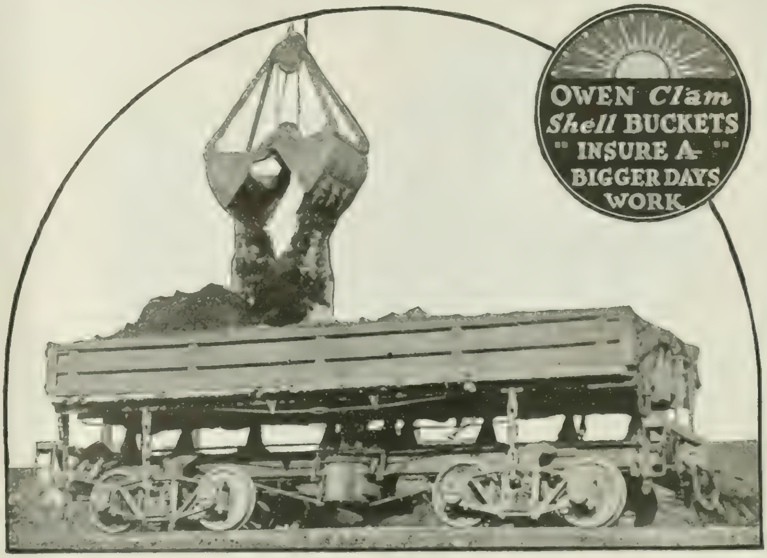
HAYWARD BUCKETS



Clam Shell, Orange Peel, Electric Motor, and Drag Scraper Buckets for all excavating, dredging, and rehandling purposes. Ask for Catalog 43, or consult our engineers gratis.

The Hayward Co., 18-50 Church St., N. Y

OWEN



RAILROAD CONTRACTORS

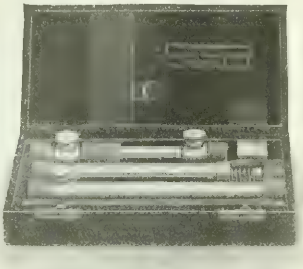
prefer the Owen Bucket because of its adaptability to the work at hand. They have found the "Owen" equally efficient when loading or unloading sand and crushed stone as when digging for abutment footings. They buy *one* bucket now for both classes of work where *two* types were used heretofore because the "Owen" adjustable features of weight, digging power and closing speed enables it to meet every material-handling requirement in the wide range of work encountered in railroad construction. This feature is illustrated and briefly described under Reason No. 4 in Pamphlet No. 11. This is one of 8 reasons based upon 8 new and exclusive features of bucket construction, outlined below, contained in this pamphlet covering our Type "J"—The Railroad Contractor's Bucket. Act now. Get Pamphlet No. 11 for your file today.

THE OWEN BUCKET COMPANY
533 Kirby Bldg., Cleveland, O.

THERE ARE 8 REASONS

why Owen type J Buckets Cost Less to Operate, are more durable and insure a bigger day's work.

1. [illegible] of entire weight is in the center and at the lowest point of the [illegible]
2. [illegible] closing power of [illegible]
3. [illegible] bucket [illegible] digging power.
4. [illegible] digging power and [illegible]
5. [illegible]
6. Cutting edges or teeth hit the material first.
7. V-shape arm construction preserves rigidity.
8. Hinge assembly guaranteed unbreakable.



Color and Turbidity of Water Determined with Accuracy

Water is often "colored" by vegetable matter or "turbid" from mud and silt carried in suspension. When water is used for a municipal supply, color and turbidity are always objectionable; when furnished to industries either quality is usually harmful to the products.

The U. S. Geological Survey Design Color and Turbidity Determining Instruments based on the Platinum-Cobalt methods of color measurement devised by Allen Hazen, C. E., make possible at small cost the scientific determination of color and turbidity of water.

We are prepared to furnish complete sets of these instruments packed in neat, pocket-size cases ready for immediate use in the field.

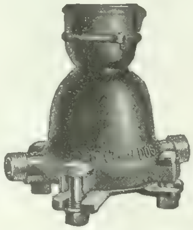
Send for Bulletin No. 41

Builders Iron Foundry, Providence, R. I.

"Builders of the Venturi"

NEW YORK CHICAGO PHILADELPHIA PITTSBURGH ATLANTA DALLAS
SAN FRANCISCO LOS ANGELES KANSAS CITY PORTLAND, ORE. TORONTO OTTAWA

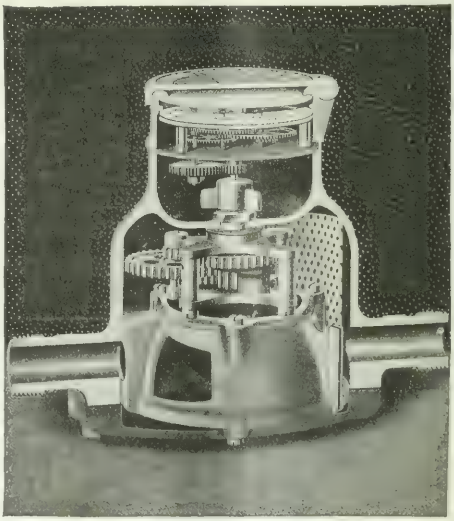
"WATCH DOG"



WATER METERS

Accurate
Durable
Efficient

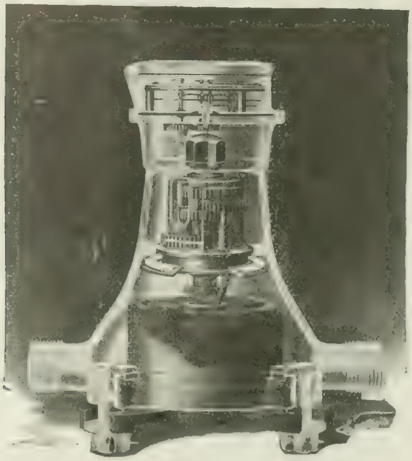
GAMON METER COMPANY
Main Office and Works:
NEWARK, NEW JERSEY



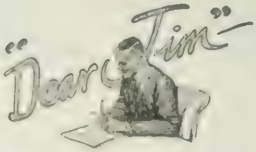
HERSEY DISC METER, MODEL HF which is the Highest type of Frost protected Meter and HERSEY DISC METER MODEL HD which is the Highest type of Divided or split case Meter are the product of thirty-five years' experience and refinement in the manufacture of Water Meters. These Models excel all Meters of all makes in all those essentials which go toward making exceptionally desirable Meters.

HERSEY MANUFACTURING COMPANY
Boston, New York, Chicago, Columbus, O., Philadelphia, Atlanta
San Francisco Los Angeles

Trident Meters



Made where the Spirit of Craftsmanship dominates automatic machinery



A series of short common-interest letters describing [illegible] of the making of Trident Meters—get acquainted with these famous "Bill to Jim" letters— [illegible]

Neptune Meter Company

Pioneers in Meter Progress

50 East 42nd Street

New York City

Boston [illegible] [illegible] Atlanta Los Angeles Seattle Portland St. Louis Mo.

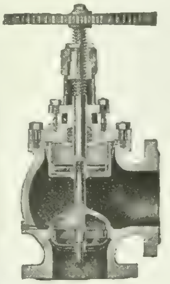
Made for maximum service not merely the average

TRADE JENKINS MARK

Jenkins Bros

Automatic Equalizing Stop and Check Valves

(Also known as "Non-Return" Valves)



Sectional view, Fig. 293. Extra Heavy Iron Body Automatic Equalizing Stop and Check Valve, Angle Pattern.

This valve automatically shuts off the flow of steam from header to boiler in case a tube should burst or other internal rupture occur, thereby suddenly reducing the pressure in that boiler. They prevent one boiler from working at a lower pressure than another.

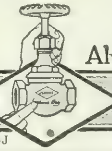
Their installation makes it impossible to accidentally turn steam into a boiler which is being cleaned, because the valve can be opened only by the pressure in the boiler to which it is attached.

Made in extra Heavy Globe and Angle Patterns — Iron Body for working steam pressures up to 250 pounds; Cast Steel up to 350 pounds.

Send for descriptive folder

JENKINS BROS.

80 White St. .... New York
524 Atlantic Ave. .... Boston
133 No. Seventh St. .... Philadelphia
646 Washington Blvd. .... Chicago



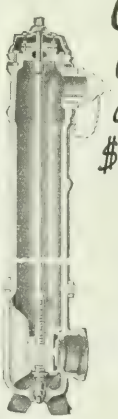
Always marked with the "Diamond"

Jenkins Valves

SINCE 1864

2734-J

Over 3,000 cities and towns are guarding against $1,000 a minute fire loss!



They were Ludlow Fire Hydrants—because of their simple construction, non-freezing feature, freedom from binding and water hammer, and the patented device which prevents flooding, should they be broken. As can be seen, the Ludlow Fire Hydrant is of the gate type.

Get the Ludlow Catalog on Valves and Hydrants.

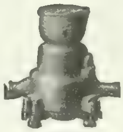
The Ludlow Valve Mfg. Co.

Troy TRADE LUDLOW MARK **New York**

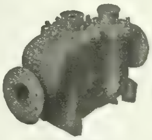
BRANCHES: New York, 62 Gold Street; Boston, 112 Water Street; Philadelphia, Harrison Building; Pittsburgh, First National Bank Building; Chicago, 633-635 The Rookery, Kansas City Office, R. A. Long Building; San Francisco, Calif., W. P. Horn Co., Rialto Building; Los Angeles, Calif., W. P. Horn Co., Kerckhoff Building.

Southern Representative:
W. F. Wilcox, 1206 Fourth National Bank Bldg., Atlanta, Ga.

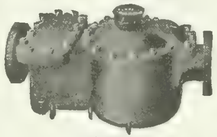
WATER METERS



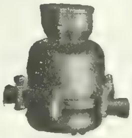
ARCTIC
Frost Bottom



KEYSTONE
COMPOUND



EUREKA
Current



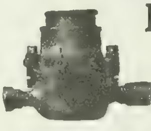
KEYSTONE
All-Bronze

PITTSBURGH METER COMPANY
East Pittsburgh, Pa.

NEW YORK—50 Church St.
CHICAGO—5 So. Wabash Ave.
KANSAS CITY—Mutual Bldg.
COLUMBIA—1433 Main St.
SEATTLE—4038 Arcade Bldg.
LOS ANGELES—Union Bank Bldg.

WORTHINGTON

Meters



Meter frozen, showing compression of frost clamps

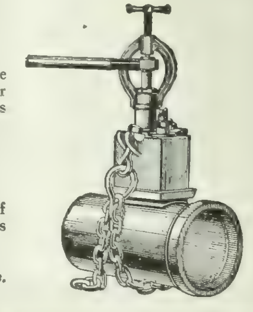
The upkeep cost of 35,000 Worthington Model "G" meters was four cents a year. Worthington frost clamps save money in winter, too. Ask for proof.

WORTHINGTON PUMP AND MACHINERY CORPORATION
Executive Offices: 115 Broadway, New York City
Branch Offices in 24 Large Cities W.68

Easily Carried By One Man

This light, durable machine will be sent on approval for 30 days trial. If not as represented, send it back.

Corporation Tapping Machine



Write for latest bulletins of this and other waterworks appliances.

The A. P. Smith Mfg. Co.
East Orange, N. J.

CHLORINATION BREVITIES

340,000,000 Gallons of Water are Sterilized Each Day at the Dunwoodie Installation of W & T Apparatus for New York City's Water Supply

BEFORE chlorination the typhoid fever death rate in the cities of the United States was over 25 per 100,000.

Now with chlorination it is less than 5.

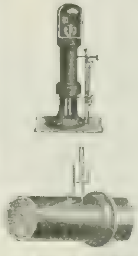
The only safe water supply is one that is sterilized.

WALLACE & TIERNAN
COMPANY, INCORPORATED
Manufacturers of Chlorine Control Apparatus
NEWARK, NEW JERSEY

8

Number Two of a series of four advertisements explaining the adaptability of Simplex Pitot Tube Meter as an accurate hydraulic measuring device.

THE SIMPLEX PITOT TUBE METER



Cut shows standard Simplex Meter Register connected to a Simplex Pitot tube which is inserted in the pipe line.

is adapted for use in water mains of any size, and for the measurement of water at any pressure and at any velocity down to ½ foot per second. It is widely employed for metering flow in:

- Discharge mains from pumping station and filtration plants:
- Pipe lines from storage dams and reservoirs:
- Distribution mains within city limits:
- Water supply lines in industrial establishments for recording the total water supplied to the entire plant, to sections of the plant, or the water supplied for special purposes, as for condensing.

Interesting data on "Pitot tubes and their practical application" sent upon request—

"Simplex Installations Give Satisfaction."

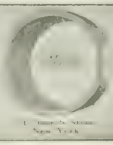
Simplex Valve and Meter Company
300 Fidelity Building, Philadelphia
MANUFACTURERS OF METERS AND RATE CONTROLLERS OF THE VENTURI TYPE, GAUGES AND OTHER WATER WORKS DEVICES

Clean Water Mains

Deliver Full Capacity

We are glad [illegible]
with our [illegible]
or Water [illegible]

[illegible]



National Water Main Cleaning Company,

[illegible]
New York

GRAVER
Steel
Tank and Plate Work
HEADQUARTERS

Steel Tanks and Steel Plate Work

Water Softeners, Filters and Heaters

[illegible]

GRAVER *Corporation*

[illegible]

DEAN

ELECTRIC CONTROL UNIT
FOR THE MOTOR OPERATION OF LARGE GATE AND GLOBE VALVES

Write for bulletins

PAYNE DEAN LIMITED
STAMFORD CONN.

CHICAGO NEW YORK PITTSBURGH

EBG

Liquid Chlorine

Electro Bleaching Gas Co.

PIONEER MANUFACTURERS *of* LIQUID CHLORINE

[illegible]

ROBERTS FILTERS

WATER-*fit for use*

Filtration and Water Softening Plants

ROBERTS FILTER MFG CO.

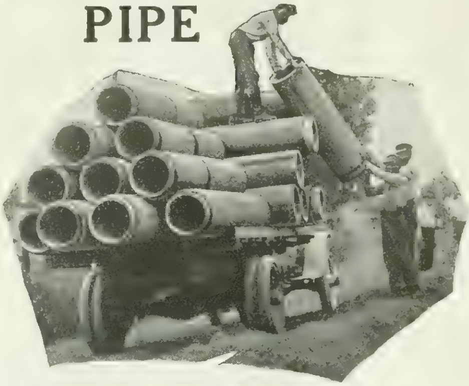
[illegible]

CHLORIDE OF LIME

For Purifying Water

Pennsylvania Salt Mfg. Company, Philadelphia, Pa., U. S. A

MICHIGAN PIPE



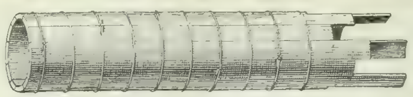
Puts Real Pipe Value Into the Trench

Low Initial Cost — Exceptional Performance
Low Labor Cost — Shipment from Stock

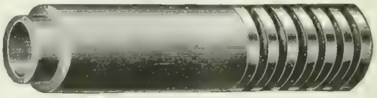
Said a waterworks engineer: "My investigation brought to my knowledge a waterworks in Indiana with 28 miles of Michigan Pipe, with an extremely low maintenance account."

The Michigan Pipe Co.
Dept. 17, Bay City, Michigan

Oklahoma City, Okla., 105 W. 16th St.; New York City, N. Y., 522 Fifth Ave.; Chicago, Ill., Letter Bldg., 15 E. Van Buren; Boston, Mass., Room 1121, Oliver Bldg.; Cleveland, Ohio, 919 Ulmer Bldg.; Chattanooga, Tenn., 702 James Bldg.; Philadelphia, Pa., 318 Widener Bldg.; Pittsburgh, Pa., 323 Fulton Bldg.



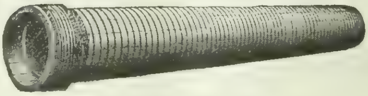
Douglas Fir Continuous Stave
WOOD PIPE



"Standard" Wood Pipe

STANDARD WOOD PIPE CO.
Williamsport, Penn.

PACIFIC REDWOOD AND DOUGLAS FIR PIPE



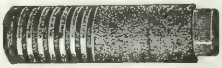
Made in all sizes from 2 inch to 14 feet in diameter

Write for Catalogue

PACIFIC TANK & PIPE CO.
THE STANDARD SINCE '88

8 Rector St., New York — **306 Market St., San Francisco**
169 Washington St., Chicago

WATER SOFTENING AND FILTRATION PLANTS
INTERNATIONAL FILTER CO.
333 West 25th Place, Chicago
New York Office: Woolworth Bldg.



Save 25% to 50% by using
Wyckoff Wood Pipe
instead of Cast Iron Pipe

Cheaper. Lasts as long. Delivers more water. Get catalogue.

A. WYCKOFF & SON CO., ELMIRA, N. Y.

Branches: ATLANTA, GA., H. H. White, 1503 4th Nat. Bank Bldg.
SCRANTON, PA., Valley Supply Co., Coal Exch. Bldg.

WATER SOFTENING AND FILTRATION PLANTS
AMERICAN WATER SOFTENER COMPANY
4th and LEHIGH AVES. PHILADELPHIA, PA.
No affiliation or working agreement with any of our competitors

CONTINENTAL (WOOD) PIPE
CONTINUOUS STAVE AND MACHINE BANDED
(Plain and Creosoted)
CREO-WOOD FLUME — WOOD CONDUIT
Write for Catalog
CONTINENTAL PIPE MFG. CO.
Ballard Station, SEATTLE, WASH.
3904 Woolworth Bldg., New York

WATER FILTERS SOFTENERS STERILIZERS
Industrial-Municipal-Domestic-Swimming Pools
"BEAR BRAND" LIQUID CHLORINE
CALIFORNIA FILTER CO.
The Merchants Exchange — *San Francisco*

ECONOMY
AMERICAN-CREOSOTED
WOOD STAVE PIPE
AMERICAN WOOD PIPE CO. INC.
TACOMA WASH. — 30 CHURCH ST. NEW YORK — 140 S. DEARBORN CHICAGO
DURABILITY

SLUICE GATES
Shear, Flap and Butterfly Valves
FLEXIBLE JOINTS
COLDWELL-WILCOX CO
NEW WINDSOR NEWBURGH N.Y.

Hand or Motor Operated Hydraulic Gate Hoists—

Standard Capacities up to 60,000 pounds

Dilts Machine Works, Inc.
Fulton, New York

Warren Foundry & Pipe Company
Manufacturers of
CAST IRON PIPE
SPECIAL CASTINGS
Bell and Spigot—Flanged—Flexible Joint—Culvert—Tubes—Milled and Plain Ends — Cylinders — Manhole Heads and Covers—High-Pressure Fire Service Pipe—All Sizes.
Works: Phillipsburg, N. J.
Sales Offices Bowling Green Bldg., New York
201 Devonshire Street, Boston, Mass.

TRADE **"LEADITE"** MARK
Registered U. S. Patent Office
FOR JOINTING CAST IRON WATER MAINS
NO CAULKING
Saves 50% to 75%
Leadite Joints Improve with Age
THE LEADITE COMPANY, 1232 Land Title Bldg., Phila., Pa.

UNIVERSAL CAST IRON PIPE
THE CENTRAL FOUNDRY COMPANY
41 EAST 42d ST., NEW YORK
Chicago Birmingham Dallas San Francisco
no packing *no calking* *no bell holes*

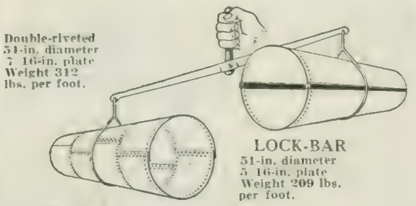
U. S. PRODUCTS
CAST IRON PIPE
USICAST CASTINGS
United States Cast Iron Pipe & Fdy. Co.
General Offices: Burlington, N. J.

Nicholas Engel
JOHN FOX & CO.
Cast-Iron Water, Gas and Flange Pipe, Special Castings, Fire Hydrants, Valves, General Foundry and Machine Work.
Woolworth Building, 233 Broadway NEW YORK CITY

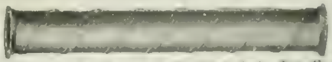
GLAMORGAN PIPE & FOUNDRY CO.
LYNCHBURG, VA.
GENERAL FOUNDERS AND MACHINISTS
Manufacturers of
Cast Iron Pipe
For Water and Gas, Flange Pipe and Fittings
Western Office: 543 The Rookery, Chicago

CAST IRON PIPE
—AND FITTINGS—
American Cast Iron Pipe Company
Birmingham, Ala.
SALES OFFICES IN PRINCIPAL CITIES

R. D. WOOD & CO.
ESTABLISHED 1803
PHILADELPHIA, PA.
"Mathews" Reg. U. S. Pat. Off.
Fire Hydrants
Valves
Gate, Foot and Check
Cast Iron Pipe and Fittings, Special Castings
For Water, Gas and High Pressure Service



LOCK-BAR STEEL PIPE
is generally given a preference of 3 in. less diameter than riveted steel pipe for a given capacity—and will carry approximately 30% greater working pressure than riveted steel pipe of similar plate thickness. Its coefficient of friction is the same as new cast iron pipe *and never grows less.*
Altogether, a fine investment. See our full page ads. every other issue for detailed discussions. Send business card for 200-page "Handbook of Pipe."
EAST JERSEY PIPE CO.
7 Dey Street, New York City
LOCK-BAR
STRONG AS THE PLATE ITSELF

LOCK-SEAM SPIRAL PIPE For Low Pressure Service

Made in continuous lengths up to 30 lineal feet. Smooth on inside and true to diameter. We specialize in dredging pipe. We also make welded Spiral Seam pipe of special analysis hard sheet steel for heavy duty service. Write for particulars.
For By-Products, Blow-off Pipes, Water Supply Lines, Irrigation, Sluicing and Dredging
ROBERTSON BROS. MFG. CO. 5401 So. Western Blvd., Chicago, Ill.

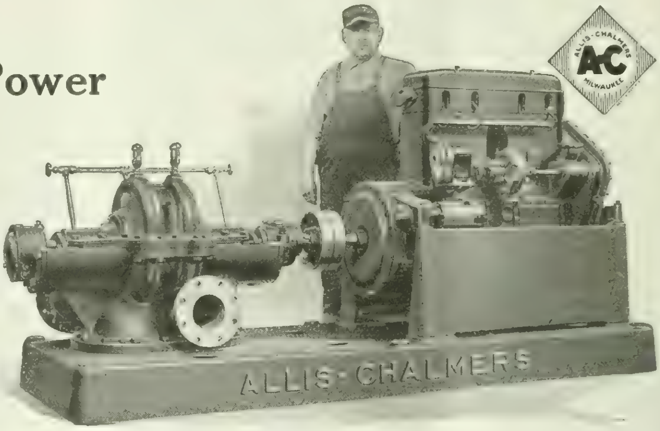
ROOT
Spiral Riveted Pipe
Pipe Specialists for 45 years
Abendroth & Root Mfg. Co
Works: Newburgh, N. Y.
N. Y. Office: [illegible] Broadway

Spiral Riveted Pipe [illegible]
AMERICAN SPIRAL PIPE WORKS
50 Church St., New York Main Office and Works, CHICAGO, Box 485

McWANE PRECALKED JOINT PIPE CAST IRON
Sizes 1¼ in. and Up
McWANE CAST IRON PIPE CO
Birmingham, Alabama
No Bell Holes

If you haven't Electric Power

A gasoline engine driven pump will take care of your pumping requirements. They can be used for gravel washing, sluicing and supplying water for steam shovels in the Rock Products industries or for fire pumps, tank pumps and general supply pumps anywhere. Our Bulletin 1632-F describes other applications.



Bulletin 1632-F Sent on Request

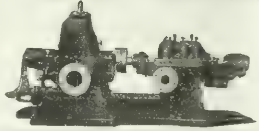
ALLIS-CHALMERS
MILWAUKEE, WIS. U. S. A.

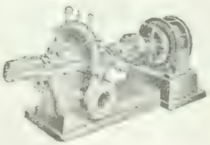
MORRIS Since 1864
CENTRIFUGAL PUMPS
Since 1864 we have been building Centrifugal Pumps, Hydraulic Dredges and Steam Engines.
Morris Machine Works, Baldwinsville, N. Y.
Agents in Principal Cities

RoTURBo CENTRIFUGAL
PUMPS
Manistee Iron Works Co., Manistee, Michigan

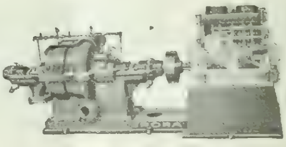
LC LE COURTENAY LC
CENTRIFUGAL PUMPS
(Lea Courtenay)
LE COURTENAY CO.
3 Main Street
Newark, New Jersey
2093-T

EARLE - CENTRIFUGAL - PUMPS
For all purposes where Centrifugal Pumps of the better class are adapted.
The Earle Gear & Mach. Co.
4707 Stenton Ave.
Philadelphia, Pa.

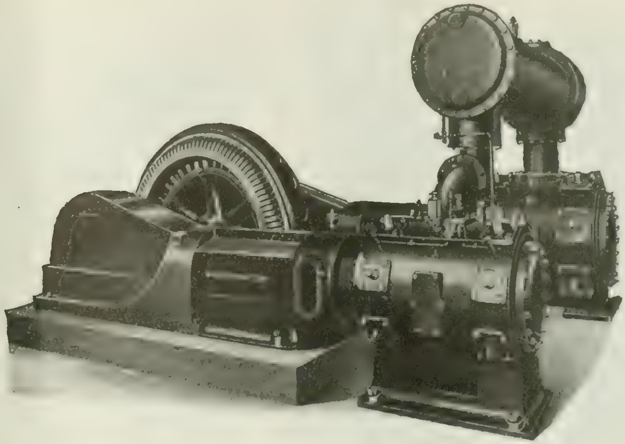




Pumps —AURORA— *Pumps*
Single and Two-Stage, open impeller pumps ¾ in. to 24 in. discharge openings. Double-suction pumps, 1½ in. to 72 in. Multi-stage pumps all capacities. Deep well turbines and Power Heads. Special Mine-Sinker Pumps.
AURORA PUMP & MFG. CO.,
Loucks St., Aurora, Ill.



KERR
KERR TURBINE COMPANY
WELLSVILLE, N.Y. U.S.A.
Oldest Exclusive Builders of Steam Turbines, Reduction Gears
TURBINES KERR GEARS



. . . So They Asked FEATHER (Reg. U. S. Pat. Off.) Valve Owners

The Brooks Callaway Co., of Atlanta, Georgia, wanted an air compressor. They telegraphed several firms who had used Worthington FEATHER Valve Compressors and asked these users what they thought of their machines.

Here are the Replies:

We have two Laidlaw Feather Valve Compressors which are giving perfect satisfaction.

Concerning your wire of the twentieth, we have two Laidlaw Feather Valve Air Compressors manufactured by Worthington Company in service **for two years which have given entire satisfaction.**

We have 3,000 feet Laidlaw Feather Valve Compressors; three purchased 1915, three purchased **1920. Service exceptionally favorable. Maintenance very low. Efficiency very good.**

We are using Feather Valve Compressors for air and amonia and giving repeat orders. We know of nothing better for a valve. The details of the **rest of the machine should vary according to your** particular service and price you wish to pay.

We have one 800 cubic foot steam-driven **Feather Valve Compressor and one 3,000 cubic** foot motor driven compressor, operating at 120 **pounds period with our conditions. Both machines operate very satisfactory.**

Your telegram June 20th. We have found **Laidlaw Feather Valve Compressor quite satisfactory and can recommend it.**

Our operating experience with Laidlaw Air Compressors satisfactory.

Three Laidlaw Feather Valve Compressor has been generally satisfactory on this work for three years.

Our experience with Laidlaw Compressors and Worthington Pump and Machinery Company have been most satisfactory. Have nothing unfavorable to report.

Names of senders furnished upon request

WORTHINGTON PUMP AND MACHINERY CORPORATION

Executive Offices 115 Broadway, New York City. Branch Offices in 24 Large Cities

W-205.8

WORTHINGTON

Deane Works, *Holyoke, Mass.*
Blake & Knowles Works
East Cambridge, Mass.
Worthington Works
Harrison, N. J.
Laidlaw Works, *Cincinnati, Ohio*

Hazleton Works, *Hazleton, Pa.*

Gas Engine Works, *Cudahy, Wis.*
Power & Mining Works
Cudahy, Wis.
Snow-Holly Works
Buffalo, N. Y.
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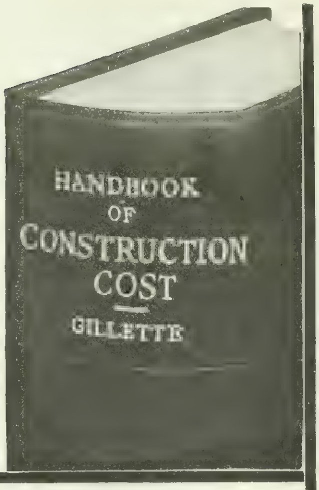

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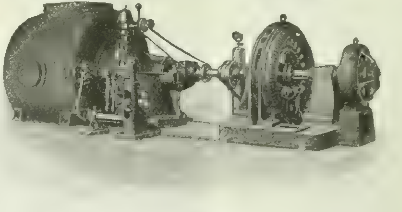

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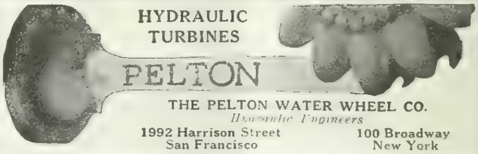

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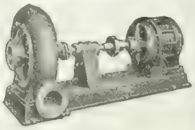

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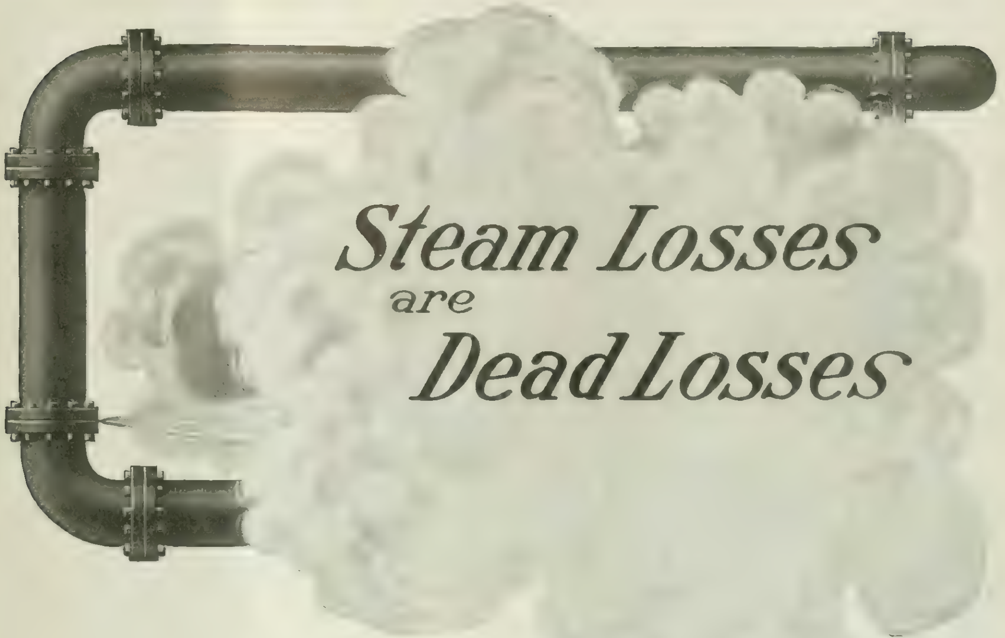

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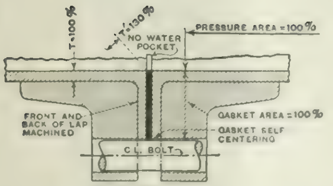

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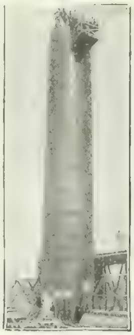

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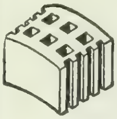

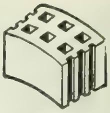

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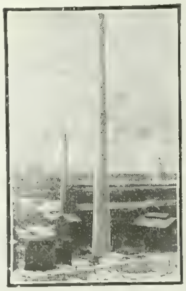

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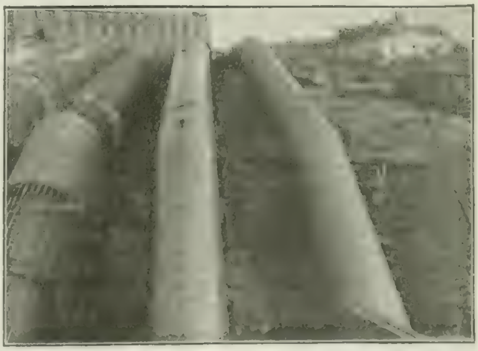

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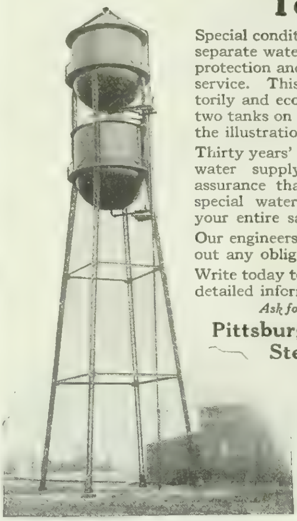

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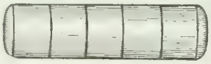

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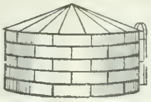

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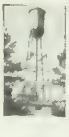

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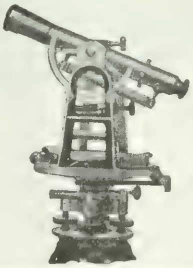

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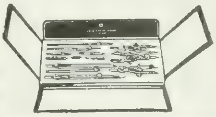

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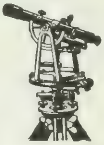

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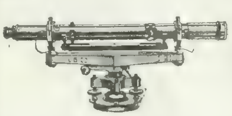

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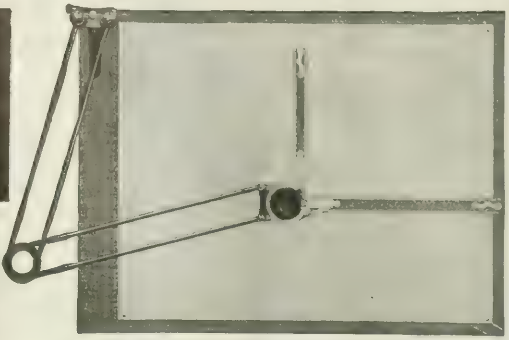

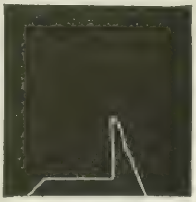

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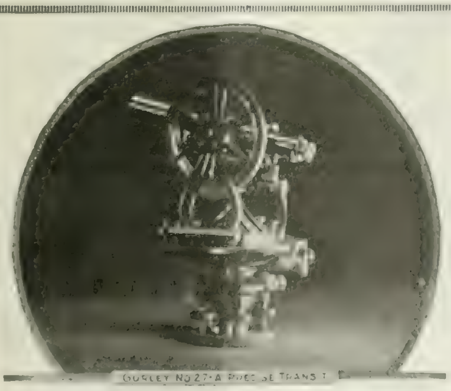

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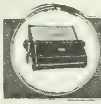

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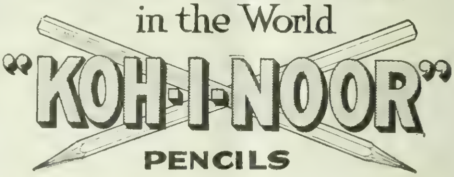

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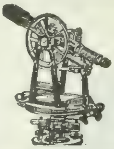

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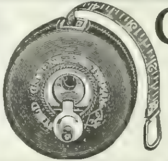

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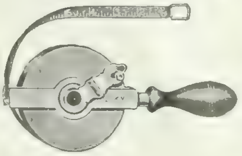

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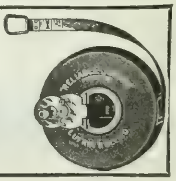

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WHAT AND WHERE TO BUY INDEX

A Classified Index of Advertisers in this Issue

Equipment, Apparatus and Supplies Used in the Civil Engineering and Contracting Fields with Names of Manufacturers and Distributors

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See Searchlight Section for used Equipment.

Acetylene, Compound
Linde Air Products Co.

Aerial Photo Service
Fairchild Aerial Camera Corp.

Asbestos & Asbestos Prods.
Carey Co., The Philip

Ash Handling Machinery
Chain Belt Co.
Haiss Mfg. Co., Inc., Geo.
Jeffrey Mfg. Co.
Portable Mchy. Co.
Specialty Engr. Co.

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Carey Co., The Philip
Standard Oil Co. of N. Y.

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Austin Machinery Corp.

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Austin Machinery Corp.
Buckeye Traction Ditcher Co.
Moore Trench Mch. Co.
Northwest Engineering Co.
Parsons Co.

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Koehring Company
Ransome Concrete Mach. Co

Bar Chairs, Reinforcing
Concrete Steel Co.
Corrugated Bar Co.
Truscon Steel Co.
Universal Clamp Co.

Barges, Concrete
Ambursen Construction Co.

Barges, Steel
American Bridge Co.
Graver Corpn.

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Bethlehem Steel Co.
Ryerson & Son, Joseph T.
Truscon Steel Co.

Batchers, Adjust. Measuring
Blaw-Knox Co
Heltzel Steel Form & Ir. Co.

Beam Wrapping
Mitchell-Tappen Co.

Belting
Robins Conveying Belt Co.

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Berger Mfg. Co.
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Brown Hoisting Mach. Co.
Heltzel Steel Form & Iron Co.

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du Pont de Nemours & Co.

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Kerr Turbine Co.

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Pease Co., C. F.
Wickes Bros.

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Abendroth & Root Mfg. Co.
Babcock & Wilcox Co.

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Ballard, Sprague & Co.

Bolts, Nails, Nuts, Rivets & Spikes
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Foster Co., L. B.
Ryerson & Son, Joseph T.

Books, Engineering and Technical
Carpenter, C. C.
Hayden, Edward
McGraw-Hill Book Co.
Wiley & Son, John

Bonding Companies
See Searchlight Section

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Westinghouse Tr. Br. Co.

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Belmont Iron Works
Berlin Constr. Co.
Bethlehem Steel Co.
Blaw-Knox Co.
Boston Bridge Works
Brown Hoisting Mach. Co.
Eastern Bridge & Struc. Co.
Fort Pitt Bridge Works
Independent Bridge Co.
Kenwood Bridge Co.
McClintic-Marshall Co.
Milwaukee Bridge Co.
Morava Construction Co.
Mount Vernon Bridge Co.
Parsons Klapp, Brinckerhoff & Douglass
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Pittsb'gh-Des Moines St. Co.
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Riverside Bridge Co.
Shoemaker Bridge Co.
Virginia Bridge & Iron Co.
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Williams Co., G. H.

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Ransome Concrete Mchy. Co
Union Iron Works

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Hayward Co.

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Marion Steam Shovel Co.
Mead-Morrison Mfg. Co.
Osgood Company
Owen Bucket Co.
Union Iron Works
Williams Co., G. H.

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Buckets, Orange Peel
Hayward Co.
McMyler Interstate Co.
Mead-Morrison Mfg. Co.
Orton & Steinbrenner Co.
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Corrugated Bar Co.
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Lidgerwood Mfg. Co.
Mundy Hoist. Eng. Co., J. S.
Roebling's Sons Co., J. A.

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(See Excavators Cableway)

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Graver Corpn.

Cars, Concrete
Ransome Concrete Mchy. Co.

Cars, Industrial V Dump
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Ramapo Ajax Co.
Western Wheeled Scraper Co

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Ransome Concrete Mchy. Co.

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Jeffrey Mfg. Co.
McWane Cast Iron Pipe Co.
Marion Malleable Iron Wks.
Marion Steam Shovel Co.
U.S. Cast Ir. Pipe & Fdy. Co.
Vulcan Iron Works of Pa.
Warren Fdry. & Pipe Co.

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Central Foundry Co.
U. S. C.I. Pipe & Fdry. Co.

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Pennsylvania Cement Co.
Portland Cement Assn.
Vulcanite Port. Cement Co.

Cement-Guns
Cement-Gun Co.

Cement-Making Machinery
Allis-Chalmers Mfg. Co.
Austin Machy. Corp.
Vulcan Iron Works of Pa.
Willsea Works, The
Worthington Pump & Mchy. Corp.

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Blaw-Knox Co.

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Brown Hoisting Mchy. Co.
Chain Belt Co.
Haiss Mfg. Co., Geo.
Jeffrey Mfg. Co.
Ryerson & Son, Joseph T.

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Sullivan Mchy. Co.

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General Concrete Constr. Co.
Heine Chimney Co.
Rust Engineering Co.
Summerhays & Sons Co.,
Weber Chimney Co.
Wiederholdt Construction Co

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American Chimney Corp.
Ballard, Sprague & Co.
Custodis Chimney Construction Co., Alphons
Heine Chimney Co.
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Penna. Salt Mfg. Co.

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Wallace & Tiernan Co., Inc.

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Pyle-Rogers Corp.
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Heltzel Steel Form & Ir. Co.

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Ingersoll-Rand Co.
McKiernan-Terry Drill Co.
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Toch Brothers
Truscon Laboratories

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Willsea Works, The

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Concrete Steel Co
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Chain Belt Co.
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Portable Mchry. Co.
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Consolidated Expanded Metal Cos.
Truscon Steel Co.

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Industrial Works
Northwest Engineering Co.

Cranes, Electric
Northwest Engineering Co

Cranes, Locomotive
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Browning Co.
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Industrial Works
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Marion Steam Shovel Co.
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Cranes, Wrecking
Industrial Works

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Colonial Creosoting Co.
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Jeffrey Mfg. Co.
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Hardesty Mfg. Co., The R.
Newport Culvert Co.

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Armco Culvert & Flume Mfrs. Assn.
Austin-Western Rd. Mch.Co.
Hardesty Mfg. Co., The R.
Newport Culvert Co., Inc.
U.S. Cast Ir. Pipe & Fdy. Co.

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Canton Culvert & Silo Co.
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Concrete Steel Co.
Truscon Steel Co.

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Milburn Co., Alexander

Dams
Amburson Construction Co.

Dealers, Equipment
See Searchlight Section

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Hayward Co.
Insley Mfg. Co.
Lidgerwood Mfg. Co.
McMyler Interstate Co.
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(See Road Oilers, Pressure)

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(See Excavators)

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Snare Corp., Frederick

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Drawing Tables
(See Tables and Bds. Drg.)

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Hayward Co.
Lidgerwood Mfg. Co.
Marion Steam Shovel Co.
Osgood Company

Dredges, Dipper
Austin Mchy. Corp.
Erie Steam Shovel Co.
Osgood Company

Dredges, Hydraulic
Atlantic Gulf & Pacific Co
Marion Steam Shovel Co.
Morris Machine Co.

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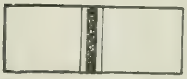
Ingersoll-Rand Co.
Keystone Driller Co.
McKiernan-Terry Drill Co.
Sullivan Mchy. Co.

Carey Elastite

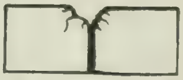
TRADE MARK REG. U.S. Pat. Office

EXPANSION JOINT

PROVED AND ACCEPTED



Carey Elastite Expansion Joint, cushions the slab against the shock of traffic.



The traffic impact shatters the unprotected joint.

A concrete road or city street expanded to the extreme in severe summer temperatures is under great stress at the joints. Every shock of traffic shatters and breaks down the edges of the concrete slabs—unless the joints are Carey Elastite Expansion Joint.

Carey Elastite Expansion Joint helps rigid pavements bear heavy traffic

THE pulverizing impact of tons of traffic dosen't injure the road with Carey Elastite Expansion Joints. Carey Elastite Expansion Joint resiliently cushions the concrete slab against shocks, strains and stresses, besides relieving stresses of expansion due to high temperature, preventing cracking of surfaces, and keeping joints water-tight and frost-tight in cold weather, thus protecting the sub-grade.

Carey Elastite Expansion Joint is a body of tempered asphalt sandwiched between two layers of felt. This construction prevents Carey Elastite Expansion Joint slabs from melting or sticking together in hot weather and from chipping or breaking in cold temperatures, as ordinary asphalt slabs will. Send for sample and list of cities where Carey Elastite Expansion Joint stocks are maintained for immediate shipments.

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18 Wayne Avenue, Lockland, Cincinnati, Ohio

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Georgia State Highways
Kansas State Highways
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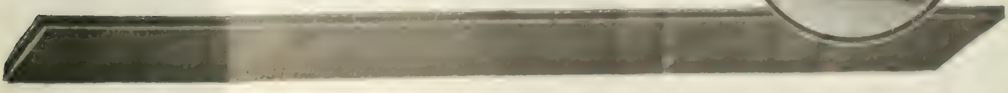
Lincoln Highway
Massachusetts State Highways
Michigan State Highways
Missouri State Highways
New Jersey State Highways
New York State Highways
Pennsylvania State Highways
Texas State Highways
Utah State Highways
Washington State Highways
Washtenaw County, Mich.
Wayne County, Michigan
Wisconsin State Highways



Drills, Rock
Chicago Pneumatic Tool Co
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McKiernan-Terry Drill Co.
Sullivan Mchy. Co.

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Hendrick Mfg. Co.
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Insley Mfg. Co.
Ransome Concrete Mchy. Co

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Ridgway & Son Co., Craige

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Marks Corp., The H. E.

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Ingersoll-Rand Co.
Worthington Pump & Mchy. Corp.

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Morris Machine Works

Engines, Hoisting
(See Hoists)

Engines, Steam
Chicago Pneumatic Tool Co.

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Best Tractor Co., C. L.

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Lidgerwood Mfg. Co.
Mundy Hoist. Eng. Co., J. S.
Sauerman Bros.

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Keystone Driller Co.
Marion Steam Shovel Co.
Moore Trench M'ch. Co.
Northwest Engineering Co.
Osgood Company
Parsons Co.
Potter Mfg. Co., The
Thew Shovel Co.

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Bay City Dredge Works
Byers Mach. Co.
Erie Steam Shovel Co.
Hayward Co.
Marion Steam Shovel Co.
McMyler-Interstate Co.
Northwest Engineering Co.
Osgood Company
Sauerman Bros.

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Consolidated Expanded Metal Cos.
Northwestern Expanded Metal Co.
Truscon Steel Co.

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National Lead Co.

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du Pont de Nemours & Co.

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California Filter Co.
International Filter Co.
Roberts Filter Mfg. Co.

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Marks Corp., H. E.
Truscon Steel Co.

Floor, Asphalt Mastic
Standard Oil Co. of N. Y.

Floor Hardener, Concrete
(See Conc. Floor Hardener)

Floor, Wood Block
Barrett Company
Jennison-Wright Co.

Flooring, Fireproof
Irving Iron Works
Marks Corp., H. E.
Universal Safety Tread Co.

Flumes
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Flumes, Iron & Steel
Armco Culvert & Flume Mfrs. Assn.
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Hardesty Mfg. Co., R.

Forgings
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Carnegie Steel Co.

Form Clamps
Concrete Steel Co.
Insley Mfg. Co.
Pyle-Rogers Co.
Universal Form Clamp Co.

Form Tighteners
Concrete Steel Co.
Marion Malleable Iron Wks.

Forms, Culvert, Road, Sewer, Tunnel, etc.
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Foote Concrete Machy. Co.
Heltzel Steel Form & Ir. Co.
Lakewood Engr. Co.
Metal Forms Corp.

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Blaw-Knox Co.
Metal Forms Corp.

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Blaw-Knox Co.
Concrete Steel Co.
Heltzel Steel Form & Ir. Co.
Metal Forms Corp.

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New England Fd. Co., Inc.
Raymond Concrete Pile Co.
Spencer, White & Prentis.
Underpinning & Found. Co.

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Foster Co., L. B
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Coffin Valve Co.
Coldwell-Wilcox Co.
Hardesty Mfg. Co., R.

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Simplex Valve & Meter Co.

Gauges, Rates of Flow
Simplex Valve & Meter Co.

Gears
Earle Gear & Mach. Co.

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General Electric Co.
Kerr Turbine Co.

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(See Wire Glass)

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Worthington Pump & Machy. Corp.

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Austin-Western Rd.Mchy.Co.
Erie Steam Shovel Co.
Good Roads Mchy. Co.
Koehring Company
Western Wheeled Scraper Co.

Granite
Granite Paving Block Mfrs.'

Graphite
Detroit Graphite Co.

Gratings, Subway
Irving Iron Works
Mitchell-Tappen Co.
Universal Safety Tread Co.

Gravel Washing Plants
Sauerman Bros.

(Gypsum)
Keystone Gypsum Fireproofing Co.
Marks Corp., H. E.

Hammers, Pneumatic
Chicago Pneumatic Tool Co.

Hammers, Steam Pile
(See Pile Hammers, Steam)

Heaters, Tar & Asphalt
Honhorst Co., The Jos.
Littleford Bros.

Hoists, Concrete Tower
Clyde Iron Wks Sales Co.
Insley Manufacturing Co.
Lakewood Engr. Co.
National Hoisting Eng. Co.

Hoists, Contractors' Electric
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Bay City Dredge Works
Byers Mach. Co.
Clyde Iron Wks. Sales Co.
Dobbie Foundry & Mach.Co.
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Mundy Hoist. Eng. Co., J.S.
National Hoisting Eng. Co
Porter Co., H. K.
Ransome Concrete Mchy. Co.
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Yale & Towne Mfg. Co.

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Lidgerwood Mfg. Co.
Mundy Hoist. Eng. Co., J.S.
National Hoisting Eng. Co.
Stroudsburg Engine Works
Van Dorn Iron Works Co.

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Byers Mach. Co.
Clyde Iron Wks. Sales Co.
Ingersoll-Rand Co.
Lidgerwood Mfg. Co.
Mead-Morrison Mfg. Co.
Mundy Hoist Eng. Co., J. S.
National Hoisting Eng. Co
Stroudsburg Engine Works
Vulcan Iron Works of Pa.

Hoists, Hydraulic Head Gates
Dilts Machine Wks., Inc.

Hoists, Motor, Truck
Wood Hyd. Hoist & Body Co.

Hoists, Pneumatic
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stroudsburg Engine Works
Sullivan Machinery Co.

Hoppers, Concrete
Insley Manufacturing Co.
Ransome Concrete Mchy. Co.

Hoppers, Steel
Heltzel Steel Form & Ir. Co.
Honhorst Co., The Jos.

Horses, Steel
Economy Scaffold Co.

Hose, Air
Chicago Pneumatic Tool Co.

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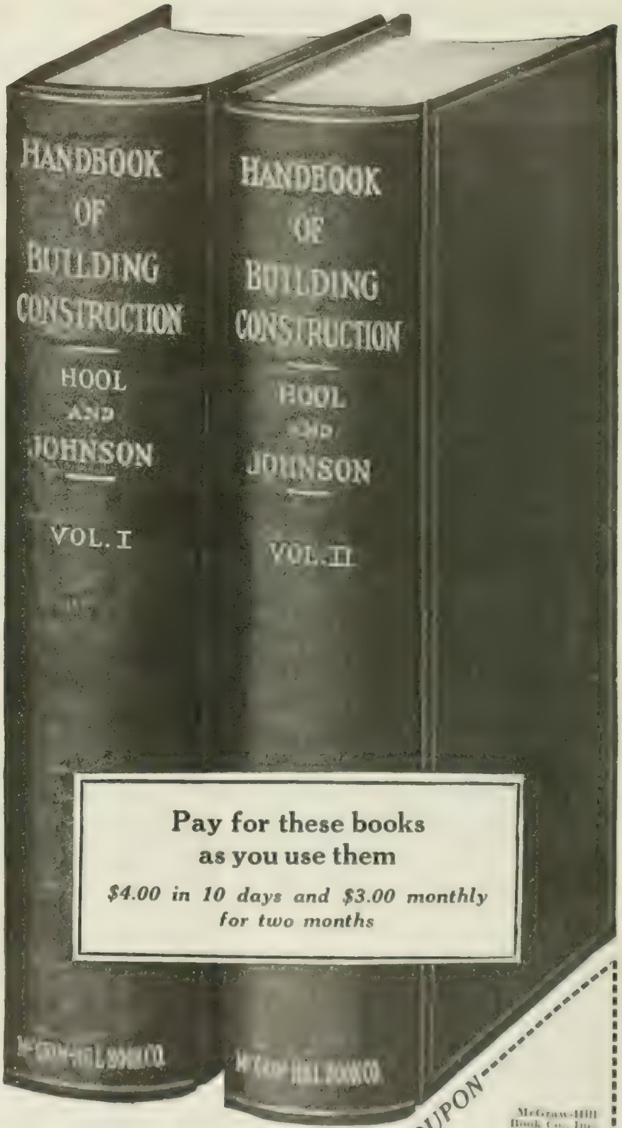

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